EXTERNALITY AGGREGATION IN THE FIELD OF BIOMASS PRODUCTION

Csaba FOGARASSY PhD, József KÁPOSZTA PhD, Henrietta NAGY PhD
SZENT ISTVÁN UNIVERSITY, GÖDÖLLŐ, HUNGARY
E-mail addresses: fogarassy.csaba@gtk.szie.hu, kaposzta.jozsef@gtk.szie.hu, nagy.henrietta@gtk.szie.hu

ABSTRACT

The economic explanation of the externalities comes from environmental economics. This examination system has been concentrated for the economic management of the pollution and the related negative externalities. The economic background it can be clearly seen that economists would like to solve the internalization problems with market-based instruments (tax, emission trading) which may provide the cost-effective alternative to the traditional regulation. But to apply these equipments in the field of biomass production is very complicate. There is some debate about whether to quantify externalities (or other values) if the methods are imperfect. The usual response is that as long as we are honest about the flaws in the numbers, it is better to have some numbers than none. The strong link between food production and global trade is at such a high level in most of the developed countries that meeting the population's food demand at the highest extent, suffer from oversupply, overproduction and also agricultural crisis. In case we do not want to overuse our resources, or facing the mass unemployment because of lands uncultivated, we must have a great shift in the interpretation of agricultural production. Keeping partly the function of food production, agriculture may play a significant role in energy production or industrial raw material production. For this, a good example can be the utilization of biological materials (biomass) for heating. They can also be used for making fuels, as well as vegetable oils can be used in plastic industry, or medicine and different chemicals may also be made from them.

KEYWORDS
biomass, externalities, alternative energy sources, internalization

INTRODUCTION

Thorough investigations have already been carried out into energy production with biomass origin and the use of renewable energy sources. According to their findings, the major lines in energetic utilization of biomass are forestry biomass, agricultural byproducts, animal byproducts and energetic crop production. Therefore, these can be the major energy sources as listing up the energy potentials. The other option, the industrial utilization of biomass, has become a practice in Hungary too. Moreover, one third of the national income derives from the production and utilization of these materials, making these resources significant. Although the structure of the relationship between the different biomass producer systems (food-, industrial raw material-, energy source production) is not really known, the relevant coherences have only been partly discovered. The investigations presented in this study strive to interpret the biomass production systems in their complexity.

Different groups in the biomass product lines

Biomass is made of organic materials and living organisms. Its speciality is that its quantity can be characterized by the number, the weight, the change and the energy content of the individual organisms. Biomass is created in the ecosystem and it does not require energy costs related to the production. Agricultural production and forestry can actually be considered as the transformation of solar energy: the solar energy reaching the Earth is transformed into chemical energy due to the plant' photosynthesis. Thus, biomass is a kind of transformed solar energy, which can be used in several different ways. Biomass is mainly an organic material with C-, H- and O- content.

Its characteristic is that any kind of product or waste of biomass origin is environment-friendly and their impact on environment can be well treated. In addition, its special advantage is that energy can be produced from it without CO2 emission surplus. Biomass production or formation has a very important feature. The transformation processes have close relations with each other, providing a closed material flow, and they are able to renew continuously.

Taking this main feature into consideration, the operation of the sub-systems (crop production, animal husbandry, food industry, forestry etc.) related to the production and utilization is often put into the background. In order to the correct interpretation of the economic aspects of the biomass production and formation, it is necessary to discover the system of relationships in its complexity. It establishes the efficient operation of the material flow and -transformation processes during the planning procedures of each sub-system [Fogarassy, 2001].

According to the production and formation of biomass the following groups can be distinguished:
Primary biomass: /plants grown and natural vegetation/

- Natural vegetation (e.g. protected areas, national parks, certain elements of biothop networks)
- Plants grown for food consumption (grains, vegetables, fruits etc.)
- Plants and products for industrial utilization (rapes, corns, herbs etc.)
- Plants and products for energetic use (Chinese reed, energy grass, rape-biodiesel, corn-ethanol etc.)
- Agricultural byproducts (e.g. straw, corn stalk, sunflower stalk etc.)
- Pain- and byproducts of forestry (products from traditional and intensive forests – raw material for furniture and wooden products, timber, bio-briquette, pellet, chips etc.)

