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Philippe Le Goffe, . European Grassland Federation. Should we promote grassland? A microeconomic analysis. 19th General Meeting European Grassland Federation Multi-function Grasslands, European Grassland Federation (EGF). CHE., May 2002, La Rochelle, France. 13 p. hal-02306183

HAL Id: hal-02306183

<https://hal.science/hal-02306183>

Submitted on 7 Jun 2020

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« Multi-Fonction Grasslands »
European Grassland Federation 19th General Meeting
La Rochelle (France) 27-30 May 2002

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Should we promote grassland ? A microeconomic analysis

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Summary : Unfavourable or no incentives at all make the farmers use insufficient grassland areas, from the society's and economic efficiency's point of view. On the one hand the CAP premium encourage to exploit more crops and less grasslands than what real profit would imply. On the other hand, the farmer who seeks to maximise his profit does not take into account the effects external to the market due to the lack of incentives. However the market could contribute to the provision of grasslands the society needs, because milk and meat produced by grass-feeding have specific characteristics valued by the consumer. Nevertheless, the public good characteristics of grasslands make market failures remain and public policy become necessary. The conception of efficient policies for grasslands' multifunctionality requires the survey of transaction costs and jointness between breeding and grassland. The different kinds of grassland premium probably allow to make environmental benefits without increasing excessively the transaction costs in comparison to price support.

Keywords : grassland, multifunctionality, policy, externality, transaction costs, jointness.

Introduction

The OECD (2000) defines the multifunctionality as a distinctive trait of agriculture, in other words the capacity to produce both base products (food) and other products. When these other products are characterized as public good, the markets do not do well and the supply may then be inadequate or insufficient. Grass feeding systems are typically multifunctional, which fits the OECD's definition since grasslands offer not only meat and milk productions but also several collective benefits. As a matter of fact, grasslands contribute to a high degree to the struggle against erosion and to the regularizing of water regime or flow ; to the purification of fertilizers and pesticides, and to biodiversity. They, at last, have aesthetic roles (landscape) and recreational functions as far as they provide public access that other agricultural uses do not allow.

However, although grasslands have a real social interest, a steady decrease of surfaces in permanent grassland has been noticed in France for 30 years, the equivalent of 1% a year . At the same time, since 1992, the European Union and the state members have been trying to set up policies aiming at promoting grassland, in order to meet the social demand. Among those measures grassland premium and some measures for the Farming Territorial Contracts (FTC) in France can be quoted.

DOCUMENTATION ÉCONOMIE RURALE RENNES



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Bearing this context in mind, this article's purpose is to present the economic mechanisms which explain why there are not enough grasslands from society's point of view. Then we will examine how the market and the public policies might efficiently provide the grasslands the society needs.

The first part deals with the microeconomic modelisation of the producer's behaviour. One can see how the presence or the lack of signals encourages the producer to deviate from the supply of grasslands necessary for society. The second part tries to apply to the case of grasslands the recent studies on the policies for multifunctionality and their interaction with agricultural policies.

1. Producer's behaviour, market and agricultural policies failures

The microeconomic modelisation of the producer's behaviour provides an analytical framework which helps to explain how the producer divides his farmlands between crops and grasslands (see Guyomard and Mahé, 1995). Let us take the example of a farmer who produces agricultural goods from grasslands and crops. Let us make the classical hypothesis in microeconomics that the producer, a self-interested and rational individual, wants to maximise his private profit knowing that his total agricultural area is constrained (see appendix). The programme's resolution of the producer leads to the equality of marginal profits taken from an extra hectare of grassland or crop. The marginal profit of an extra hectare is the extra value of milk or meat production diminished by variable costs per hectare of grassland or crop (according to accounting terms, this is a gross margin).

Figure 1

Because of the hypothesis of decreasing yields, true to what is being observed in agriculture, the marginal profits of grasslands and crops, shown in figure 1, are decreasing functions. We also have to take into account the incentives provided by the Common Agricultural Policy (CAP). The CAP crop premium increases the marginal profit of crops, so that the equality of marginal profits takes place for a grassland area of x_m . The producer will then choose a grassland area equivalent to x_m .

