

Turek Rahoveanu, Maria Magdalena; Turek Rahoveanu, Adrian; Turek Rahoveanu, Petruta

**Conference Paper**

## Environmental public goods specific to agriculture

**Provided in Cooperation with:**

The Research Institute for Agriculture Economy and Rural Development (ICEADR), Bucharest

*Suggested Citation:* Turek Rahoveanu, Maria Magdalena; Turek Rahoveanu, Adrian; Turek Rahoveanu, Petruta (2013) : Environmental public goods specific to agriculture, In: Agrarian Economy and Rural Development - Realities and Perspectives for Romania. 4th Edition of the International Symposium, November 2013, Bucharest, The Research Institute for Agricultural Economy and Rural Development (ICEADR), Bucharest, pp. 144-151

This Version is available at:

<https://hdl.handle.net/10419/111577>

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## ENVIRONMENTAL PUBLIC GOODS SPECIFIC TO AGRICULTURE

TUREK RAHOVEANU MARIA MAGDALENA<sup>1</sup>, TUREK RAHOVEANU ADRIAN<sup>2</sup>,  
PETRUTA TUREK RAHOVEANU<sup>3</sup>

**Abstract:** *Agricultural and rural development policies have had and have a great influence in developing areas over others, by intensifying the use of land and the abandonment of others, with effect on exodus of rural population to urban areas, soil erosion, the continued decline of many species and habitats, diminishing water resources, forest fires. At the same time agricultural and rural development policies have great potential in providing public goods, which the general public becomes aware of an increasing extent. Agriculture in Romania which occupies more than 60% of the land is not only responsible for the provision of raw materials and products for the food and other industries. Moreover, it has a strong influence on the environment and the countryside and therefore the environmental quality highly depends on resource management and applied management at farm level.*

**Keywords:** *Public goods, the production of soybean, subsistence farms, optimizing the production of public goods*

### INTRODUCTION

Agriculture as a productive activity whose main purpose is the production of food and other materials, has a significant impact - both positive and negative - on the environment and the functioning of natural systems.

Some of these changes have occurred in the natural environment over time, but others are more recent. Agricultural technologies practiced in the last half of century, in response to the growing demand for food, caused agriculture to have an increased impact on the environment. These productivity gains were not without environmental and social costs. Like any productive activity in competition for limited resources, agriculture has had a negative effect on the environment because it involves the use of resources that are de facto non-renewable or at least renewable on long periods (fertile soil). There is widespread evidence of these adverse effects on the environment, such as: habitat loss, pollution of groundwater and surface water, soil degradation.

Certain forms of agricultural production have provided a wide range of social and environmental benefits to society in the form of public goods. Agricultural systems which have a low intensity offer a range of public goods to maintain and improve the farmland biodiversity and landscape, associated practices that promote good soil and water management.

Moreover, agriculture has a particular influence on economic and social public goods such as development of dynamic and prosperous rural communities.

### MATERIAL AND METHOD

The paper aims to answer the following questions:

- What is the demand and supply of public goods in agriculture?
- How do we define public goods at soybean crop in this context?
- How are public goods provided by agriculture in Romania?

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<sup>1</sup> SRII - Research Institute for Agriculture Economy and Rural Development, Lecturer PhD University Dunarea de Jos Galati, email: [turek.magdalena@iceadr.ro](mailto:turek.magdalena@iceadr.ro)

<sup>2</sup>SRII - Research Institute for Agriculture Economy and Rural Development Lecturer PhD University of Agronomic Sciences and Veterinary Medicine, Bucharest, email: [turek.adrian@iceadr.ro](mailto:turek.adrian@iceadr.ro)

<sup>3</sup> SR - Research Institute for Agriculture Economy and Rural Development, email: [turek.petruta@iceadr.ro](mailto:turek.petruta@iceadr.ro)

In our approach we conducted a research on the production of environmental goods from agriculture with emphasis on soybean crop<sup>4</sup>. A key role is to know the level of support for the production of public goods in Romania, and knowing the status of implementation of rural development measures for the period 2007-2013 in the provision of such goods.

The main responsibility is coming from the NRDP 2007-2013 Axis II aimed at maintaining and improving the quality of rural areas by promoting sustainable management of both agricultural land and of the forest land. It is also concerned the animal breeding sector, particularly through the promotion of higher standards of animal welfare (table no. 1).

