# Indicator-based agri-environmental payments for the efficient supply of public goods

Knut Per Hasund
Swedish University of Agricultural Sciences, SLU
Swedish Board of Agriculture

## Abstract

Biodiversity, cultural heritage, and scenery are major public goods produced in the agricultural landscape. Theoretically, Indicator-based Agri-Environmental Payments have the properties of providing socially efficient production. A system of seven composite state indicators, expressing the public goods of the respective fields or field elements, was developed and tested to assess if the model worked in practical policy implementation. The evaluation indicated a more efficient resource allocation, better dynamic incentives and lower transaction costs, compared to the current Swedish payment programmes. A disadvantage is that such value-differentiated payments do not comply with tailoring and with present WTO- or CAP-regulations of cost-based payments.

**Keywords**: Agri-environmental payment; environmental value; indicator; landscape; policy evaluation; public good

# 1. Introduction

## 1.1 The policy problem and the objective of the study

Three conditions have to be considered if aiming to develop socially efficient policy measures for the environmental services connected to agricultural landscapes. A basic condition is the non-rival and non-excludable characters of these environmental goods, which normally causes a market supply below social optimum (Randall, 1972, 1988). Secondly, these environmental goods are positive externalities produced by agriculture, which limits the feasibility of policy restrictions since unprofitable land use and management cannot be enforced. Thirdly, the agricultural landscapes are quite heterogeneous in many dimensions, implying that the values of the environmental public goods vary widely between fields, pasturelands and field element objects. The present agri-environmental payments (AEPs) to pastureland and field elements according to EU Council Regulations 1698/2005 and 1974/2006 is an appropriate policy response, but only to the first two conditions stated above. Their management based payments, cost-based designs and more or less uniform payment tariffs do not consider the differences in environmental values which make them inefficient.

The aim of this explorative study is firstly to test whether it is possible to develop feasible public good indicators and agri-environmental payments that are directly linked to estimates of such indicators. Secondly, to assess whether these value differentiated AEPs are better or not than the present Swedish management based and unit-price AEPs. The assessments are carried out by Multi Criteria Analysis with respect to efficiency, fairness and implementation feasibility criteria. A coherent set of indicators is accordingly developed to reflect the respective environmental public goods of the individual field, pastureland and field element objects. The idea is that the more public goods, the higher indicator estimate, and the higher the AEP. This involves "paying for the product" instead of rewarding management measures.

## 1.2 The agricultural landscape and the environmental problem

The agricultural landscapes of Sweden have changed drastically with the modernization of food production over the last decades. New technology and mixture of input factors have reduced the maintained area and its environmental quality. This process is likely to continue. It has large impacts on biodiversity, cultural heritage, and other socio-cultural landscape amenities.

In quantitative terms, the area of arable land has declined from 3.5 Mha in 1950 (SBA, 2005b) to 2.7 Mha in 2005, with the largest reductions in the north and the forest regions (SS, 2009). The area of traditional meadows has plummeted from 2 Mha to 9400 hectares during the 20$^{th}$ century (SBA, 2005b, 2009). In addition, the area of semi-natural pastures[1] has declined drastically, but has now stabilised around 230,000 ha (SBA, 2005a, 2009). Field elements, such as stonewalls or ponds, were removed on a large scale until a ban was imposed in 1985, or disappeared functionally as the land was abandoned or afforested. Surveys by Ihse (1995), comparing air-photos between 1947 and 1978, show a loss between 50 to 90% of the linear and point elements in arable fields in twenty representative areas analysed. It was projected to the estimate that at least 50% of the former field elements in Sweden have been removed.

Environmental quality has decreased in substantial parts of the remaining agricultural land, partly caused by the use of fertilizers and pesticides, which have reduced the biodiversity of pastureland and field edges. Decreased management of field elements, permanent forest edges and pastureland, with lower grazing pressure and less clearing of shrubs and brushwood have negative ecological, cultural heritage, and socio-cultural landscape effects (SBA et al., 2002; Jonasson and Kumm, 2006; SBA, 2006). Similar patterns of agricultural landscape deterioration have taken place in most industrialized countries (EEA, 1995; OECD, 1999b).

The Swedish Environmental Protection Agency states the ecological impoverishment of the agricultural landscape is the largest threat to the biodiversity in Sweden (SEPA, 2002). Among the 317 red-listed[2] vascular plant species in Sweden, for example, 228 are linked to the agricultural landscape (SSCI, 2005). The Official Swedish Environmental Goal "A Rich Agricultural Landscape" cannot be achieved according to official assessments by Miljömålsrådet (2008), unless further policy measures are taken and the negative external trends mitigated. The decline is due to the loss of traditional meadows, semi-natural pastures, and field elements, as well as qualitative deterioration. In intensively cultivated regions, field elements are almost the only remaining habitats (Robertson et al., 1990; Weibull et al., 2003; SBA, 2005c). Traditional meadows and many of the semi-natural pastures are most species rich terrestrial habitats in Scandinavia (Svensson, 1988; Kull and Sobel, 1991). It is uncertain if the trend of biological deterioration of many pastures has ceased through the existing policy measures (SBA, 2006; Miljömålsrådet, 2008; Sohlman, 2008).

The cultural heritage of the agricultural landscape is linked to land use patterns and structures showing earlier systems of cultivation, and to cultural relics such as wooden fences, cultivation cairns and coppiced trees. The large scale abandonment of arable and pasture land since 1930, the removal of ditches and other field elements in arable fields, as well as changed management methods have affected the cultural heritage negatively (Ihse, 1995). The national LIM-study revealed that in 1993 only 15% of the cultural relics of the arable or pasture areas were still visible in their original state (Ihse and Blom, 2000).

---

[1] Semi-natural pastures are permanent grasslands that have never been exposed to measures such as soil cultivation, fertilizing or pesticide spraying.

[2] Red-listed species in the three most severe categories: critically endangered, endangered, and vulnerable.

Aside from biodiversity and cultural heritage, the remaining, environmental public goods of the landscape are classified here as socio-cultural qualities. They include scenery and aesthetic values, emotional qualities (intimacy, openness, freedom, etc.), identity (national, regional and local), religious, moral and spiritual features, as well as access for recreation and tourism.

## 1.3 The present Swedish system of Agri-Environmental payments

The production of environmental public goods by Swedish agriculture is affected by a complex set of policy measures, including the tax system, general agricultural policy measures, infrastructure, and animal welfare regulations. By influencing the choice of production technology, the profitability of crop and animal husbandry, or the prospects of continuing rural living and farming, the measures operate upon the abandonment of land, the tending of pastures or field elements, and environmentally harmful management methods (Hasund, 1991). Although many of them are important, they are generally inefficient measures of supporting the positive externalities of agriculture. Targeted measures are recommended or requested by several actors, e.g. OECD (2001, 2007a), mainly advocated in terms of goal attainment or efficiency. The more important directed regulations are in The Swedish Environmental Code (SFS 1998:808), concerning Nature Reserves (7 kap. 4, 5 §§), Biotope Protection (7 kap. 11 §), and Environmental Concern in Agriculture (12 kap. 8, 9 §§). These are aimed at restricting environmentally harmful activities, locally or generally, but cannot support positive maintenance. By limiting this study to comparing the present Swedish AEPs with an Indicator based Agri-Environmental Payment (IAEP) system, the starting-point of the comparative assessments was that also directed AEPs might have different efficiency and fairness properties.

The Agri-Environmental payments to Swedish farmers are regulated by CAP, EU Council Regulations 1698/2005 and 1974/2006, which are established in the Swedish Rural Development Plan (MA 2007a, 2007b). Within the programme, the two most important directed schemes for landscape public goods are the AEPs to “Traditional meadows and pastureland” (Permanent Grassland, PG-scheme) and “Nature and culture environments in the cultivated landscape”, where the latter is directed to Field Elements of arable land (FE-scheme). There are also the AEPs to “Restoration of meadows and pastures” and “Management and restoration of wetlands”, but their budgets are relatively small.

The PG-scheme distributed 815 million SEK[3] to 294,900 hectares in 2007 (Table 1). All permanent grassland received 1100 SEK/ha/y, whereas qualifying pastures and traditional meadows receive 2500 SEK/ha/y and 3500 SEK/ha/y. An official of the

[3] Swedish Crown (1 SEK ≈ 0.1 Euro)

county board determines if the grassland object is eligible for higher AEP, and then establishes a detailed, site-specific management plan linked to it. There are also specific payments to scythe mowing and pollarding. Besides providing financial support, the scheme involves a set of strict management requirements, such as clearing of all brushwood. Farmers who do not comply with the requirements on an object are subject to severe repayment claims (MA, 2007a, 2007b).

The FE-scheme distributed 148 MSEK in 2007. Most types of linear elements are rewarded by 0.6 SEK/m, but some types receive 2.6 SEK/m/y (MA, 2007a, 2007b: Table 1). There are no payments to wood edges. Each object of point elements such as ponds, field islets and redundant traditional field buildings may receive 180 SEK/y, whereas, others are paid 60 SEK/y (ibid.). No further differentiation of the payments exists. The payments are conditioned by management requirements, such as clearing of brushwood. About 32% of the Swedish linear elements and 28% of the point elements are involved in the AEP schemes, varying between element types (calculated from SBA, 2006).