However since agriculture is a multifunctional activity, other products and more particularly public goods are being produced in addition of base products (vegetal and animal ones). Public goods are different from private goods as far as one cannot prevent people from enjoying them (the landscape example). This impossibility of exclusion resulting from the collective consumption is responsible for the lack of market for public goods whether they are goods or bads. As a consequence there are interactions taking place between agents with no monetary compensation. Thus farmers do not secure spontaneously the victims of agricultural pollution. At the same time the collective services provided by the farmers cannot be paid by consumers who benefit them. These effects that the market cannot control are called as externalities or external effects. The lack of market incentives is at the heart of an excessive pollution and of insufficient collective services. The concern for maximising the collective value for society leads to making these external effects paid by the agents, that is to say by internalising them.

In order to identify this optimum solution in a collective way, we represented the external effects in figure 1. Crop farming generally has external negative effects : erosion, pollution

linked to the bad use of fertilizers and phytosanitary products, even to landscape damages (Poux, 2000). These environmental damages decrease the real marginal profit of crops (figure 1). On the contrary, as indicated above, grasslands provide collective services whose value must be added to the marginal profit. The consequence is that the equality of corrected marginal profits for the external effects (and for CAP distortion) is now taking place in x^* , which corresponds to the optimum area of grasslands for society. The CAP distortion and the market failures result in the farmers using insufficient areas, the consequence being a social loss represented by the shaded area at figure 1. The social loss comes from the differential premium which alters the profitability of crops, from the damages inflicted to the environment and the loss of income linked to the lack of collective services not provided by grasslands. In the second part, we shall see how the market and the public action should allow to go toward an optimal solution.

2. The optimal supply of grasslands by the market and the public policies

2.1 Context and challenges

The problem of promoting grasslands in cattle systems is a specific case of the more general debate about the multifunctionality of agriculture. In European countries, the authorities have started to reply to the citizens' request for a multifunctional agriculture (agri-environmental measures of the CAP, FTC in France, etc...). The policies for multifunctionality are obviously linked to classical agricultural policies acting on the markets and the prices, whose reform is at stake in the negotiations with the OMC. The subsidies to the agricultural production and the frontiers' protection are being blamed for creating distortion of competition on the markets and the exchanges, by stimulating the agricultural production and the use of input (one can talk of coupled measures when the support directs the production and the markets). While a pressure aiming at decreasing agricultural subsidies is real, the trading partners on the international scene fear that the multifunctionality may be used to maintain the distortion of competition which favours agricultures traditionally highly subsidized (Europe, Japan).

In this context how can we conceive policies for multifunctionality which are economically justified and how do the latter interact with classical agricultural policies? The OECD has tried to answer these questions, especially in a document entitled « Multifunctionality : the building up of an analytical framework » (OECD, 2000), and at a workshop which took place in July 2001.

These works have enlightened three questions which are at the heart of the conception of efficient policies for multifunctionality :

- the question of the market failures that we dealt with in the first part and which justifies public action,
- the question of the jointness of production between other products and base products which is essential in the cost of production of public goods (concept of range economics),
- the question concerning transaction costs observed during the setting up of public policies or during trading transactions.

Economically speaking, it is legitimate to look for supplying the public goods which society needs, at the lowest possible cost including transaction costs and provoking the least possible distortions in the markets and the exchanges. Following this we will endeavour to explain those notions and will apply them to the particular case of grasslands.

2.2 Joint production and transaction costs

The joint production of base products and other products is due to the complementarities of the production, which we qualify as technical interactions, or is due to the fact that the multiple products are obtained with only one input (non affectable input). The technical interactions are for example the source of agricultural pollutions. In the case of cattle grazing, grassland is the non affectable input which allows to produce at the same time the meat or the milk and the public goods associated with grasslands. However, in agriculture the joint productions are rarely produced on a steady proportion, because there are numerous production systems which use different technologies and agricultural practices. In other words the jointness is not always strong and the dissociation between the joint productions is often possible. This explains that cattle breeding can be practised with or without grasslands, and with environmental results which differ whether grasslands are permanent or cultivated (this has an impact on biodiversity and erosion), or according to the level of fertilization and the use of chemicals for plant protection. Even with organic agriculture, an example of strong jointness between base products and public goods, the environmental benefit compared to conventional agriculture is better for crop protection and nitrogen balance than for biodiversity (Rainelli and Vermersch, 1999).