Table 1. Financial support on Axis II in 2007-2013

Measures		
<ul style="list-style-type: none"> <li>➤ Support for disfavoured mountain areas</li> <li>➤ Support for disfavoured areas - other than mountain</li> </ul>	<ul style="list-style-type: none"> <li>➤ Agro – environmental payments</li> <li>➤ Animal welfare payments</li> </ul>	<ul style="list-style-type: none"> <li>➤ First forestation of agricultural land</li> <li>➤ First forestation of non – agricultural land</li> <li>➤ Nature 2000 payments on forest land</li> </ul>
<b>1100.9 million Euro</b>	<b>1151.3 million Euro</b>	<b>229.4 million Euro</b>

Source: National Rural Development Programme 2007-2013

We specify that the purpose of Axis II will be achieved more easily by **organizing training courses and providing well-focused consulting services, as well as stimulation of awareness of local communities in order to raise awareness of the need for environmental protection.**

There are other CAP measures such as decoupled direct payments under the First Pillar of the CAP, which made a substantial contribution to the income of farmers. The large number of farms benefiting from these payments can provide public goods and some of them can rely on these payments to maintain their economic viability, allowing them to continue working to provide public goods further. Other farms while benefiting from these payments may not be providing public goods or even cause environmental degradation.

Measures not directly focus on the provision of public goods, which may have a positive impact on the provision of public goods include:

- Training and advice: Measure 111
- Modernisation of agricultural holdings: Measure 121
- Modernization of agriculture and forestry infrastructure: Measure 125
- Payments for disfavoured areas
- Processing of agricultural and forestry products: Measure 123
- Encouragement of tourism activities: Measure 313

Linking direct payments to the standards of agricultural and environmental good practice (AEGP), helps to ensure the basic levels of public goods.

## RESULTS AND DISCUSSION

### **What is the demand and supply of public goods in agriculture?**

The mechanism for the **allocation of adequate public goods** is based on the adjustment of supply to demand, as follows:

<sup>4</sup> The research was conducted under the Project ADER 4.1.3. "Impact assessment of irrigated / intensive soybean crop on the balance of environmental, economic and economic-productive soil characteristics while minimizing losses of biodiversity in agro-eco-systems, in order to define the specific environmental public goods."

- Private goods are provided through the market, and demand is achieved through pricing mechanisms.
- The effective functioning of this mechanism is based on the ability of consumers to record demand for goods, and for farmers to obtain production factors in ways that enable them to obtain such goods.

Otherwise, the **public goods market cannot function** as an efficient mechanism for allocation if:

- consumers can not be easily identified and can not be excluded from the consumption of goods, whether there was a preference for such a good or was paid to provide.
- on the supply side, the farmers have no incentive to provide public goods, but they are not paid to do this.

### **Defining the environmental public goods specific to the irrigated / intensive soybean crop**

The public goods constitute a product or service that provided to an individual remains available to others at no additional expenses.

The essential features of **pure public goods** are:

- non-rivalry in consumption. This means that in the situation of individual consumption of good, does not diminish its availability for other potential consumers. In other words, it is possible a simultaneous consumption of this good.
- non-exclusion. This refers to the impossibility braking consumption by excluding some consumers to use.

If a good is provided in conditions of exclusion or its consumption is not completely non-rival, it is called mixed good or impure public good, namely imperfect.

Public goods can be found in any market economy. They are not necessarily provided only by the public sector, the private market being also involved for their insurance. When consumption of a good is non-rival, but allows excluding in the sense that there is a price that allows him access, the consumption of the public good can be considered ineffective. This is because the additional consumption generates consumer satisfaction, but that one for which must bear a price is generating dissatisfaction and even reduce utility. In this way, the public good provided by a private market does not allow to achieve the optimal level of production or consumption of that good.

The linkages, namely the interpenetration and competition between public and private sectors of public goods are obvious:

- a good can be produced both by the public and private sectors, situation in which they are competing. An example of this is public and private land fertility, suitability of climate zones offering different productions, but of quality and with different prices.
- a good can be produced only by the private sector and then it does not have the characteristics of public goods of non-rival and non-exclusive consumption. It the situation of rival goods and exclusion goods: production of sunflower, maize production, the production of wheat, etc. In these areas, the consumption of a good decreases the offer, and thus consumption for other individuals. In addition, the producer imposes the exclusion of some individuals from the consumption of goods by the price required.
- a good can be produced only by the public sector and it is a public pure good, such as national legislation, training the producers of organic agriculture, jobs in agriculture, benefiting all producers and consumers in the same way, without discrimination and restrictions of any kind.

A combination of the features of goods which can be public or private production is presented in Table 2.

