LEVELS OF PROVISION OF AGROECOSYSTEM SERVICES

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Abstract

Rural areas are characterised by high biological diversity. Farmers are both direct users of ecosystem services, but on the other hand management of agricultural land affects not only the economic outcome but also has an impact on the condition of agroecosystems. Farm activities and agroecosystems are interlinked. The more conserved and protected the ecosystem functions are, the higher the positive feedback on the farm and the surrounding ecosystems is. The provision of ecosystem services can take different forms – through private contracts, collective contracts, government payments, etc. In Bulgaria at the moment, the most common form of provision is through public payments or through ecological certification of organic products. However, private arrangements can also enhance this provision and secure a win-win scenario for both provider and buyer of ecosystem services. This study shows several case-studies on private arrangements with comparative analysis on several contract features. These examples show different levels of provision of ecosystem services. In some cases, both the efforts and the actual benefit are at the same level, for example an agricultural plot (pollination contracts). In other cases, an actual effort in the form of agri-environmental measure can take place in a certain farm holding, but the actual benefit can be seen somewhere else, for example downstream of a watershed catchment. And in some instances, the actual effort is used to compensate for someone else's pollution activities (see carbon credit markets). Very often, a farm is a user of ecosystem services, both within and outside its physical boundaries. On the other hand, some ecosystem services require collective action to be effective and meaningful (most often this is the example of biodiversity conservation). There is still a controversy over what is the best form for providing ecosystem services from agriculture - through private contracting or through the traditionally used public provision. The answer is likely to be found in the nature of the ecosystem services themselves. If for an ecosystem service such as crop pollination it is easy to establish a buyer and seller of the service, there are clear benefits for both parties, and the price can be easily determined. For others such as biodiversity, all this is very difficult to be achieved. For this purpose, it is necessary to assess the most important features characterising a contract. The form of the contract is tightly connected with whether the environmental effort of the farmer is measurable or not. For some ecosystem services, like pollination the environmental result is easily monitored and measured. Where in other instances, like the watershed groundwater quality, monitoring is difficult or impossible. Therefore, different ecosystem services pose the need for different contract arrangements. Keywords: agroecosystem services, private contracts JEL code: Q15, Q57

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Agroecosystem services

Rural areas are characterised by high biological diversity, they cover various natural processes and they are associated with the provision of various ecosystem services (soil fertility, carbon storage, biodiversity, etc.). Therefore, management must take into account the dual role of agriculture – provision of food, and conservation of ecosystems, both of which are interconnected. Agroecosystems incorporate the traditional understanding of ecosystem services, as described in the Millennium Assessment Report in 2005, but with a focus on the role of human activity in altering natural functions.

Figure 1 shows the complex interrelationship within the agroecosystem. It is believed, that the supporting ecosystem services are the basis for all other. On one hand, the agricultural holding is a direct user of the agroecosystems, therefore the state of the services (enhanced or decreased) directly affect the economic activity of the farm. On the other hand, agricultural activities (decision-making, policy implications, etc.) can lead to disservices such as habitat loss, disturbance of soil health, nutrient runoff, water pollution, etc.

Even more key is the understanding that farms should not be seen as separate units (plot-based) but as ones that extend beyond their own boundaries in terms of ecosystem services.



Source: The author

For example, an agricultural holding is a user of the ecosystem services created within its phisical boundaries, but it can also be a user of ecosystem services outside its boundaries. On the other hand, activities within the farm can contribute to both positive and negative externalities that affect the agroecosystem whitin the farm, but outside of it.

Levels of provision of agroecosystem services

Ecosystem services can be provided at different levels – from a certain agricultural plot, to regional or national level. These levels can be a subject to a twofold understanding:

A) The level of actual efforts – where the efforts for provision take place

B) The level of benefit– where the efforts for provision lead to an actual benefit Based on this understanding, in some cases both the efforts and the actual benefit are at the same level, for example an agricultural plot (*see case study 1 – pollination contracts*). In other cases, an actual effort in the form of agri-environmental measure can take place in a certain farm holding, but the actual benefit can be seen somewhere else, for example downstream of a watershed catchment (*see case-study 3 – watershed contracts*). And in some instances, the actual effort is used to compensate for someone else's pollution activities (*see case-study 2 – carbon markets*).

The provision of ecosystem services can take different forms – through private contracts, collective contracts, government payments, etc. In Bulgaria at the moment, the most common form of provision is through public payments or through ecological certification of organic products. These two types are polar opposites to the economic logic they imply. The public provision of ecosystem services is rooted in the idea of public goods and that their private provision is difficult or impossible. Unlike private goods, public goods are not easily provided through market mechanisms, mainly due to the fact that it is not possible to determine their supply and demand.