The AEPs are dependent upon a contracting procedure, where the farmers have to send in detailed applications (MA 2007a, 2007b). Many farmers employ consultants for the contracting procedure.

**Table 1. Agri-Environmental payments to permanent grassland or elements of cultivated fields.** Sweden 2007

| **Policy measure** | **Payment/year** | **Rewarded** (Sweden total ) |
|---|---|---|
| Meadow and pasture scheme (PG) | | |
| Meadows and pastures, general | 1100 (SEK/ha) | 173,700 (ha) |
| Pastures, specific values | 2500 (SEK/ha) | 121,200 (ha) |
| Meadows, specific values | 3500 (SEK/ha) | 4100 (ha) |
| Pollarding | 100 (SEK/tree) | |
| Mowing by scythe | 10,500 SEK/ha) | |
| Nature and culture environments of the cultivated landscape scheme (FE) | | |
| Stone walls, traditional wooden fences, shelter hedges | 26 (SEK/10 m) | Stone wall: 17,339 (km)<br>Wood fence: 204 (km) |
| Other linear field elements | 6 (SEK/10 m) | |
| Pollards, ponds, field islets, field barns, etc. | 180 (SEK/per element) | Pollards: 3,327<br>Ponds: 5,808<br>Field islets: 35,025<br>Field barns: 8,827 |
| Cultivation cairns, alley trees, etc. | 60 (SEK/per element) | Cairns: 191,966<br>Alley trees: 126,106 |

Source: MA (2007a, 2007b), SBA (2008a, 2008b, 2008c)

## 1.4 Outline

This paper continues with an introductory section providing a theoretical welfare foundation for how to design socially efficient policy measures for environmental public goods of the agricultural landscape. It is followed by a presentation of the methodology that starts with a section explaining the IAEPs approach based on the theoretical conclusions. Brief sections about the methodology for developing the indicators and about linking the payments to the indicators come after that. The methodology part ends with a section on the methodology for evaluating policy measures. The next part describes the results. Its first section presents the resulting set of developed indicators. One of the indicators is then presented to illustrate the set of indicators developed. The last section evaluates the IAEPs relative to the present Swedish system. The potential of an IAEP-system and its policy implications are discussed in a final, concluding section.

# 2. Welfare theoretical foundation

Agriculture produces not only private market commodities, but also biodiversity, cultural heritage, and other socio-cultural qualities. Without continued agriculture, much of these environmental goods and services would disappear. Viewed from a welfare economic perspective, the basic policy problem is that these products are non-excludable and non-rival in consumption, included in the utility functions of many persons. This implies that private markets, based on property rights and contracts, normally cannot provide socially efficient land use, or production of these environmental qualities (Romstad et al., 2000). These environmental services were previously by-products of food production by technical complementary, but joint output decreased drastically over the last decades through changing technology and changing relative prices: see ibid., Vatn et al. (2002), Wossink and Swinton (2007).

Non-excludability means that nobody could be excluded from consuming the good, whether having the legal right to it or not, and whether paying for it or not. Non-excludability provides free-riding incentives, which leads to socially sub-optimal production of goods with this character (Randall, 1972). This character applies to many environmental qualities of landscape objects, not the least to non-use values of biodiversity and cultural heritage or use values in terms of scenery and local identity. The ancient Swedish law of Public Access to Private Land gives an institutional framework that further increases the non-excludable character of outdoor recreational access.

Non-rivalry implies that a person's consumption of a good does not reduce other persons' utility from, or possibility to, consume it. Consequently, the market will produce less than the optimal amount of biodiversity, pastureland, or other non-rival goods, as the price mechanisms underestimate their social value (Randall, 1988; Samuelson, 1954). The market transaction costs for supplying the landscape goods demanded are in most cases prohibitively high, even for co-operative solutions, see Coase (1960), Dahlman (1979), Vatn et al. (2002).

In this context, it should be emphasized that the Swedish agricultural landscape is not a single good, but is heterogeneous with tens of thousands of arable fields, pastures, and field elements. Biotope conditions, geographical location, management history, hydrology, surrounding landscape, frequency of visitors, and size vary widely across the objects. Many values may also be involved in varying degrees between the objects, where biological, cultural heritage, and socio-cultural values are just broad categories; see OECD (1999b). As well as implying high transaction costs (see 4.2.2 below), another consequence is that the marginal costs and the marginal social benefits of producing the landscape public goods vary widely from site to site.

Socially efficient land use implies that each arable field and pasture, where the total social benefits are larger than its social costs, is maintained with the most efficient technology. An optimal amount of resources and resource mix would be used to optimize the output, including not only the market commodities but also public goods; see Varian (1992) and Johansson (1993).

Active management measures are required for maintaining much of the landscape public goods, as they are positive externalities of agriculture. If agricultural management disappears, so will the public goods that are specific to agriculture. This is a contrary situation to most other environmental problems that are caused by some activity that gives negative externalities. Hence, to impose restrictions on land management – as against pollution and other negative externalities – would neither be efficient, nor comply with the common conception of justice (Hodge, 1991). Farmers cannot be forced to maintain privately unprofitable land or use unprofitable management methods: some form of financing would be required (OECD, 2001).

However, to impose uniform payments coupled to management regulations would in general be inefficient, considering the heterogeneous conditions. The same applies to cross compliance measures. In a situation of heterogeneous farmers supplying heterogeneous goods, targeted payments are generally more appropriate (Falconer et al. 2001). Payments differentiated per hectare according to the production of public goods would theoretically have the necessary properties to provide efficient incentives and efficient resource allocation (Lankoski and Ollikainen, 2003; Rollett et al., 2008). Applying the points of intervention as close as possible to the desired outcomes is more likely to be effective, as the chain of action/reaction is shorter and there are fewer uncertainties (OECD, 2007a).

Payment per unit of landscape public goods produced would copy the function of market prices (Schwartz et al., 2008). By not being technology based, the choice of land use and land management is left to the landowners and farmers, according to the specific conditions at each site. For such a uniform payment for landscape goods to be efficient, it has to be at a rate equal to the marginal social costs and equal to the marginal social benefits (see e.g. Edwards and Fraser, 2001), as expressed by Equation 1:

$$p_S{}^* = MC_s(q^*) = MB_{s,n}(q^*), \qquad \text{Equation 1}$$

where:
$p^*_s$ is the price in € per unit of public goods, measured by qualitative hectares,
$MC_s{}^*$ is marginal social total costs, and
$MB_s{}^*$ is marginal social net benefits[4] (Figure 1)

[4] The baseline or reference point for the marginal benefits and costs (opportunity costs of the land) is abandonment, an agriculture-off situation.

The quantity of landscape public goods in a region or country is expressed in the same unit, qualitative hectares (qha, see Figure 1). This new concept allows analysis of heterogeneous conditions, and is derived by multiplying the objects' area with their respective indicator estimates, which expresses the public goods per hectare (see below).

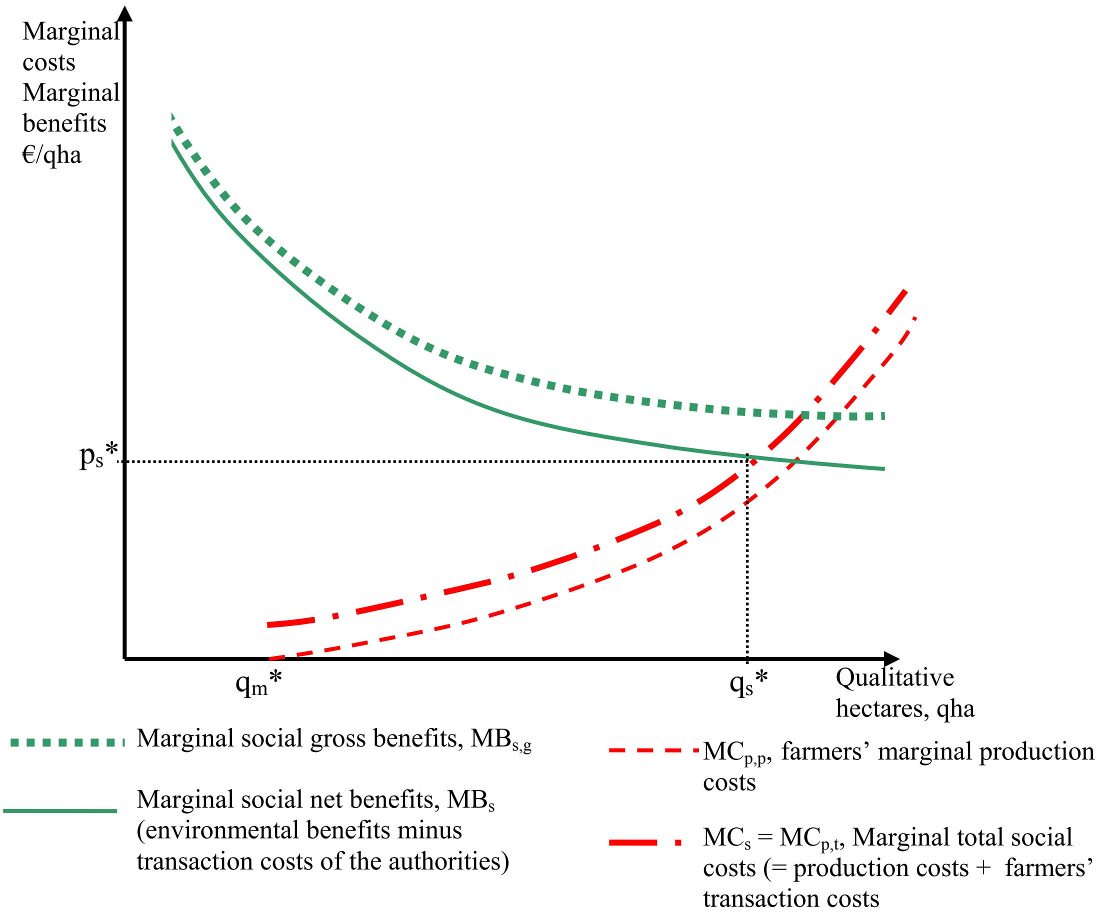


Figure 1. Principal sketch indicating the social optimum ($q_s$*) and optimal price ($p_s$*) of public goods in the agricultural landscape