Table 2. Classification of public goods at soybean crop

	<b>Exclusion</b>	<b>Non-exclusion</b>
<b>Rival goods</b>	Private goods: sunflower production, the production of corn, wheat production.	Mixed goods: land infertility, poor quality of soybeans seeds, non treatments for pest and disease control
<b>Non-rival goods</b>	Mixed goods: land fertility, favourability of zones, climate, water quality.	Pure public goods: national legislation of organic farming, land taxation, training of organic agriculture producers, consumer access to organic soy products and by-products, advertising and promotion of soy products and preparations.

Source: [www.enrd.ec.europa.eu](http://www.enrd.ec.europa.eu)

Mixed goods have characteristics of both public and private goods, they may be non-exclusionary but rival, when are offered to all consumers in the same conditions, without cost, but excess demand overwhelms them and makes them inaccessible to other users. There are also mixed goods with excluding but non-rival, when the consumer's access is hindered by practicing price or technical restrictions and thus the offer is not met by demand and goods can be consumed by other individuals.

In this classification, including of mixed goods is not rigid in time. This means that some non-rival goods can become rivals or transformations on exclusion feature can exist. For example, land fertility, that is a mixed good supporting exclusion and non-rivalry can become rival, namely private good if the land prices fall or rise, decreases or increases the demand of their sale or purchase.

Also, failure to culture soy treatments for pest and disease control, which is a good mixed non-exclusion and rivalry, can become non-rival, namely public good if it gets an organic soybean production, and consumer access is not hindered, possibly through the consumption of another product (sunflower).

A public good may become impure if it loses one of two specific conditions.

For example, the national legislation of organic agriculture makes it a public good. But charging a price for its application is a restriction by which the non-exclusion is lost and the good becomes mixed.

Sometimes, even a private good can become mixed good. For example, the soy milk offered first started free to consumers by a promotional policy, in this period is characterized by non-exclusion (price is zero) and rivalry (the consumption of some individuals reducing the available supply for other individuals).

### **How are public goods provided by agriculture in Romania?**

In Romania, agriculture has a large number of farms participating in a number of markets for the production of food, fibers, raw materials for energy and industrial products. Their distribution depending on the value of agricultural production is presented as follows: 73% fall in first class of economic size (<2000 Euro), 15.6% (2000-4000 Euro); 0.34% is held by large farms (over 50,000 Euro) (data processing, source NIS 2013 - "Typology and size of agricultural holdings 2010").

Farm size has different implications, such as the ability to use certain technologies of crop, labour availability and the pressure to maximize yields per hectare. They can create a mixture of positive and negative forces on the practices adopted and environmental outcomes. Small farms have a number of attributes that could lead, in principle, to the adoption of intensive management techniques. Even the intensity of production on the farm is less than average, a landscape of small farms is likely to provide a greater variety of management systems due to the large number of stakeholders and different perspectives.

The nature of agricultural infrastructure is also significant to provide more public goods, particularly biodiversity, water and soil management and landscape. Land merging involving the

creation of large parcels, economically viable resulted in major changes in the landscape in several Member States, often involving removal of land unused.

The environmental public goods differ in many respects. However, a number of characteristics of agriculture are particularly relevant to the provision of public goods, and they are:

- Coverage degree of crops and agricultural land use in a wider sense;
- Farm practices (including inputs used, plant varieties or livestock, types of machines used, etc.);
- Farm size and structure;
- Local agricultural infrastructure (drainage and irrigation).

Besides farming systems and practices, structural dynamics also influence the degree to which public goods are provided. Some systems are associated with a certain level of management, such as large grain farms, but variations can be found according to the farming system and socio-economic conditions. The agricultural infrastructure (drainage, irrigation) and roads are also important in providing a range of public goods and may constrain the management choices to an individual farm.

The size of farms in Romania shows the potential to provide environmental public goods widespread in this sector:

- There is a high level of interaction with the environment during the production process and therefore, causes certain types of land management, improving water and soil quality, helping to maintain semi-natural habitats and wildlife survival.
- agricultural production is spatially diffuse and occupies much of the land surface, which leads to an appreciation of the population, the close association between agriculture and rural areas

### **Optimum of production of environmental public goods**

The creation of public goods is a matter of collective decision. The access to public goods is free and without discrimination, but it does not mean that production and supply of public goods eventually maintenance is done with zero cost. Someone has to pay. And often not the beneficiaries of public goods, or not them in totally are those who bear the costs for obtaining public goods.

There are two ways to obtain funds for the production of public goods:

- A. voluntary agreement
- B. mandatory taxation

A. Voluntary agreement is a way of supporting material for the production of public goods, not very common in practice. The difficulty of this approach is the tendency of some individuals to hide their appraisal of the public good in order to be considered non-beneficiaries and escape of payment. When some of them manage to avoid paying the contribution, they are called illegal beneficiaries.