Secondary biomass: /can be created with the transformation of primary biomass/

- Main products of animal husbandry (livestock, milk, eggs etc.)
- Byproducts of animal husbandry (organic manure, biogas)
- Wastes from animal husbandry (animal cadaver, liquid manure)
- Natural animal ecosystems and their products (e.g. game management)

Tertiary biomass: /byproducts created during the processing of the primary and secondary biomass/

- Organic waste from the industrial sector (whey, waste from meat industry, slaughterhouses, spirit industry and sugar industry etc.)
- Organic waste from service industry (green waste, food-waste and hospital waste)
- Sewage
- Communal waste
- Selected waste (metal, paper, plastic, glass etc.)
- Recycled waste („recycled plastic", „recycled paper", inert waste, other products from secondary raw materials)
- Sewage sludge

In the economic analyses it is not common yet to compare the different biomass production systems based on their externality contents. However, the practical application of these examinations must be the precondition of the rational biomass production in the future.

MATERIALS AND METHODS

We have chosen the method of benchmarking for the comparison, but before that we have defined the major factors that can influence the examination program in a logframe matrix (Table 1). It provides the logical frame of the projects, summarizing the objectives, the controlling methods and indicators as well as the necessary conditions.

Logframe matrix

Table 1

	Aims	Indicators	Control	External conditions
Output	Internalization of the externalities related to agriculture	Input-utilization, reduction of pollutants	Analysis on the externality impacts	Constant regulatory background
Direct impact	Spreading of alternative farming methods, considering the environment-economic aspects	Rate of joiners, utilization of live work, volume of energy usage	Analysis on the change of the environment	The market must accept higher prices
Indirect impact	Posing taxes on the activities producing negative externalities, subsidizing the activities resulting positive externalities	Rate of subsidy	Examination of the taxation and subsidy systems	Right recognition of externality impacts

Source: own source

The aspects of classification

The essence of the classification process is that in the case of each indicator we have defined the indicators for condition and performance (aim to be achieved) and after that we have defined the amount of positive or negative externalities related to the indicators.

Indicator for condition

1. Cleanliness of the air and of the ground and surface waters

The reason for selecting the indicator: The surface pollutants, the exaggerated chemical plant protection, the use of fertilizers and the leaking of sewage greatly endanger the condition of surface and under-surface water bases. The unlimited emission of toxic gases into the atmosphere may lead to the greenhouse effect and the creation of acid rains.

Indicator for performance

1. The change in the quantity of pollutants getting into the ground- and surface waters as well as into the air

The classification method for performance: The actions taken to reduce the emission can be classified. Meeting the environmental limit values is a basic requirement. The comparison base is the quality values for the cleanliness of water and air at settlement level.

(-2)	extremely unfavorable effect:	it greatly ruins the cleanliness
(-1)	unfavorable effect:	it ruins the cleanliness of waters and air
(0)	no effect:	the level of contamination does not change
(+1)	favorable effect:	the cleanliness of waters and air improves
(+2)	extremely favorable effect:	the cleanliness improves at a high extent

The indicators of the benchmarking investigations

Table 2

Code	Indicators for conditions	Code	Indicators for performance
	Dimension for the ecological sector		
1.	Cleanliness of ground- and surface waters, CO_2 avoiding	1.	Change in the quantity of pollutants getting into the ground-, surface waters and air in relation with the biomass created
2.	Residues in products	2.	Change in the rate of natural and industrial materials during the production
3.	Spreading of the farming methods adapting to the territorial conditions	3.	Change in the size of extensive agricultural lands
	Dimension for economic and technological sectors		
4.	Level of application of energy-saving technologies	4.	Change in the level of energy-saving technologies application
5.	Efficiency of live work utilization	5.	Change in the efficiency of live work utilization
6.	Avoiding the contamination due to size-effectiveness	6.	Index for avoiding the contamination due to size-effectiveness
	Dimension for social sector		
7.	Following the reactions of consumers	7.	Intensity of the following of the consumer reactions
8.	Seasonal profitability rate	8.	Frequency of the seasonal profitability rate
9.	Activities supported by the agricultural policy	9.	Change in the level of agricultural support
10.	Extent of environment-conscious production	10.	Change in the extent of environment-conscious production

Source: own source

RESULTS AND DISCUSSION

The examinations carried out have had surprising results. We can highlight primarily the production in the case of ecological farming. Because of the great amount of positive externalities related to the production, the operation of the system cannot be viable similarly to the conventional i.e. the overpolluting biomass production strategy (Table 3).