The amount $q_m$* (Figure 1) is what would be given by the market as by-products in the production of market commodities, if there were no policy measures for the environmental public goods. Any larger amount of public goods implies costs, as illustrated by the marginal production cost function. Marginal production costs, $MC_p$, are calculated as the net between additional costs of increasing the area or the environmental quality of agricultural land minus the value of additional market commodities (Romstad et al., 2000).

Rational and profit maximizing farmers' reservation price for undertaking a contract to enhance their production of public goods is equal to their marginal production cost plus their marginal transaction cost, as indicated by the function $MC_{p,t}$ (Figure 1). Society's payment for an additional unit of public goods should not exceed its marginal social net benefit, $MB_s$, if the aim is an efficient production of public goods. This net benefit is derived as the marginal social benefit of the environmental public goods minus the authorities' marginal transaction costs.

# 3. Methodology

## 3.1 The IAEP approach

The theoretical welfare economic analysis indicates that uniform AEPs per unit of landscape public good have the properties of a potentially socially efficient policy measure (Schwartz et al., 2008), if its tariff (payment per unit) is settled at an appropriate level ($p_s$* in Figure 1). Next question is whether this theoretical conclusion also holds in practice, if it can be realized considering AEP-design, transaction costs, control, and other criteria.

The approach of this study was to develop AEPs based on indicators expressing the amount of public goods produced. Such state indicators have to be used to meet the request for tangible, targeted measures closely linked to biodiversity, cultural heritage etc. as these environmental services cannot be measured directly (Hodge, 1991; OECD, 2007a; Rollett et al., 2008; Wossink et al., 1999; Zalidis et al., 2004). Accordingly, the developed IAEP-model is a large scale, multiple-objective and "maintenance+enhancement" approach; see Schwartz et al. (2008).

The indicators are designed for and measured at the object level, in order to get an efficient incentive structure and resource allocation. An object's AEP increases with its public good indicator estimate, and is revised annually. The indicator values are derived in two steps. First, they are measured in physical or biological terms etc. as qualitative hectares, meters or numbers. These indicator estimates are in the next step multiplied by a politically settled price per unit of public goods. The approach implies a transparent distinction between how to measure the amount of public goods and how to evaluate them.

Nothing prevents that the IAEP-system is combined with restrictions against environmentally harmful activities, or information to farmers about the aims of the payments, how the system is designed, and the relations between management measures, environmental effects, indicator estimates and payments.

A feature of the IAEP-system with a general payment tariff is that the authorities do not need information about the marginal costs of each object. As farmers are remunerated without any contracting procedure for the PGs that they have supplied, the IAEP-system can be considered as *ex post* payments without any guarantee that the land will be managed optimally in coming years. However, to the extent that farmers are rational profit maximizers, and believe that the system is sustainable, they will manage the land and make improvements or investments to provide an efficient supply of PGs also in the future.

By aiming at social efficiency, this approach differs not just from the uniform AEPs or cost-based contracts employed in many European countries, but also from the auction-contract systems analyzed by Slangen (1997), Latacz-Lohmann and Hamsvoort (1997, 1998) and Moxey et al. (1999). The auction systems aim at developing cost-effective solutions within a given budget constraint. They are designed to deal with asymmetric information concerning the costs of providing environmental services. However, auction-systems demand detailed information about site-specific environmental conditions and may suffer from problems of strategic bidding behaviour, adverse selection, and high transaction costs (ibid.; Stoneham et al., 2003). According to OECD (2007a), auctions are neither suitable for small scale, local environmental goods, nor for collective action when farms are small compared to the target area.

The IAEP-model has some similarities with the US Conservation Reserve Programme, which employs site indicators to assess the environmental effects and the cost-effectiveness of farmers' offers to undertake management measures within a given set of alternatives; see e.g. USDA 2009. There are, however, also fundamental differences, as the Conservation Reserve Programme is not mainly oriented to PGs that are positive externalities, it has a wider scope of also addressing soil erosion and food security, it is not aiming at social efficiency, it operates with fixed management options, and its indicators are less precise with respect to environmental qualities.

## 3.2 Methodology for developing indicators

The methodology[5] for developing the indicators involved a six-step process, including design and selection of assessment criteria, development of candidate indicators, monitoring, testing, revising, and final choice of indicators. As a basis for designing and choosing among candidate indicators, a model of 19 criteria was developed. Policy relevance (reflecting the presence of public goods), measurement costs, temporal responsiveness and pedagogic features were among the major criteria.

The design of the indicators was based on a literature survey followed by a Best Professional Judgement iterative process by an interdisciplinary group of 25 experts in

[5] Further information about the methodology and the indicators is available in (Hasund 2009).

ecology, cultural history, geography, sociology, and landscape architecture. The approach was to identify physical, measurable phenomena correlated to the objects' environmental status, and then to rank and weight these factors as objectively as possible in biological, cultural, and social terms. Data for two case study areas were obtained from existing GIS data, air-photo surveying, and field surveys.

## 3.2 Linking payments to the indicators

To settle the price per unit of public good or the payment tariff in, for example, EUR/qha is a purely normative or political matter. With this as a separate step, the valuation is more transparent and flexible. The values and the payments can be more easily adjusted by altering demands, inflation, or different regional situations.

There are two dominating approaches, to establish the values in a political-administrative process or to base them on the citizens' Willingness To Pay (WTP). If aiming at maximising social welfare (Kaldor-Hicks criterion), the payment tariff should equal the society's marginal benefits at optimum (Figure 1). Considering the character of these environmental services, the marginal social benefits have to be estimated by some (stated preference) valuation method, but no current value estimates do yet exist that are expressed in monetary terms per qha, qm[6] or qN°. Implicit valuations from earlier political decisions are described in the next section about the present Swedish Rural Development Plan.

If instead the payments are based on social WTP-estimates, the only Swedish study currently available indicates an aggregated WTP of 2000 SEK/ha/y for maintaining permanent pastureland in general from afforestation (Drake, 1992). According to another CVM-study in 1998, the WTP for preserving field elements from being removed was 4700 MSEK/y, corresponding to 1700 SEK per hectare arable land (Hasund, 1998). Allocating WTP by type of element, the respondents stated that field islets were 50% more valuable than solitary trees, whereas, stone walls were 50% more valuable than ditches and wooden fences, which were four times more valuable per metre than headlands (ibid.)

Based on these figures, a tentative but "low-level" tariff of 1000 SEK/qha/y for permanent grassland, 1 SEK/qm for linear elements, and 100 SEK/qN° for point elements were employed in this study to demonstrate the outcome on the object, farm, and study area levels. These values were used as payment tariffs, to be multiplied with the estimated indicator for each object. The actual AEPs were disbursed accordingly to the farmers, specified for the respective objects and without any contracting process.

---

[6] qm: qualitative meters, qN°: qualitative numbers.

Thus, implementation of the system involves the main steps:

1. Developing a criteria based system for assessing candidate indicators
2. Developing the set of AEP-indicators, including testing and criteria assessments
3. Estimating indicator values for each object
4. Establishing a payment tariff per indicator unit
5. Informing farmers about their IAEPs, specified per object. Options for corrections
6. Disbursing the IAEPs to the farmers
7. Monitoring of the effects, analysis, revision of the system

## 3.3 Method for evaluating policy measures

A method modified from Olson (1995) of six main steps was applied:

1. Settling objectives of the evaluation
2. Developing/identifying the policy measure alternatives to assess
3. Designing and choosing operative assessment criteria
4. Developing an system of weighting the criteria assessments
5. Estimations, calculations or qualitative judgements of effects relative criteria, scoring
6. Comparative analysis, overall evaluation

The evaluation of alternative AEP-systems was performed by multi-criteria analysis, combining a disjunctive, non-compensatory method with a simplified multi-attribute method; see Dodgeson et al. (2000), Janssen and Munda (1999), and Keeney and Raiffa (1993). The method involves comparative assessment of the policy measures with respect to the three criteria of efficiency, fairness, and implementation feasibility. Each of these criteria has a set of sub-criteria (Table 2), which are weighted together by standard procedures of clustering trees (ibid.). In brief, the method implies that AEP-design alternatives that do not comply with the non-compensatory criteria (Producer Compensation Principle (PCP); Legal equality) get outranked, whereas other alternatives are ranked according to their performance in the multi-attribute assessments.