The voluntary agreement reflecting the unanimous will, without coercion and is the voluntary exchange model.

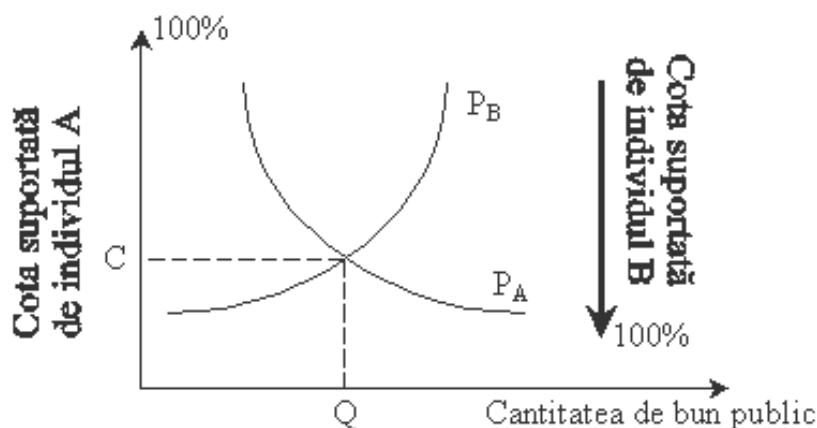
This voluntary exchange approach was presented for the first time by Knut Wicksell which showed that:

- each public good should be funded by a separate tax, known;
- unanimous consent of all members of society should be used in the decision on production (why and how) of a public good

The analysis was continued by E. Lindahl, who has developed an exchange model in which a correlation between the tax rate and the size of the public good was made. The equilibrium of this model is reached when each individual pays a fee (tax) equal to the marginal utility that gives him that good.

The voluntary exchange model can be illustrated graphically in a simplified form of a company formed by two persons A and B (Figure 1).

Figure 1. Raising funds for the production of public goods  
At the soybean crop, by voluntary agreement



In Figure 1, the curve  $P_A$  expresses the organic soybean production which the producer is willing to produce on different levels of taxation of agricultural land. It is noted that production that is willing to provide increases as the rate of taxation decreases. Also, the curve  $P_B$  reflects the individual preferences in the same manner. The higher the tax incurred, the offer, or disposition to produce of the individual B is lower.

The equilibrium conditions (rate  $C$  and quantity  $Q$ ), each individual wins in the production of public goods. In economic theory, it represents a Pareto allocation namely the allocation of resources that allows the gain of at least one individual without affecting anyone else. In other words, this equilibrium corresponds to Pareto **optimum**, in which the resources and production in an economy are so allocated that may benefit a person without the other person to feel a loss.

From Figure 2, it follows that each individual consumes the most preferred public good or optimal amount of public good to a given tax share. In practice, achieving a voluntary agreement is complicated by the possibility that individuals may not express their real preferences and become illegal beneficiaries of the public good.

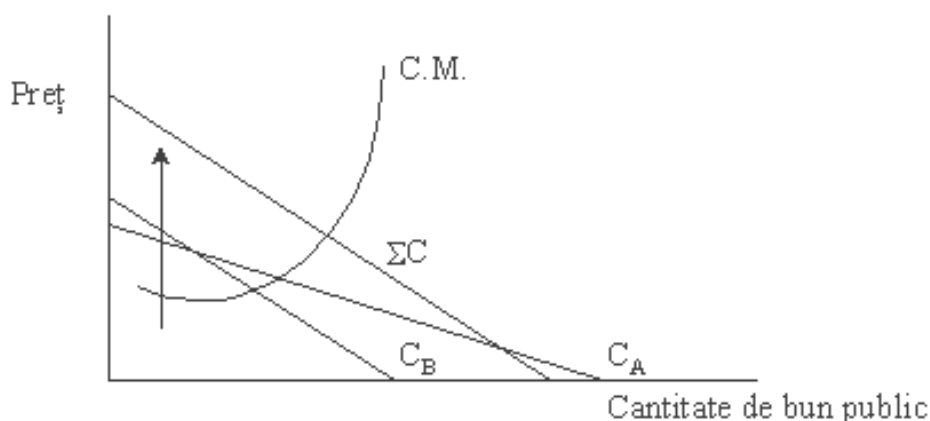
B. Compulsory taxation is a frequent way of material support of production of public goods, namely soybean crop.

Total demand for public goods is determined by summing the individual claims of members of society. For a private good total demand is obtained by summing individual horizontal applications (at different price levels gather quantities required by each person).