Although the two concepts –public goods and ecosystem services – are often considered separately, in some ways they overlap (Dwyer et al., 2015). If we consider the ecosystem service as a result of natural functions, and bearing in mind that it is a service from a human point of view, some of the ecosystem services can have the same market characteristics as public goods – non-excludability and non-rivalry. This means that once produced, the ecosystem service is used by all (non-excludability) and its use does not reduce the benefits for all users (non-rivalry). An example of this type of service is the preservation of biodiversity, or the rural landscape. Other ecosystem services, such as provisioning services, are more of a private good. For example, food and biomass production have the characteristics of excludability and competitiveness. Therefore, if we return to the two forms of provision of ecosystem services – private and public – we can say that while the market mechanism can be used for provisional services, it is practically very difficult for the other groups, like regulatory or supporting. Organic agriculture is a very good example of the provision of various ecosystem services (increased biodiversity, soil fertility, etc.) that are jointly produced to a private good. Thus, buying organic vegetables, for example, the consumer pays not only for the provisioning ecosystem service, but also for others (for example, biodiversity).



Figure 2. Levels and forms of provision of ESS Source: The author

In Figure 2 different forms of provision of ecosystem services are presented. They may relate to a specific plot/holding, may cover a catchment area, or cover the entire sector. Although ecosystem services often go beyond the boundaries of a specific farm, some types of services are more associated with those provided within the farm itself (such as food, soil fertility), others at the regional level (regulation of water quality and quantity at a watershed level), or at sector level (biodiversity).

Private vs. public provision of ESS

In the next paragraphs three different case-studies of private contracts for ESS will be examined, followed by a comparative table – private contracts vs. public. *Case – study 1: Pollination contracts*

This type of contracts originated from the US, where it is still very common for almond growers (the buyer of the pollination service). The contract can be verbal or written, with research showing (Goodrich, 2019a) that beekeepers with more years of experience prefer a written contract. In many cases, an intermediary (broker) also participates in the transaction, which provides security for both parties securing the correct payment for the service provider, and securing actual service for the buyer. The intermediary is responsible for routine inspections (monitoring) of the strength of the beehive (previously stated in the contract). Payments are per beehive with variation in bee colony strength (depending on how many active bee frames the hive contains) (Goodrich, 2019b). Other requirements for the provision of the pollination service are included in the written contracts, some of which are: 1) the beekeeper's right of access to the hives during the duration of the service, and 2) forbidden use of insecticides during the stay of the beehives (Goodrich, 2019c). This type of ecosystem services contract is one of the oldest examples that has proven its effectiveness. Unlike other ecosystem services (such as flood regulation, for example), here the quality of the service and the actual result can be clearly tracked.

Case-study 2: Carbon markets

Another example of private negotiation, which is gaining more and more attention not only in the US, where it has started, but also in the EU, is the carbon credits from agriculture.

Essentially, carbon markets were created to put a price on pollution. Although pollution of land, water and air has long been treated as "free", it still has a price that society pays in the form of depleted and degraded natural resources. Carbon credits and markets started as a way for the governments to regulate (via a cap) carbon emissions. The idea of including agricultural land in "capturing" carbon arose as another attempt to combat CO2 emissions.

In this arrangement, farmers should implement certain agro-environmental measures that are considered to possess high potential for capturing and storing carbon in soils (carbon sequestration). Most often such practices are zero tillage (no-till) and cover crops. The involved stakeholders are:

- **Farmers** as 'carbon capture and storage' service providers;
- Certifying intermediaries (brokers), the connecting link between the buyer and the seller of the service
- * **Private companies** which are willing to <u>voluntarily</u> neutralize their emissions.

The carbon markets for agriculture are at the moment a voluntary mechanism, and the participation of the government is limited to the establishment of unified protocols and certification mechanisms. This is necessary because at the moment in the US there are several intermediary companies that use different mechanisms and conditions for farmers' participation. Some pay per unit of area, others per ton of carbon dioxide.

Case-study 3: Watershed contract

Another example of private contracting is the provision of ecosystem services at the watershed level. One of the first case-studies is the bottling company 'Vittel' in France, which initiated a program to reduce water pollution in the catchment area feeding the springs that are the source of bottled mineral water. Contracts were signed with farmers for a period of 18-30 years. The contracts are individual and tailored to the location of the farm. Payments do not depend on changes in nitrate levels, but on the costs of implementing new practices and the necessary investments to decrease the use of nitrate fertilizer and therefore to reduce the contamination of groundwater. An intermediary party ('Agrivair') was created as company, part of 'Vittel', which negotiates and implements the pollution abatement program, as well as monitors the implementation of the practices (Depres et al., 2005). Prior to the start of the initiative, pilot studies and testing were initiated to ensure an appropriate link between the provision of ecosystem services and conservation practices (Perrot-Maitre, 2006). By its essence this case-study represents a classical allocation of property rights in order to solve environmental problem. Where 'Vittel' has the right to exploit the underground aquifers, the farmers influence the underground water passing by their land with the practices they implement (Depres et al., 2005). Going beyond the original creation of the 'Agrivair', up to these days the company continues in creating partnerships in the region with the aim of water protection.