The assessments and comparisons between alternative policy measure designs were based on the X-marked criteria in Table 2. The assessment criteria were selected and designed based on literature surveys.

**Table 2. Assessment criteria for agri-environmental policy analysis**

| **Criteria**<br>Sub-criteria | **Criteria used in this study** |
|---|---|
| **Dynamic efficiency** | |
| Effects | |
| Acreage and Management effects | X |
| Environmental effects (Biodiversity, Cultural heritage, etc.) | X |
| Effect profile of other policy objectives (Regional economy, GNP, etc.) | |
| Farming sustainability | |
| Costs | |
| Budget means, farm resources | |
| Production costs, resource use (opportunity costs) | X |
| Transaction costs (Administrative costs) | X |
| Conversion costs | |
| Informative and competence properties of the measures, transparency | X |
| Control properties | X |
| Acceptance | X |
| Confidence | X |
| Certainty of results (Dependability), robustness | |
| Long-term incentives | X |
| Flexibility | X |
| Inducing innovations | X |
| **Distributional effects** | |
| Between incidence groups: farmers, tax payers, etc. | |
| Temporal distribution, intergenerational distribution | |
| **Fairness** | |
| PCP, Producer Compensation Principle | X |
| Legal equality, generality of rules | X |
| **Implementation feasibility** | |
| Ethical implications | |
| Political acceptability | |
| Compatibility with existing policy measures | |
| Compliance with international treaties (EU, WTO) | X |

Source: author, compiled from e.g. Bonnieux and Dupraz (1999) and OECD (2001, 2007a).

# 4. Results

## 4.1 The resulting set of indicators

The process led to a final, coherent set of seven indicators. The indicators developed were state indicators at the object level, expressing the environmental qualities of a demarcated, single object in the landscape. Each indicator was determined by a set of variables.

The seven indicators were:

- Arable field indicator (qha)
- Permanent grassland indicator (qha)
- Linear elements indicator (qm)
- Point field elements indicator (qN°)
- Forest edge indicator (qm)
- Biorich trees indicator (qN°)
- Historic relic indicator (qN°)

The set of object indicators aimed to cover all the landscape public goods of the Swedish agricultural land. It includes the positive environmental externalities[7] of agriculture in terms of biodiversity, cultural heritage, and socio-cultural landscape features. The first two indicators referred to the two official agricultural land use types: arable fields and permanent grasslands, respectively. Weighting for differing environmental variables, they are measured in qha. The next object indicators referred to field elements within or along the fields, measured by qm or qN°.

To give an example of an indicator design, the Permanent Grassland (PG) indicator is measured in Qualitative hectares, as calculated by:

$$I_{PG} = A \cdot C \cdot Z \cdot (T+M+G+\Sigma Q_B+\Sigma Q_H+\Sigma Q_S), \qquad \text{Equation 2}$$

where:

*A*: Acreage of the PG-object measured by hectares

*C*: Active land use; C = 1 if the object is grazed or mowed in the year, otherwise C = 0

*Z*: Invading brushwood or thickets; Z = 1 if Brushwood or thickets cover 0-3% of the object's area, Z = 0.75 if 3-10% cover, Z= 0.5 if > 10% cover

*T*: Type of grassland; T = 10 if traditional meadow, T = 4 if semi-natural pastures, T =1 if cultivated permanent grassland)

*M*: Maintenance; M = 3 if accumulated organic litter is ≤ 5cm, M = 0 otherwise

[7] As stated above, negative externalities are preferably (efficiency, fairness) handled by policy measures other than agri-environmental payments. Other, non-environmental positive externalities, mainly the food security aspect of arable land, could be added to the model. It was estimated to be 50 SEK/ha in 1988 (Molander, 1988).

*G*: Trees and bushes; G = 0,5 if trees and bushes cover 0 - 25% of the object's area; G = 0 otherwise

$\Sigma Q_B$ Biodiversity qualities; $\Sigma Q_B$ is in the range 0 – 2.5 depending on the object's number of confirmation species, tree diversity, and bushes diversity

$\Sigma Q_H$ Cultural heritage quality (farm or farm village vicinity); $\Sigma Q_H = 0.2$ if the object is not more than 50m far from farm or farm village in its closest edge

$\Sigma Q_S$ Social qualities, additional use values; $\Sigma Q_S = 0.5$ if the object is less than 1 km away from a village /town with more than 200 inhabitants, or having more than 100 different visitors/y for other reasons; $\Sigma Q_S = 0.5$ if the object can be seen from a road or a railway with more than 10,000 passengers/y; $\Sigma Q_S = 1$ if both.

The equation implies that the payments increases linearly with the area of the object (variable A) and become zero if there is no producing activity (C = 0). The variables inside the parenthesis are designed to be additive, although there in reality may be correlations between environmental factors.

## 4.2 Evaluation of IAEPs and the current AEPs

The following section presents the results of the evaluation of the IAEP-system and the current policy measures. It is divided into sub-sections, one for each of the assessment criteria efficiency, transaction costs, informative properties, etc. Every sub-section starts with a description of the criterion and its relevance for the problem, followed by the evaluation results concerning the current policy and concerning the IAEPs.

Alternative designs of IAEPs were assessed against the present Swedish AEP-measures for permanent grasslands and field elements, employing the criteria listed above. In this study, the empirical criteria assessments underlying the scores of the performance matrix are mainly qualitative (see below).

A number of IAEP-alternatives were assessed. They have the same basic design, but differ with respect to how their indicators are designed and weighted. The performance scores of the IAEP-alternatives were the same for many of the criteria, but differed for: Environmental effects, Management measures, Production costs, Transaction costs, Informative properties, and Control properties. The following section presents the evaluation of the present Swedish AEP-programmes and the IAEP-alternative that turned out with the highest ranking.

### 4.2.1 Efficiency: Environmental effects and Production costs

The efficiency concept applied was social efficiency, precisely defined within micro-economic theory (see Johansson, 1993); Varian, 1992) and refers to a hypothetical state characterised by maximal utility over time for the (weighted) sum of all individuals in society. Concerning aggregation of benefits and costs over the individuals in society, the Kaldor-Hicks efficiency criterion was applied.

There are numerous studies stating that the Common Agricultural Policy of EU (CAP) is inefficient in general and with respect to the provision of positive environmental externalities (e.g. OECD, 2005; Pain and Pienkowski, 1997). It is widely acknowledged that its production and price oriented support has been ineffective, costly and giving negative environmental effects (Bureau and Mahé, 2008), which led to several revisions involving decoupling and more targeted measures. However, also many specific measures within the RURAL DEVELOPMENT PLANs may suffer from inefficiency by not being targeted for specific outcomes. As OECD (2007a) emphasizes, sub-optimal policy designs arises when instruments are not precisely focused on the objective, when some objective dimensions are missing, or when the incentive rate is too high or low. Although the policy performance effects (in terms of contracted area, etc.) of the grassland schemes are good in many European countries, there are hardly any studies on policy outcome effects in terms of environmental impacts, etc. (Kleijn, 1997; Kleijn et al., 2001; Primdahl et al., 2003). According to Kleijn et al. (2001), the Dutch grassland schemes have no significant, positive effects on biodiversity, neither on the flora, nor on the fauna.

The Swedish PG-scheme (Table 1) is criticized for not considering varying site conditions, rigidly enforcing uniform management measures, providing insufficient remuneration to the most environmentally valuable land, and being administratively cumbersome. However, it has still mitigated the decline of the pastureland area and had large positive quality impacts (SBA, 1997, 1999, 2006, 2008c; SBA et al. 1999, 2002; SNAO, 1999; MA, 2003; Andersson et al., 2008). Rigorous sanctions combined with some obscurities about the interpretation of the regulations have caused reluctance about the programme among some farmers, and in some cases hesitation against entering into a contract. The scheme has increased the amount of land cleared from brushwood or thickets and reduced overgrown area. In some pastures, the scheme has improved environmental quality (SBA, SEPA and SNHB, 2002).

The FE-scheme is correspondingly important for the cultivated landscape through providing financial support coupled to some management requirements, although Herodes (2008) reports that many farmers find that the payments are too low considering the administrative and management costs. The scheme also implies an indirect support for restraining abandonment of fields with many such elements. It has enhanced the interest and knowledge of the farmers about landscape values and management, which has reinforced their readiness to maintain the elements (SBA, 2006; Sandström and Klang, 2007; Andersson et al., 2008). A general critique is that the regulations are too detailed, intricate, and not adopted for varying natural, cultural, or management conditions (ibid).

For obvious reasons, the IAEP has not been assessed empirically. Interviews with farmers with current contracts indicate they would continue with the present management on most of the pastureland, if there was a change to IAEP. However, on some sites, they considered they could improve their efforts, while on other sites or farms relaxing the clearing of brushwood, or rather, doing it less frequently. A minority of the farmers suggested they would possibly expand their pastureland area, at least if the IAEPs were sufficiently high.