A serious issue to be considered is if dissociation is costly or not. As a matter of fact meat and milk can be produced without grass and grassland areas can be tended by non agricultural firms. But in this case, the cost will be higher because the rural firm will have to be paid for a service which would have been provided at a low cost by the farmers. The jointness in production is responsible for range economics, which means that the cost of joint production is lower than the one of separated production of multiple products. Grass feeding systems thus creates range economics, which makes it, generally speaking, the cheapest solution to provide public goods associated with grasslands. In other agricultural situations, the dissociation is possible without cost and the non agricultural providing of public goods can then be taken into account (example : the tending of hedges, banks, walls...). This can also affect the tending of grasslands, in the areas of specialised agriculture where grass-feeding animals disappeared, and where its reintroduction is extremely costly. But in this case, the quality of public goods has also to be taken into account : does the consumer enhance in the same way the aesthetics, ecological and recreational qualities of grasslands whether they are grazed or only cut ?

The definition of transaction costs offered by Coase (1960), in the case of market transactions can be enlarged to different kinds of transactions, whether they are being done on the market or by a government, whether they imply a financial transfer or not (Challen, 2001). These are all the costs associated to the necessary operations to the making of a transaction : prospection, agents'information, negotiation, making of a contract, its control and its application... These costs of running the economy have been compared to frictions in physical systems ; as too much friction prevents movement, the more expensive the costs of transactions are, the more they prevent the market from working well when they are higher than expected benefits of market transactions.

Although they are the same type of costs, it is nevertheless convenient to make a difference between the transaction costs observed on the market and the ones which are linked to the setting up of public policies (OECD, 2001). In the case of environmental goods provided by agriculture, Challen (2001) offered a typology for the transaction costs which may be an obstacle to the functioning of the market. Notably, there are transaction costs linked to the

characteristics of credence goods and of public goods. The environmental characteristics of agricultural products are as a matter of fact credence goods, whose quality cannot be checked neither at the purchase nor at the consumption, unless one starts checking the steps which would be costly for the consumer. This asymmetry of information is the source of high transaction costs. The characteristics of public goods make it very difficult and costly to exclude consumers from consuming those goods. These difficulties favour a type of behaviour called « free-rider » (taking advantage of a good without paying for it), which is antinomic to the market. So the costs of exclusion are equally serious transaction costs.

2.3 Interest and limits of the market

If the transaction costs observed on the market are inferior to the benefits potentially drawn from the transactions, then the spontaneous providing of other products by the market is possible. This is for example what we can frequently notice for the practise of fishing and hunting, because the exclusion costs are low in this case and they are not credence goods (this market management is less frequent in France than in other european countries for institutional reasons). When the non-governmental providing of other products is possible, it is interesting because it is less expensive and often allows a better adjustment of the supply to the demand than the public one ; however, by excluding consumers it may create a problem of equity. When there is no market, one can seek to decrease the transaction costs in order to allow the non-government providing.

Challen (2001) shows how the eco-labelling of agricultural products reduces the transaction costs linked to the credence goods because the asymmetry of information is being reduced. That is why the State has to promote the ecolabelling and the systems of quality warranty (systems of environmental management), in the initial phase of their development where profit is not guaranteed. On the other hand, decreasing the exclusion costs is difficult when the other products are real public goods, which is very often the case of environmental characteristics of agricultural goods. This incentive to the free-rider may explain the low market share of green products (Ifen, 1994). Surveys reported by Ifen (1998) show that consumers motivated to buy organic products do it for health reasons (private attributes) rather than for environmental concerns (public attributes) ; here however, by joining specific private attributes and public attributes, this process of production allows the market supply of base products and other products.

In a survey presented in this congress, Coulon and Priolo (2002) show that grass-feeding influences the meat and milk characteristics (nutritional, technological, hygienic and sensory). These constitutive characteristics of the quality of the products are private attributes for the consumer, which are going to merchandise well if the consumer looks for them. In this case the strong jointness between the public attributes and the private ones - those characteristics of the products being specific of grass feeding - implies that the market is going to provide the public goods associated to grasslands. Some of these characteristics have been sought for very long in the AOC framework. Thus in the Comté (pressed cooked cheese) Protected Denomination of Origin (PDO), it is essentially technological and sensorial arguments which led to impose constraints on grass feeding (norm concerning the minimal grassland area, silage and other fermented food are forbidden, forages must come from Comté's area, etc...). Other cheese PDO are right now debating on silage ban, given the sanitary risks of contamination by pathogen bacteria (listeria mainly).