Table 1 presents the three private arrangements for provision of ecosystem services and the most common public one. There are many comparative features that can be used to distinguish different forms of ecosystem services provision. Some of the most common ones are listed in the table: 1) form of the contract; 2) negotiation costs; 3) if an intermediary (broker) is needed; 4) longevity – duration of the contract, which in some case like carbon credits is immensely important; 5) monitoring costs; 6) payment mechanism; 7) if due to the efforts there is a measurable outcome (effect).

Regarding the form of contract, in some cases like the watershed contract it is possible for the buyer of the ESS to contract a collective organization (farmers' association). In this way negotiation efforts will be facilitated in an easier manner. However, in the case-study with 'Vittel' there was no possibility for this kind of collective initiative and therefore the negotiation costs were very high.

The intermediary party can be mandatory in some private contracts like it is the case with the carbon credit markets. The broker is an irreplaceable link between the buyer and seller of ESS. On one hand, the broker is the one creating the framework and rules for how the carbon credit system works, since at this moment carbon credits from agriculture are not included in the national carbon emission trading system.

	PRIVATE			PUBLIC
Comparative features	Pollination contracts	Watershed contract	Carbon markets	AEM
Form of contract	Private between two private agents	Private between one buyer and more than one seller of ESS	Private be- tween two private agents	Public funding
Negotiation costs	Low	Very high	Low	None
Intermediary service	Non-obligatory, but used in many contracts	Mandatory	Mandatory	Not mandatory
Longevity	From an yearly contract to more	Long-term (18-30 years)	Depends on the broker	Long-term (5 years)
Monitoring costs	Moderate	Moderate	Very high (soil testing)	High
Payment mechanism	Per beehive	Per adopted practice	Per ton CO2	Per ha (areas under AEM)
Measurable outcome	Yes (harvested production)	To some extent (not measurable by individual plots, but overall im- proved water quality)	Yes (in- creased car- bon in soil)	No

 Table 1. Comparative table of feature regarding private vs. public provision

 of ecosystem services (ESS)

Source: The author

The broker is also responsible for negotiating and contacting farmers willing to participate in the initiative, also undertaking necessary monitoring activates, and ensuring payments for the farmers. For the other private case-studies the intermediary service is non-obligatory, but can be used for easing the process.

Longevity is one of the most important features of ESS contracts. In some cases, like the watershed quality in order to receive the desired result the practices should be implemented for a long time. The same is with the carbon markets, where the real offsetting of carbon emissions can be secured only be long-term engagement. However, some authors believe (Lewandrowski et al., 2004) that shorter contract period is better for reflecting the change in farmers 'opportunity costs for implementing the measures.

Monitoring costs can be a stumbling-block for private contracts. In cases like the carbon markets they can be so high as to diminish the benefit of participation for

the farmers. In both carbon markets and pollination contracts monitoring can be based on real testing (soil samples, beehive strength), but in the case of the watershed contract it is not possible. Finally, the payment mechanism is a crucial aspect of the private ESS contracts. When possible to monitor and test a physical feature like soil sample or a beehive strength, payment can be calculated quite easy. With the watershed case-study, payments depend on the individual costs incurred by each farmer for adopting a certain measure. In the same way, the outcome of the effort is measurable – in the quantity/quality of the harvested production (pollination con-tracts), or the level of captured carbon (carbon credits).

Concluding remarks

In conclusion, the provision of ecosystem services is one of the main ways to achieve ecological sustainability in agrarian management. Given the characteristics of ecosystems, their complexity and interdependence, it is necessary to consider the levels and forms of management. Very often, a farm is a user of ecosystem services, both within and outside its physical boundaries. On the other hand, some ecosystem services require collective action to be effective and meaningful (most often this is the example of biodiversity conservation). There is still a controversy over what is the best form for providing ecosystem services from agriculture - through private contracting or through the traditionally used public provision. The answer is likely to be found in the nature of the ecosystem services themselves. If for an ecosystem service such as crop pollination it is easy to establish a buyer and seller of the service, there are clear benefits for both parties, and the price can be easily determined. For others such as biodiversity, all this is very difficult to be achieved. Therefore, different ecosystem services pose the need for different contract arrangements. In Bulgaria, agroecosystem services are mostly under public provision, where both understanding and motivation of farmers is starting to grow. However, with the public support under the national agricultural policy, environmental stewardship will only be increasing in the years to come and it should be expected that some of the private forms pointed out in this report might be accepted by Bulgarian farmers as well.

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