For comparing the outcome of the current AEP and IAEP schemes in terms of payments, calculations for the permanent grasslands of Selaö case study area were made. These revealed that indicator based payments would allocate payments across grasslands differently, and accordingly have different incentives for management and maintenance. Applying the tariff 1000 SEK/qha/y, 5 pastures or 3% of the pastureland area would receive more than 1000 SEK less per hectare than today, and 7% of the area would get 0 – 1000 SEK/ha less. The area that would receive higher remuneration was larger: 12% getting 0 – 999 SEK more, 32% getting 1000 – 3999 SEK more, and 45% of the area getting ≥ 4000 SEK more.

These results indicated the IAEPs would give a wider range and another relative distribution of payments across pastures, but also that the total present payments to the permanent grasslands may be too low for providing social efficiency, at least if not considering the indirect payments of general CAP subsidies to agriculture. The sum of reduced payments in the study area would be 7700 SEK/y, whereas, the sum of the increased payments for the grasslands concerned would be 478,000 SEK/y at this payment tariff. This difference implies that the present 181,000 SEK in AEPs to the study area’s grasslands is just 28% of what they would receive from the IAEP-system at the tariff 1000 SEK/qha, which is settled at a level aiming for social efficiency.

A calibration of the tariff to provide the same sum of IAEPs to grasslands as in the present programme, and a comparison of the allocation of payments, still produced marked differences. If this budget constraint is accepted and assuming that the indicators correctly reflect the presence of public goods, 14% of the Selaö pastureland area was overpaid by more than 1000 SEK/y and 37% was overpaid by 0 – 1000 SEK/y. About 14% of the area was relatively underpaid by 0 – 1000 SEK/y and 34% was underpaid by more than 1000 SEK/y.

The comparisons illustrate that the present, cost-based Swedish AEPs to grassland are little differentiated and targeted to the provision of public environmental public goods. The potential for enhancing efficiency by IAEPs appeared large. Conversely, the IAEP system developed did not comply with the criterion of tailoring (OECD, 2007a), as the payments could be higher than the farmers’ reservation price on some sites, at least in the short run. However, this is mainly a distributional issue of less efficiency relevance.

In these partial efficiency assessments, costs were not estimated explicitly. An optimally designed IAEP system has, however, the property of inducing only costs that are lower than the benefits, as rational farmers will not undertake measures that are more costly than they generate in market plus AEP revenues. Being targeted, but not fixing the technology, the IAEPs allow the farmers freedom too choose the cost-minimising solution for the actual situation (OECD, 2007b; Schwartz et al., 2008). The comparative calculations presented indicated the present policy overpays on some land, especially considering general CAP subsidies, which tend to induce costs that are unjustified with respect to efficiency. Another issue is that the present payments to grassland are higher than the farming additional costs for environmental concern on larger pastures but insufficient on smaller objects and traditional meadows, according to detailed case study calculations[8] by Päiviö (2008).

Payment-by-results schemes are in general more efficient than payment-by-actions or prescriptions, as they can improve the environmental targeting and involve lower costs by giving farmers freedom to choose technology and apply their superior knowledge on farm conditions (Blandford, 2001; Rollett et al., 2008; Schwartz et al., 2008). Assuming rational, profit maximising farmers and no other resource allocation distortions, the IAEP system would induce efficiency, if the indicators expressed the public goods. Farmers would use all land and carry out all management measures to improve the environment, whose social benefits were larger than the social costs.

### 4.2.2 Transaction costs

Policy related transaction costs (PRTCs) refer to all costs arising from interactions between and within the authorities, organisations, and private actors induced by the policy measure (Coase, 1960; Dahlman, 1979; Williamson, 1989; Falconer et al., 2001; OECD 2007b; Challen, 2001). They include costs incurred by government bodies for attaining information, designing the policy measure, implementation, monitoring, enforcing and evaluation, and by farmers for obtaining information, contracting, and supplying information (Romstad et al., 2000; Falconer et al., 2001; OECD, 2007b). The PRTCs should be minimised jointly with the total costs in relation to the benefits, as there is a trade-off between precision and the PRTCs (Falconer and Whitby, 1999a; Vatn et al., 2002; OECD, 2007b).

The size of the PRTCs depends upon the design of the measures, the number of transactions, the monitoring demands, if objectives are clearly stated, the duration of the programme, the transparency and the political acceptance of the measures among farmers and officials, etc. (Eklund, 1999; Falconer and Whitby, 1999a; Falconer et al., 2001; Vatn et al. 2002; OECD, 2007b; Rørstad et al., 2007). Targeting outcomes rather than processes facilitates evaluation, and lowers the PRTCs (Falconer et al., 2001; Vatn et al., 2002; OECD, 2007b). This does not contradict that targeted AEPs

[8] These calculations include just the costs for managing the grassland, and do not take into account whether the animal production is profitable or not.

normally have higher PRTCs than broad-based policies, by spreading fixed costs over smaller units of transfer and having additional costs of identifying target variables. PRTCs are normally higher if the goods or services are heterogeneous (ibid.; Falconer and Whitby, 1999a), which applies to landscape public goods.

Falconer et al. (2001) found that farmers have economies of size by distributing fixed PRTCs over larger areas. The same applies for the authorities, according to Eklund (1999). This implies that the contracting AEP design favours large farms, which may result in negative landscape impacts on smaller farms.

Estimates of AEP-scheme running PRTCs were on average 12.4% of the total policy expenditures for ESAs and 20.5% for NSAs in UK (Falconer et al., 2001). Whitby et al. (1998) estimated the PRTCs of ESA schemes to 25.4 BPD/ha, or 10 million BPD, compared to 20.1 million BPD payments. Whittaker et al. (1991) revealed a large variation in ESA PRTCs, ranging from 2.4 – 77 BPD/ha. Falconer and Whitby (1999b) estimated the PRTCs of AEPs in eight EU-countries to 20–30% of total payments on average, varying widely from 1.1 – 79% between measures.

For the Swedish PG-scheme, the PRTCs were 10.1% of total government scheme cost in 1995, and 11.3% for the FE-scheme (ibid.). The state borne PRTCs of the PG-scheme was 11.9% and the FE-scheme 14.1% in 1997 (Eklund, 1999). The total Swedish governmental administration cost of the CAP-support to agriculture was 431 MSEK in 2007 (SBA, 2008a, 2008c). On average, every SAM-application cost the authorities 4448 SEK to handle (ibid.). The schemes have been criticised for having complicated regulations and arduous and costly administration; see e.g. Herodes (2008) or Sandström and Klang (2007).

It was not possible to measure the complete PRTCs of the developed IAEP system. However, the farmers' PRTCs in terms of application should, be close to zero, as there are no contracting procedures. The costs for appeals depend upon the accuracy of the indicator measurements (Hodge and Reader, 2007, from Schwartz et al., 2008), which could be larger than in the present system. The farmers will not have the relatively high time costs related to the present site-specific management plans. The cost of acquiring knowledge and information about the relations between management, the environmental outcome, and the AEPs, which varies between farms and farmers, could be reduced by relevant information from the authorities. These costs are not negligible and will increase. In an IAEP system, farmers' PRTCs are expected to be significantly lower, even if they normally are small relative total costs.

The PRTCs of the authorities were also assessed as significantly lower with IAEPs than with the present system. The presented model was developed within a relatively low project budget, indicating small initiation costs. The major PRTCs are from estimating the indicators of each object, and partly from disseminating information. Much indicator data can be obtained from existing GIS-databases at an almost negligible cost. Other indicator data can be obtained by air-photo surveying at a sparing time-cost (Table 3). Although it would be feasible with this level of precision to suffice with low PRTCs, further differentiation by supplementary field surveys appeared motivated for balancing additional PRTCs against total benefits and costs. By applying a tariff of 25 EUR/h, the field survey cost varied between 1 – 10 EUR/object, excluding travel costs to the object. The additional costs of annual, or every third year national air-photography may be may be small at the margin if done anyway, otherwise large. Satellite remote sensing is, however, expected to reduce these costs in the future.

**Table 3. Measured time for air-photo surveying the final AEP-indicator variables**

| **Type of object** | **Surveying time** (Seconds per object) |
|---|---|
| Pastures | 62 – 91 |
| Point field elements | 4 – 16 |
| Linear field elements | 71 – 93 |
| Forest edges | 10 – 37 |
| Total (arable land and permanent grassland) | 1.3 – 2.3 (minutes per hectare) |

### 4.2.3 Informative and educational properties

Policy measures operate not only by direct regulating or incentives, but also more indirectly by transmitting information, communicating values, influencing attitudes, teaching about the problem, etc. (Drake et al., 1999; Lowe et al., 1999; Vanslembrouck et al., 2002). Some policy instruments can transmit information about preferences, technological changes and resource scarcities, and cause adaptations among thousands of producers and consumers at low information costs. In general, policy measures that explicitly express society's demands are, ceteris paribus, superior in this respect (OECD, 2007a). If combined with flexibility for the producer responses, inherent information may contribute significantly to overall efficiency (ibid.).