When the technological link is not so obvious, the market will probably be failing and a labeling based only upon public good - here grasslands - will not have any success ; this explains why, as far as we know, a specific quality sign « grass feeding » does not exist right now on the market. On the other hand, the public goods associated to grasslands takes part in the collective image of a sign of quality, evenmore so when the region of production is known (PDO, Protected Geographic Indication). However, as we saw in the first part, the farmer is not economically incited to resort to grasslands as much as it should be expected. Although the non-production of public good is collectively detrimental, the individual strategy of the agents leads them not to cooperate for this production (behaviour qualified in economy as « the prisoner's dilemma »). A collective solution to this problem consists in introducing constraints concerning grasslands in the requirements associated to quality signs, which results in creating the jointness between private and public attributes of agricultural products. As an example we are pleased to notice the reenforcing of grass feeding in the requirements of the different French milk or meat PDO (Coulon, personal communication). This policy could be applied to other quality signs.

In this case of technological or statutory jointness between the private and public attributes of agricultural products, the market fits the supply of private attributes, but not necessarily the one concerning public attributes obtained in addition. Market failures will remain linked to the fact that the amateurs of the services provided by grasslands are not necessarily the consumers of quality products produced by grass-feeding cattle, and that the consumption of those goods is not in the same ratio as their production.

Can the market of rural tourism contribute to giving the grasslands surfaces wanted by the society ? According to the data coming from the Brittany region (western part of France), Le Goffe (2000) showed that the renting price of rural cottages from a rural zone increased with the importance of permanent grasslands in the agricultural lands of the zone. The problem lies in the fact that the consumer is sensitive to the environmental attributes of a large rural area – among others are grasslands - and not only to the ones of the lands which are in the immediate surroundings of the rural cottage (which belong sometimes to the cottage's landlord). As the landscape of the rural area is a public good, the farmers who are incited to replace grasslands by crops, do not compensate the cottages'landlords for the loss of profit which they suffer from (case of externality). In the same way, the consumers of tourism do not have the possibility to pay the grasslands producers of the area. Even if we imagine that the farmers are also the owners of the rural cottages, the individual strategy of the agents implied by the « prisoner's dilemma » would lead to areas of grasslands too little to maximise the income of the area, because the agents do not have any interest in cooperating (see Mahé and Ortalo-Magné, 2001). The characteristic of public good linked to landscape (the lack of property rights) is the source of too high exclusion costs for the market to be functioning (but transaction costs linked to credence goods could also be present since the environmental quality is not necessarily known to the consumer). This situation, as the restrictions mentioned in the former case, justify to resort to public policies.

2.4 Should public policies be targeted or coupled ?

Here again, the type of jointness and the governmental transaction costs are the central elements which largely condition the type of public policy to set up and interaction with the classical agricultural policies (OECD, 2000). If the base products and the other products are not joined, the policies for multifunctionality will be targeted on the public goods and independant from the agricultural policies. In this case, the lack of range economics may

make the non-agricultural providing of public goods competitive (case of hedges, banks and walls, for their market function has almost disappeared, except for some alternative production systems).

Vatn (2001) studied the opposite case where there is a total link between the multiple products, and where the provision of other products is insufficient (market failure at worldmarket price). Vatn (2001) shows that we would get an apparently similar result, either by supporting the price of base products (coupled policy) until one obtains the desired level of other products, or by targeting the support on the provision of public goods (through agro-environmental contracts), since the multiple products are linked. However, the coupled policy will be systematically preferred because it allows to save the transaction costs linked to the agro-environmental contracts. The same arguments would lead to tax the price of base products, in the case where the other products were negative externalities (for example pollution).

Figure 2

As we saw it, the reality of agriculture often corresponds to the intermediary case where the jointness is partial. Here the choice between coupling and targeting depends on the trade-off between the public benefits and the transaction costs of the targeting. On the figure 2 taken from Vatn (2001), one can see that the finer and finer targeting provides decreasing marginal benefits and creates increasing marginal transaction costs. An economic optimum is reached when marginal benefits equal marginal transaction costs of targeting ; beyond it, the targeting is inefficient because the extra benefits are overshoot by the higher transaction costs.

We saw that grasslands fit with this situation of defective jointness. In order to clear up the choice of policies for grasslands' multifunctionality, it is important to better understand the jointness between cattle-breeding and grasslands : are the quantity, the quality and the grasslands' localisation satisfying ? What is the impact of milk or meat price support on the use of grasslands ? Would its suppression lead to the neglect of grasslands surfaces ? What are the negative externalities implied by the price support ? What is the loss of environmental benefits in comparison to a more precise targeting ? At the same time, one needs figures on the transaction costs associated to the agro-environmental contracts, which have been scarcely studied until now. A policy supporting the prices of milk or meat could be economically justified because of the low transaction costs it creates, although it produces less public services than a targeted policy (for it is less accurate), and more negative externalities.