Instead, for a public good, the total demand curve is obtained by vertical aggregating individual requests curves, as in Figure 2.

Individual curves of individuals A and B applications, namely  $CA$  and  $CB$  are vertically summed to obtain the total demand curve  $SC$ , since non-rivalry conditions, each unit of the public good is provided to all members of society. The problem is to determine the price that society is willing to pay for each unit of public good. It is calculated by adding the prices that individuals are willing to bear to produce a public good, namely in a simplified graphic form, the amount of the price that individual A it is willing to bear and the price individual B is willing to bear.

Figure 2. Total demand for a public good



**The optimal level of public good production** is recorded when the aggregate demand ( $C$ ) coincides with the marginal cost ( $MC$ ). At this level of production, the society cost needed to supplement the public good by one unit equals the amount the society is willing to pay for it. Of course, balance is a trend that reality constantly pursues. In general, achieving this level is difficult, especially in the area where the aggregate demand can not express the real demands of individuals. Therefore, the total demand is pseudo-demand aggregated. However, in terms of some pure public goods, the agreement of individuals in relation to their production is total; is about public goods such as national legislation of organic farming, land taxation, training producers of organic agriculture, consumer access to products and by-products of organic soy.

## CONCLUSIONS

All types of agriculture can provide public goods where land is managed properly. However, there are significant differences in the type and quantity of public goods, which can be provided by various types of farm and agricultural systems. Some agricultural practices necessary for the provision of public goods are found throughout the agriculture, others are more associated with certain specific regions. Many of these management practices offer many environmental public goods simultaneously. In addition, the range of agricultural practice due to the new technology offers some possibilities for increasing the average value of the specific practice, for example, by improving energy efficiency.

The main public goods associated with agriculture:

- *Farmland biodiversity*: historically, many plants and wild animals have coexisted with the food production. Given that agriculture is very much intensified, the farmland biodiversity depends largely on areas of low intensity (uncultivated strips between crops, hedges and ponds). Farmland biodiversity also includes the rich genetic diversity of local breeds of farm animals and varieties of plants, many of them highly suited to soils, vegetation and climate in the region.
- *Water quality and availability*: The use of fertilizers, herbicides and pesticides to improve agricultural production results are common, can have a major impact on water quality both surface and groundwater. Finding ways to reduce the amount of nitrates and phosphates that end up in rivers and aquifers, will have the effect of protecting drinking water sources and contribute to the biodiversity of rivers and wetlands. As agriculture is a major user of water, particularly for irrigation of high value crops, it is at the heart of efforts to ensure a more efficient and sustainable use of water.
- *Functionality of soil*: Soil is the basis of food production. A well maintained soil has a good structure, sufficient organic matter and is resistant to erosion by wind or water. The



impact of agricultural practices can improve or degrade the functionality, but it may be preserved by the use of different methods.

- *Climate stability - Increasing carbon storage and reducing emissions of gases with greenhouse effect:* Plants can accumulate carbon dioxide very effectively and farming methods that maintain cover with permanent vegetation and plant waste are a good way of collecting carbon. Also, permanent grasslands can store almost as much carbon as forests. Such as carbon storing, the agriculture can also play an important role in reducing emissions of greenhouse gases that are responsible for global warming - not just CO<sub>2</sub>, but also methane and nitrogen protoxide.
- *Inundations and fire resistance:* the central and southern Member States, in particular well grazed, vegetation can be a significant barrier to the spread of forest fires, as well as reduce the risk of fire in permanent crops such as olive groves. Land capacity to absorb excess rainfall and flooding will become increasingly important as climate change increases flood risk in urban areas.
- *Agricultural landscapes:* agriculture shaped the distinctive rural landscapes of Europe for thousands of years and continues to do so. These range from alpine grasslands to terraced landscapes, orchards and flood plains to mosaic landscapes of mixed arable and grass. Many land use patterns and distinctive features of the local landscape are not essential to the current modern methods of agriculture. Protecting agricultural landscape diversity plays a key role in protecting the attractiveness of rural areas as a place to live or travel.
- *Vitality of rural areas:* rural areas in the EU-27 have differences in the land use. Agriculture can help to support the vitality of the countryside, by the role that the agricultural population, associated rural activities and traditions play in rural areas. Rural areas economically and socially can support further economic activity such as agriculture and forestry, which in turn are important in providing environmental public goods that many areas - such as rural tourism and the recreation - depend.
- *Food security:* while the food is a private good, a common action is needed to ensure long-term food supplies at a European or global level. To achieve this it is essential to preserve the ability to produce food sustainably in the future by maintaining the characteristics of land and other resources.

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