The current information provided to farmers focuses on the regulations of the Swedish programmes, but there is also extensive information about their objectives, historical, and ecological conditions, provided by printed brochures, web-sites, personal communication and courses offered by the Swedish Board of Agriculture and the county boards (SBA, 2008b). Personal extension is given related to management plans when contracting for specific payments to grassland. The information is in general positively received by the farmers, especially when concerning historical and environmental facts (SBA, 2006; Sandström and Klang, 2007). Personal contacts and advising have the best effects (ibid.). One third of farmers not applying for field element contracts reported that they did not know about the programme (SBA, 2006).

In an IAEP-system, the information given to the farmer would be more focused on management measures that enhance the indicator values and the AEPs, but also include the aim of the AEP-system, the payment and indicator value per object, or the environmental and socio-cultural motives behind the indicator variables.

#### 4.2.4 Control properties

Between the alternative different policy measure designs, control properties vary with respect to relevance of control information, control costs, and how the control affects farmer acceptance of and attitudes to the programme.

The controls of the current Swedish AEPs to grassland and field elements function well, according to Sandström and Klang (2007). The controls focus on whether the management criteria have been met, but there are no investigations on how they are related to the controlled objects' biodiversity, cultural and social services. In 2007, the county boards controlled 3208 grassland contracts and 1286 field element contracts. The control costs were 9600 SEK per controlled farm in 2007 (SBA, 2008c). The control revealed that about 10% of the elements were not managed according to the contract in 2001–2003, and 8% (linear) and 4% (point) too many elements were incorrectly contracted (SBA 2006). The farmers and their representatives have criticised the controls for being rigid, unpredictable, and leading to disproportionate sanctions if some component is just below the limit (FSF, 2006; Sandström and Klang, 2007; Herodes, 2008). Unclear control criteria of management compliance have caused a widespread reluctance among farmers to enrol in the FE-scheme (Herodes, 2008).

Result-based payments have in general smaller needs for compliance controls than action-based (Schwartz et al., 2008). The alternative IAEPs do not require specific controls, except in cases of farmer appeals of indicator outcome. The effects are largely auto-monitored within the system by the recurrent estimation of the indicators, so the control is integrated with developing reliable indicator estimates.

#### 4.2.5 Acceptance and Confidence

The acceptance of a policy measure – and hence also the response to it – depends on whether it is conceived as fair and sound with respect to overall goals, which financial consequences it provides to agents, the nature of the measure, farmers' participation in the scheme development, how it is presented, if it is perceived as relevant and proportionate, and its antecedent measures (accustom factor), simplicity and transparency (Drake et al., 1999; OECD, 1999a; Winter and May, 2001; Vanslembrouck et al., 2002; Prager and Nagel, 2008). Policy measures having clearly defined and transparent objectives are more likely to be accepted by consumers, taxpayers, and farmers (OECD, 2007a). To obtain a sustainable and effective policy measure it has to be acceptable to all major parties.

The landowners' and farmers' confidence in the durability of a policy measure determines their behaviour, in particular investments. Their beliefs about a policy's political credibility should be considered when estimating long-term effects (Drake et al., 1999). Payment-by-result schemes make investment grants redundant, but have to be long-lived or consider farmers' risk and time-lags of measures to enhance the provision of PGs (Schwartz et al., 2008).

According to Schwartz et al. (2008), payment-by-results can enthuse farmers by rewarding the provision of PGs while giving flexibility and responsibility of management. Such approaches can also stimulate farmers in expressing that the efforts are a matter of production, and that they are valued by society.

Policy acceptance and confidence were assessed by interviews with officials and farmers in the study areas. The farmers have increasingly accepted the present system in principle, especially as it has been revised, although many are critical of some of the scheme regulations and the control-sanction mechanisms (Sandström and Klang, 2007). The officials currently involved in the implementation of the scheme are generally positive to the present system, although they have detailed critique. Almost all farmers were positive to the IAEP-system and expressed preferences for a system without regulations and with freedom to choose management. Almost all officials accepted the IAEP-system, but about half of them still preferred the present system. Those that were hesitant expressed doubts about the indicator quality and about outcome security if there were no strict regulations and contracts.

#### 4.2.6 Flexibility

Flexibility refers to the capacity of a policy measures to adapt and be efficient between sites or over time (OECD, 2007a). Different situations and shifting conditions require that policy measures are open to adaptation of the management in order to obtain efficiency (Bonnieux and Dupraz, 1999). The more flexibility that is given concerning how to achieve a well-defined and measurable target, the lower the costs will be, and fine-tuning, and enforceability will be easier. Flexibility with respect to management technology may also be positive for enhancing farmers' acceptance and attitudes to the policy (OECD, 2001).

The current Swedish schemes for permanent grasslands and for field elements are more flexible than preceding ones because of fewer technology prescriptions. However, all stipulations concerning brushwood are fixed and nationally uniform for the general AEPs. The grassland management plans in connection with the higher payment level often have detailed stipulations on what, when, and how to manage the objects, and may run for five years. Result-based policy measures give farmers freedom to choose methods and management changes, in contrast to prescriptionbased measures (Schwartz et al., 2008). The IAEP-system is by construction wholly flexible with respect to management technology. To change regulations, indicator criteria etc. at the national level might be equally difficult between the two systems.

### 4.2.7 Innovations

The capacity of inducing technological development increases the dynamic efficiency of policy measures, giving the agricultural sector possibilities and incentives to find new solutions for organising production. Objective-directed incentive instruments are generally better than quantitative regulations for inducing innovations, which are superior to technology regulations (OECD, 2007a).

A qualitative assessment by simple deduction and farmer interviews indicated that the current basic AEPs do not imply any prevention against developing lower cost technology, and provide little or no incentives to finding new management methods that enhance environmental quality. There are limited possibilities for improving technology in compliance with the specific stipulations of the grassland management plans. In contrast, a well-designed IAEP-scheme would not impose restrictions against innovation, but provide economic incentives for it; see Schwartz et al. (2008).

### 4.2.8 Fairness

Among the most common fairness criteria, the PCP[9] states that the provision of goods should be compensated (Vail et al., 1994). The principle is the inverse of the Polluter Pay's Principle, PPP, which is applicable for negative externalities (OECD, 1992). The principle is widely adopted in policy decisions, in particular for the provision of public goods from agriculture (Hanley et al., 1998).

Another fairness principle, equality before the law and in the treatment of authorities is established in western democracies, but has been violated in Agri-Environmental policies (Hasund, 1991). Its signification for this study was that no farmers are favoured or disfavoured in the design or implementation of policy measures. Justice would as the principle is defined here imply that payments are according to the social values of the landscape services, and not dependent on the relations between farmer – authorities, selective priorities, or other criteria.

The present grassland and field element schemes are in concordance with the weak PCP, which is not the case for subsidies to ecological production, reducing nutrient leaching etc. or many general CAP measures (Bonnieux and Dupraz, 1999). The IAEP-system is in concordance with the strong PCP by remunerating in relation to the provision of public goods. Both the AEP and the IAEP systems provide equality in treatment, and are in this respect better than many other Rural Development Plan measures for restoration and investments.

---

[9] The concept has also been called *Provider Gets Principle* by Hanley et al. (1998).

### 4.2.9 Compliance with international treaties

Compliance with international treaties concerns whether policy measures cannot be implemented because they would offend a present international convention or a superior EU-regulation. Highly pregnant treaties for the agro-biodiversity and landscape measures include the WTO-regulations (Bonnieux and Dupraz, 1999), whereas, the specific biodiversity and landscape conventions do not involve constraints and sanctions in practice against the AEPs. However, the IAEPs do not comply with CAP Regulation 1974/06 art. 27.10 stating that payments must not give more than cost compensation and 20% of verified transaction costs. Neither do they comply with WTO Green Box criteria limiting payments to based on additional costs and income foregone (Edwards and Fraser, 2001; WTO, 2009). These CAP and WTO regulations were imposed to avoid trade distortions by unlimited agricultural subsidies by linking payments to verified costs. As important as controlling manipulating cost figures in the present system, would be to control the PG values in an IAEP-system. A model of internationally applied, standardized (stated preference) valuation survey instruments to estimate social WTP would reduce the risk of inappropriate subsidies and inequalities or conflicts between countries.

# 5. Discussion and concluding remarks

New production technologies within agriculture and changing relative prices have begot a drastic decline in the provision of environmental public goods over many decades. CAP has been criticised for being ineffective and costly in handling agri-environmental problems. The introduction of decoupled, targeted AEPs to support land or management practices favourable to biodiversity and other landscape amenities involved major progress. However, also these measures are questioned in terms of long-term efficiency. In Sweden, concerns have been raised that the measures are ill adapted for varying conditions and insufficient for preserving the natural and cultural qualities in the long-term (Sandström and Klang, 2007).

The main idea of this study was to develop and evaluate an alternative model for AEPs based on a welfare economic foundation and implemented in practice by indicators. A major challenge of this interdisciplinary approach was to develop indicators that reflect the presence of public goods and that complied with criteria of low monitoring costs and transparency. The system must be feasible in large scale. Settling an efficient payment tariff per indicator unit of the public goods was another delicate task, related to issues of environmental valuation (see e.g. Randall, 2002), where there is a call for more research and appropriate surveys.