One can nevertheless think that a support based on the non affectable input, that is to say a grassland premium, would permit to produce more public benefits linked to grasslands and less negative externalities, without increasing in an excessive way the transaction costs (this depends on the contracts' complexities). In all the cases, no economic argument justifies differential premium favouring crops, as far as they produce less public goods than grasslands.

Table 1

In France, farmers have access to a wide range of measures aiming at promoting grassland (table 1). The premium to the maintaining of extensive breeding systems (PMEBS, the former grassland premium) is the more general one : the requirements only concern the minimal proportion of grassland surface, the nitrogen fertilization and the stocking rate. The measures

included in the FTC are better targeted : patch of land with high plant-care risk, grassed stripes near the waters. The competition with the CAP crop premium leads to paying high-price grassland measures, whose extension is necessarily limited and makes the least subsidized measures little attractive, mainly in the intensive agricultural areas (Le Goffe and Mahé, 2001). Once these distortions are suppressed, the analysis of environmental benefits of targeting and the transaction costs would allow, here again, to choose between general grassland premium and targeted contracts. The choices would probably be different according to the regions, for the targeting benefits depend on the regional context. In this perspective, it would be interesting to test even less constraining measures than the PMEBS (no fertilization or stocking requirements), as a simple premium to grassland areas (like the CAP crop premium), or a premium to permanent grassland, which would have the advantage of diminishing the checking costs while targeting the most interesting grasslands (biodiversity, erosion, etc...).

Conclusion

Unfavourable or no incentives at all make the farmers use insufficient grassland areas, from the society's and economic efficiency's point of view. On the one hand the CAP premium encourage to exploit more crops and less grasslands than what real profit would imply. On the other hand, the farmer who seeks to maximise his profit does not take into account the effects which get out of the market's hand, because of the lack of incentives. The result is an excess of environmental damages due to the crops and a shortage of collective services offered by the grasslands, that is to say a loss of collective value. The internalisation of these external effects would correct the rotation in favour of grasslands.

The market may contribute to provide the grasslands' areas society needs, because milk and meat produced by grass-feeding have particular characteristics which can be enhanced toward the consumers, with low enough transaction costs. However, the characteristics of public good of grasslands may make market failures last, such as the ones linked to the « free-rider » syndrome or to the « prisoner's dilemma ».

Public policies for grasslands' multifunctionality are then necessary. The economic justification of the choice between coupled or targeted policies depends upon the trade-off between the environmental benefits and the transaction costs of the targeting. The different kinds of grassland premium probably allow to make environmental benefits without increasing in a high proportion the transaction costs in comparison to the price support. On the other hand, the differential premium favouring crops have no economic justifications. The conception of efficient policies for grasslands' multifunctionality make it necessary to start economic research on the jointness between breeding and grasslands and on the measurement of transaction costs.

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Appendix : Maximisation program of farmer's private profit

$f_1(x_1)$ is the production function which describes the production of an agricultural product, which price is p_1 , from grassland area x_1 .

Similarly, $f_2(x_2)$ is the production function which describes the production of an agricultural product, which price is p_2 , from crop area x_2 .

X is the total agricultural area available to the farm.

w_1 and w_2 respectively design operating costs per hectare of grasslands and crops and FC the farm's fixed costs.

The producer's profit maximisation program can be written as follows :

$$\max_{x_1, x_2} \pi = (p_1 f_1(x_1) - w_1 x_1) + (p_2 f_2(x_2) - w_2 x_2) - FC$$

Subject to constraint :

$$x_1 + x_2 = X$$

Solving the producer's program leads to the following first order condition :

$$\begin{cases} p_1 \frac{df_1}{dx_1} - w_1 - \lambda = 0 \\ p_2 \frac{df_2}{dx_2} - w_2 - \lambda = 0 \end{cases}$$

where λ is the Lagrangian multiplier associated with the constraint.