The externality aggregation of different biomass production systems

Table 3

Code	Conventional production	Ecological farming	Crop production for energetic use
1.	-2	+1	+1
2.	0	+2	+1
3.	0	+2	+1
4.	-1	+2	+2
5.	0	+1	-1
6.	0	+2	+1
7.	+2	-1	+1

8.	-1	+1	0
9.	+1	+2	+2
10.	0	+2	+1
Total	-1	+14	+9

Source: own calculations

From the examination row it can be clearly seen that externality aggregation is not totally consequent related to the different biomass production processes, but the rates hopefully reflect that which production processes will produce the negative externalities for the society in the future without changes or modifications, i.e. having obvious impact on the environment. The great amount of negative externality related to the conventional production shows us that the system application overuses our environment, despite of the +14 externality level related to the ecological farming. After analizing the results of the investigations we think that with the application of the present system of indicators we can imagine the optimum presence of externalities between (+) 5 and 10. According to this statement, the energetic crop production is at the nearest to the externality range and the minimal use of chemicals, the application of crop rotation and the special utilization form were all parts of the system application. Though these features can only be partly recognized and identified in the existing energy crop production strategies.

CONCLUSIONS

Positive externalities cause underproduction, while negative externalities cause overproduction. Thus the organic farming strategies cannot meet the social demand, while the conventional farming overuses the resources unnecessarily. Both systems serve the market improperly, which would like to set the appropriate rates for the resource-utilization for the society. We must state that in this case the market is not the same as the internationalized market segments induced by the global capitalism, because in those markets external effects, especially the positive ones do not exist.

The redefined multifunctional agriculture is the source of several positive and negative externalities. The maintenance of the positive externalities is good from environmental and economic aspects, but the negative ones must be avoided. Several different possibilities have already been worked out for the internalization of externalities created during agricultural production. One possible solution can be the zonation program and the agro-environmental program, especially the program for sensitive natural areas and the support for ecological and integrated production. The market adaptation, the planning of the resource usage, however, can only be imagined with a totally repositioned resource-utilization, in which biomass production and consumption are carried out in the same supply-demand space. The results of the benchmarking examination show that organic farming can be considered the most favorable farming method from environmental aspects. Alternative farming systems match more to the natural endowments, they do not pollute the environment, due to their application the production is getting more extensified. Less input is necessary, the efficiency of live work can be improved but the prices of the products do not include these positive factors.

The biggest problem of the measures presently taken is that the subsidies regulate only the supply. The environmental aims could be more easily achieved if instruments affecting demand were also applied. These possibilities for the internalization of externalities are not known enough in the field of regulations. However, it can be clearly stated that abreast the state support of the alternative farming methods, imposing tax on the technologies with high environment impacts may also be necessary. Therefore, the applied instruments would affect not only the supply, but with the introduction of the taxation system the demand could also be influenced. Due to the applied taxes the prices of agricultural products produced with technology of high environmental load may increase, encouraging the consumers to have more environment-friendly preference-systems. It also promotes the internalization of negative externalities at the level of the whole society.

REFERENCES

1. Fogarassy Csaba [2001] Energianövények a szántóföldön (Energy crops on the arable lands). *Európai Tanulmányok Központja*, Gödöllő.
2. Kerekes S. –Fogarassy Cs. [2006] Fenntartható fejlődés és környezetgazdálkodás (Sustainable development and environmental management). DE-*ATC HEFOP program*, Debrecen.
3. Szlávik János [2005] Fenntartható környezet- és erőforrás-gazdálkodás (Sustainable environment-and resource-management). Környezetvédelmi Kiskönyvtár. *KJK Kerszöv*, Budapest.