The assessments indicated a significant potential of IAEPs to attain better environmental effects and higher efficiency than the present Rural Development Plan schemes. A system was developed that appears implementable in practice, is satisfactory in terms of effectiveness, transaction costs, acceptance, control, flexibility, and fairness, but encounters difficulties by violating CAP and WTO rules.

The validity, reliability, and relevance of the indicators are crucial for the success of the IAEPs. As these properties depend upon the indicator designs, research is necessary to determine optimal solutions for the respective national or regional situation. State indicators are preferred, as they focus on the outcome (OECD, 2001, 2007a). There are innumerable possible changes of factors and their combinations with varying effects depending on the circumstances, making pressure or response indicators short-lived and difficult to adjust. The optimal trade-off between precision and effectiveness on one hand, and simplicity, transparency, transaction costs etc. on the other hand, is mainly an empirical question. This is to some extent endogenous, influenced by the design of the indicators. Investigations are needed to determine optimal differentiation in respective nation or region.

What an optimal IAEP-scheme design is certainly depends upon the policy context, where the first best solution of full payments at social optimum presupposes that other policy or market imperfections are removed.

The distributional effects among farmers and landowners were not assessed in this study, but it is likely that a strict, sole IAEP-policy would involve considerable re-allocations, and may cause some political resistance from disfavoured groups. The total transfers to agriculture may be larger than at present in some regions and lower in others. Whether they would be larger than the current total direct and indirect transfers is an empirical or political question, depending upon society's WTP.

On the whole, IAEPs appear promising for more dynamically efficient handling of the threats to environmental qualities, or the non-rival, non-excludable goods of the agricultural landscape. Besides issues of fine-tuning, the main problem may be the political process.

# References

Andersson, R., Kaspersson, E., Wissman, J. 2008. Slutvärdering av miljö- och landsbygdsprogrammet 2000 – 2006 –vad fick vi för pengarna? Swedish University of Agricultural Sciences, Dnr SLU ua 12-3269/07, Uppsala.

Blandford, D., 2001. Are Disciplines Required on Domestic Support? The Estey Centre Journal of International Law and Trade Policy, 2:1, 35-59.

Bonnieux, F., Dupraz, P. 1999. Policy indicators and a typology of instruments. In: Huylenbroeck, G. V., Whitby, M. (eds.), Countryside Stewardship: Farmers, Policies and Markets. 47–66. Elsevier Science, Oxford.

Bureau, J.-C., Mahé, L.-P., 2008. CAP Reform beyond 2017; An idea for a longer time perspective, EU Parliament. Notre Europe.

Challen, R,. 2001. Non–Government Approaches to the Provision of Non–Commodity Agricultural Outputs: a Transaction-Cost Perspective. OECD, Directorate for Food, Agriculture and Fisheries. Paris.

Coase, R. H., 1960. The Problem of Social Cost. J Law Econ, III, 1–44.

Dahlman, C. J., 1979. The Problem of Externality. J Law Econ, 22, 141–162.

Dodgeson, J., Spackman, M., Pearman, A., Philips, L., 2000, Multi-criteria analysis manual, Department for Communities and Local Governments, UK, London.

Drake, L., 1992. The non–market values of the Swedish agricultural landscape. Eur Rev Agric Econ, 19, 351–364.

Drake, L., Bergström, P., Svedsäter, H., 1999. Farmers' Attitudes and Uptake. In: Huylenbroeck, G. V., Whitby, M. (eds.), Countryside Stewardship: Farmers, Policies and Markets. Elsevier Science, Oxford.

EEA, European Environment Agency, 1995. Europe's environment – the Dobris Assessment, Copenhagen.

Edwards, G., Fraser, I., 2001. Reconsidering agri-environmental policy permitted by the Uruguay round agreement. Ecol Econ, 37:2, 313-326.

Eklund, A., 1999. Transaction Costs of the Swedish Agri-Environmental Program. Department of Economics, Swedish University of Agricultural Sciences, 128. Uppsala.

FSF, 2006, Federation of Swedish Farmers [Lantbrukarnas Riksförbund, LRF]. Remissyttrande Dnr. 2006/3364. Stockholm.

Falconer, K., Whitby, M., 1999a. The invisible costs of scheme implementation and administration. In: Huylenbroeck, G. V., Whitby, M. (Eds.), Countryside Stewardship: Farmers, Policies and Markets. 67–88. Elsevier Science, Oxford.

Falconer, K., Whitby, M., 1999b. The transaction costs of countryside stewardship policies in 8 EU member states. In: Huylenbroeck, G. V., Whitby, M. (Eds.), Countryside stewardship: farmers and markets, 17 edn. Elsevier Science, Oxford.

Falconer, K., Dupraz, P., Whitby, M., 2001. An Investigation of Policy Administrative Costs Using Panel Data for the English Environmentally Sensitive Areas. J Agric Econ, 52 (1), 83–103.

Hanley, N., Kirkpatrick, H., Simpson, I., Oglethorpe, D., 1998. Principles for the Provision of Public Goods from Agriculture: Modelling Moorland Conservation in Scotland. Land Economics, 74 (1), 102–113.

Hasund, K. P., 1991. Landskapspolitiken i Sverige 1960 – 1990. En empirisk utvärdering. Department of Economics, 41, Swedish University of Agricultural Sciences, Uppsala.

Hasund, K. P., 1998, Valuable Landscapes and Reliable Estimates. In: Dabbert, S., Dubgaard, A., Slangen, L., Whitby, M. (Eds.), The Economics of Landscape and Wildlife Conservation, Wallingford, New York: CAB International, 65–83.

Herodes, M., 2008. Reflecting Environmental Land Use Needs into EU Policy: Preserving and Enhancing the Environmental Benefits of Unfarmed Features on EU Farmland. Case Study report Sweden. Institute for European Environmental Policy. London

Hodge, I., 1991. The Provision of Public Goods in the Countryside: How Should it be Arranged? In: Hanley, N. (ed.), Farming and the Countryside: An Economic Analysis of External Costs and Benefits. CAB International, Wallingford, 179–196.

Ihse, M., 1995. Swedish agricultural landscapes – patterns and changes during the last 50 years, studied by aerial photos. Landsc Urban Plan , 31 (1–3), 21–37.

Ihse, M., Blom, G., 2000. A Swedish countryside survey for monitoring of landscape features, biodiversity and cultural heritage – the LiM–project. In: Mander, Ü. and Jongman, R. G. H. (Eds.), Consequences of Land–use Changes. Wit Press, Southampton and Boston, 39–74.

Janssen, R., Munda, G., 1999. Multi–criteria methods for quantitative, qualitative and fuzzy evaluation problems. In: van der Bergh, J. (ed.), Handbook of Environmental and Resource Economics. Edgar Elgar Publishing, Cheltenham, 837–852.

Johansson, P.–O., 1993, Cost–Benefit Analysis of Environmental Change. Cambridge University Press, Cambridge.

Jonasson, L., Kumm, K.–I., 2006. Betesmarkerna efter 2003 års jordbruksreform – hot och möjligheter. Jordbruksverket, 2006:3. Jönköping.

Keeney, R.L., Raiffa, H., 1993. Decisions with multiple objectives. Preferences and value tradeoffs. Cambridge University Press, Cambridge.

Kleijn, D., 1997. Species richness and weed abundance in the vegetation of arable land boundaries. Ph.D. thesis. Wageningen Agricultural University.

Kleijn, D., Berendse, F., Smit, R., & Gilissen, N., 2001. Agri–environment schemes do not effectively protect biodiversity in Dutch agricultural landscapes. Nature, 413, 723–725.

Kull, K. & Zobel, M., 1991. High species richness in an Estonian wooded meadow. J. Veg. Sci.. 2, 715–718

Lankoski, J., Ollikainen, M., 2003. Agri–environmental externalities: a framework for designing targeted policies. Eur Rev Agric Econ, 30 (1), 51–75.

Latacz–Lohmann, U., Hamsvoort, C., 1997. Auctioning Conservation Contracts: A Theoretical Analysis and an Application. Am J Agric Econ, 79 (2), 407–418.

Latacz–Lohmann, U., Hamswoort, C., 1998, Auctions as a Means of Creating a Market for Public Goods from Agriculture. J Agric Econ, 49 (3), 334–345.

Lowe, P., Ward, N., Potter, C., 1999. Attitudinal and Institutional Indicators for Sustainable Agriculture. In: Brouwer. F., Crabtree, B. (eds.), Environmental Indicators and Agricultural Policy. Wallingford: CAB International, 263 – 278.

MA, Ministry of Agriculture [Jordbruksdepartementet], 2003. Ett levande kulturlandskap. SOU 2003:105. Stockholm

MA, Ministry of Agriculture [Jordbruksdepartementet], 2007a. Landsbygdsprogram för Sverige 2007 – 2013. [The Swedish Rural Development Program 2007 – 2013], Stockholm.

MA, Ministry of Agriculture [Jordbruksdepartementet], 2007b. SFS 2007:481. Förordning (2007:481) om stöd för landsbygdsutvecklingsåtgärder. http://www.regeringen.se/content/1/c6/08/27/24/a0a25a58.pdf

Miljömålsrådet, 2008. Miljömålen - nu är det bråttom! Miljömålsrådets utvärdering av Sveriges miljömål 2008. Stockholm. http://www.naturvardsverket.se/sv/Nedre-meny/Webbokhandeln/ISBN/1200/978-91-620-1264-9 .