It follows the equality between marginal profits from grasslands and crops :

$$p_1 \frac{df_1}{dx_1} - w_1 = p_2 \frac{df_2}{dx_2} - w_2$$

Table 1. Measures aiming at promoting grassland (France)

Measure	Conversion or preservation	Subsidy (per hectare per year)
Conversion of arable lands with high plant-care risk into grasslands	Conversion	375 € (crops) 305 € (cultivated grasslands)
Set up of grassed stripes along rivers	Conversion	375 € (crops)
Adoption of a production system mainly based on grasslands and low inputs	Conversion or preservation	137 € (for the whole farm area)
Extensive grassland management	Preservation	76 € (concerned area)
Premium to the maintaining of extensive breeding systems	Preservation	46 € (concerned area)

Figure 1. Trade-off between crops and grasslands : private and social optima.

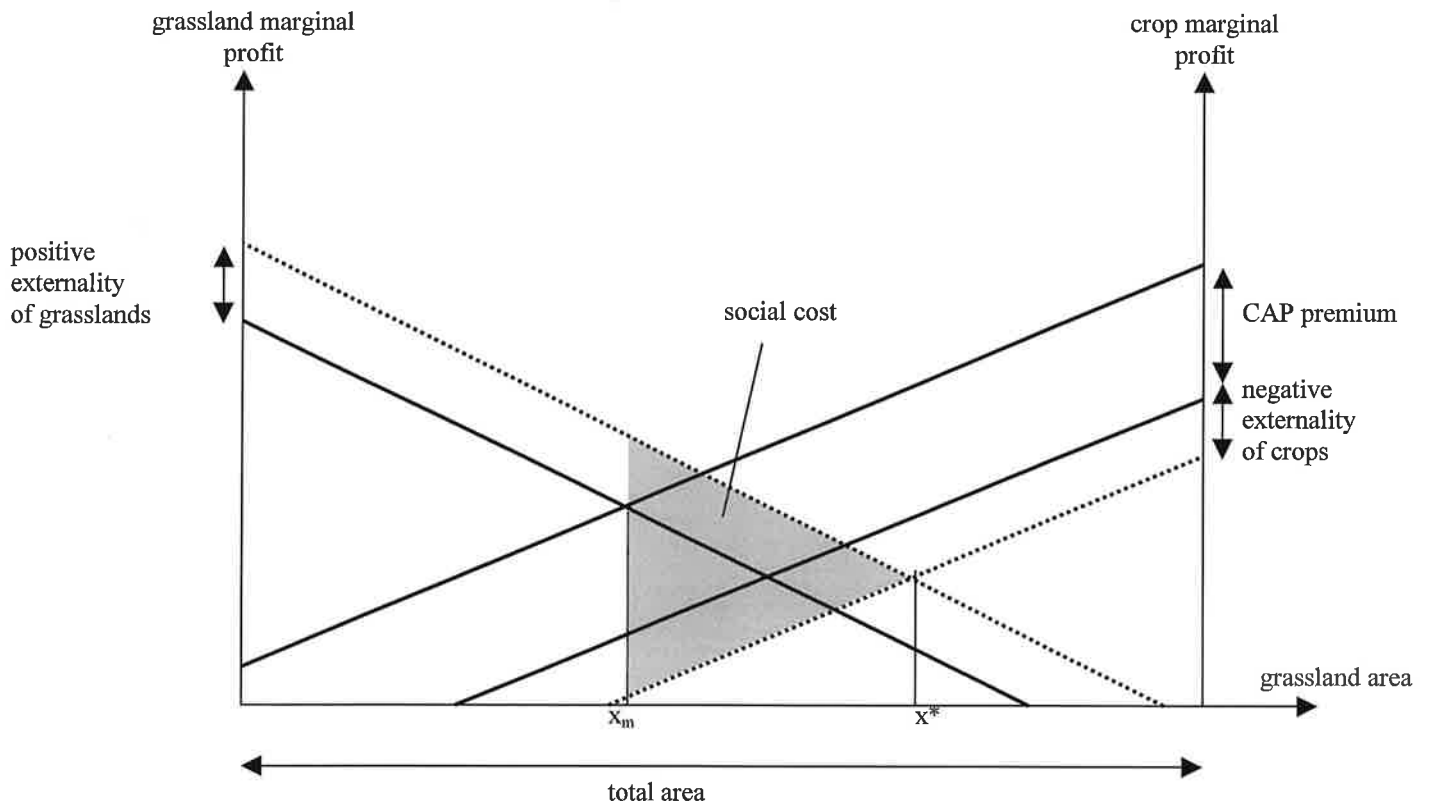


Figure 2. Trade-off between benefits and transaction costs of targeting (from Vatn, 2001).