Molander, P., 1988. Säkerhetspolitiska aspekter på livsmedelsförsörjningen. FOA, Försvarets Forskningsanstalt, C 10311–1.2, Stockholm.

Moxey, A., White, B., Ozanne, A., 1999. Efficient Contract Design for Agri–Environment Policy. J Agric Econ, 50 (2), 187–202.

OECD, Organization for Economic Co-operation and Development, 1992. The Polluter-Pays Principle. Environment Directorate, OECD/GD (92) 81, Paris.

OECD, Organization for Economic Co-operation and Development, 1999a. Environmental Indicators for Agriculture. Volume 2. Issues and design, Paris.

OECD, Organization for Economic Co-operation and Development, 1999b. Handbook of incentive measures for biodiversity : design and implementation, Paris.

OECD, Organization for Economic Co-operation and Development, 2001. Improving the Environmental Performance of Agriculture: Policy Options and Market Approaches, Paris.

OECD, Organization for Economic Co-operation and Development, 2005. Agricultural policies in OECD countries: Monitoring and evaluation, Paris.

OECD, Organization for Economic Co-operation and Development, 2007a. Effective Targeting of Agricultural Policies, Paris.

OECD, Organization for Economic Co-operation and Development, 2007b. The Implementation Costs of Agricultural Policies, Paris.

Olson, D., 1995. Decision Aids for Selection Problems. Springer Verlag, New York.

Pain, D. J., Pienkowski, M. J. (eds.), 1997. Farming and Birds in Europe: The Common Agricultural Policy and its Implications for Bird Conservation. Academic Press, London.

Päiviö, E.-L., 2008. Det agrara landskapet på vinst och förlust. Biologiska och historiska värden inom lantbrukets nya uppdrag. Doctoral Thesis No. 2008:95, Department of Economics. Faculty of Natural Resources and Agricultural Sciences. Swedish University of Agricultural Sciences. Uppsala.

Pragel, K., Nagel, U. J., 2008. Participatory decision making on agri-environmental programmes: A case study from Sachsen-Anhalt (Germany). Land Use Policy 25, 106–115.

Primdahl, J., Peco, B., Schramek, J., Andersen, E., Onate, J. J., 2003. Environmental effects of agri–environmental schemes in Western Europe. J. Environ. Manage. 67 (2), 129–138.

Randall, A., 1972. Market Solutions to Externality Problems: Theory and Practice. Am J Agric Econ, vol. 54 (2), 175–183.

Randall, A., 1988. Market Failure and the Efficiency of Irrigated Agriculture. In: O'Mara, G. T. (ed.), Efficiency, Irrigation: The Conjunctive Use of Surface and Groundwater Resources. The World Bank, 21–30.

Randall, A., 2002, Valuing the outputs of multifunctional agriculture. Eur Rev Agric Econ, vol. 29, no. 3, pp. 289–307.

Robertson,G., Eknert,B., Ihse,M., 1990. Habitat analysis from infra–red aerial photographs and the conservation of birds in Swedish agricultural landscapes. Ambio 19 (4), 195–203.

Rollett, A., Haines-Young, R., Potschin, M., Kumar, P., 2008. Delivering environmental services through agri-environment programmes: a scoping study. Land Use Policy Group, Report. Peterborough, Nottingham http://www.lupg.org.uk/pdf/Delivering_Env_Services_through_agri-env_programmes-scoping_study.pdf

Romstad, E., Vatn, A., Rørstad, P. C., Søyland, V. 2000. Multifunctional Agriculture – Implications for Policy Design, Department of Economics and Social Sciences, Agricultural University of Norway, 21, Ås.

Rørstad, P. C., Vatn, A., Kvakkestad, V., 2007. Why do transaction costs of agricultural policies vary?. Agric. Econ., 36, 1–11.

SBA, 1997, Swedish Board of Agriculture [Jordbruksverket]. Utvärdering och översyn av det svenska miljöprogrammet för jordbruket. 1997:10, Jönköping.

SBA, 1999, Swedish Board of Agriculture [Jordbruksverket]. Ett rikt odlingslandskap. 1999:18, Jönköping.

SBA, 2005a, Swedish Board of Agriculture [Jordbruksverket]. Ängs- och betesmarksinventeringen 2002 – 2004. 2005:1, Jönköping.

SBA, 2005b, Swedish Board of Agriculture [Jordbruksverket]. Svenskt jordbruk i siffror 1800 – 2004. Statistikrapport 2005:6, Jönköping.

SBA, 2005c, Swedish Board of Agriculture [Jordbruksverket]. Indikatorsystem för småbiotoper. 2005:7. Jönköping.

SBA, 2006, Swedish Board of Agriculture [Jordbruksverket]. Kulturhistoriska bidrag och särdrag – uppföljning och utvärdering av miljöersättningen till natur– och kulturmiljöer. 2006:10, Jönköping.

SBA. 2008a. Swedish Board of Agriculture [Jordbruksverket]. Myndigheters kostnader och åtgärder vid hantering av EG-stöd 2007. 2008:4, Jönköping

SBA 2008b, Swedish Board of Agriculture [Jordbruksverket]. http://www.sjv.se/amnesomraden/stodtilllandsbygden.4.7502f61001ea08a0c7fff24864.html

SBA, 2008c, Swedish Board of Agriculture [Jordbruksverket]. Årsrapport 2007. Landsbygdsprogram för Sverige år 2007–2013. CCI 2007SE06RPO001, Jönköping.

SBA, 2008d. Swedish Board of Agriculture [Jordbruksverket]. http://www.sjv.se/amnesomraden/stodtilllandsbygden/statistik/miljoersattningar/miljoersattningar2007.4.677019f111ab5ecc5be80002571.html

SBA, 2009. Swedish Board of Agriculture [Jordbruksverket]. Statistical Yearbook of Swedish Agriculture 2008, Jönköping

SBA, SEPA, SNHB, 1999, Swedish Board of Agriculture, SEPA, Swedish Environmental Protection Agency, Swedish National Heritage Board. Miljöeffekter i Sverige av EU:s jordbrukspolitik. 1999:28, Jönköping.

SBA, SEPA, SNHB, 2002, Swedish Board of Agriculture, SEPA, Swedish Environmental Protection Agency, Swedish National Heritage Board. Miljöeffekter av EU:s jordbrukspolitik. 2002:2, Jönköping.

SEPA, Swedish Environmental Protection Agency, 2002. http://www.naturvardsverket.se/sv/

SNAO, 1999, Swedish National Audit Office [Riksrevisionsverket], Jordbrukets miljöstöd – minskning av kväveläckage och bevarande av biologisk mångfald. 1999:2, Stockholm.

SS, 2009, Statistics Sweden. Statistical Yearbook of Sweden 2008. Stockholm

SSIC, 2005, Swedish Species Information Centre [ArtDatabanken]. Rödlistade växter i Sverige 2005, Swedish Red Data Book of Plants 2005, Uppsala.

Samuelson, P. A., 1954. The Pure Theory of Public Expenditure. Rev. Econ. Stat., 36, 387-389.

Sandström, A., Klang, L., 2007. Landskapselement med miljöersättning – en intervjustudie om regionala och lokala erfarenheter av landskapselementens skötsel i åkermark och betesmark, Jordbruksverket, 2007:5, Jönköping.

Schwartz, G., Moxey, A., McCracken, D., Huband, S., Cummins, R., 2008. An analysis of the potential effectiveness of a Payment-by-Results approach to the delivery of environmental public goods and services supplies by Agri-Environmental

Schemes, Land Use Policy Group.
http://www.lupg.org.uk/pdf/LUPG_Payment_by_Results_Feb09.pdf

Slangen, Louis H. G., 1997. How to organise nature production by farmers. Eur Rev Agric Econ, 24, 508–529.

Sohlman, A., ed., 2008. Arter och naturtyper i habitatdirektivet – tillståndet i Sverige 2007. Artdatabanken, SLU, Uppsala.

Stoneham, G., Chaudhri, V., Ha, A., Strappazzon, L., 2003. Auctions for conservation contracts: an empirical examination of Victoria's BushTender trial. Aust J Agric Resour Econ, 47:4, 477-500.

Svensson, R., 1988. Floravård i jordbrukslandskapet. Sven Bot Tidskr, 82, 458–465.

USDA, 2009. United States Department of Agriculture. Conservation Reserve Program. http://www.nrcs.usda.gov/programs/CRP/

Vail, D., Hasund, K. P., Drake, L., 1994. The Greening of Agricultural Policy in Industrial Societies: Swedish Reforms in Comparative Perspective. Cornell University Press, Ithaca and London.

Vanslembrouck, I., Van Huelenbroeck, G., Verbeke, W., 2002. Determinants of the Willingness of Belgian Farmers to Participate in Agri-environmental Measures. J Agric Econ, 53 (3), 489–511.

Varian, H. R., 1992. Microeconomic Analysis, 3rd. edn. W. W. Norton & Company, New York, London.

Vatn, A., Kvakkestad, V., Rørstad, P. K., 2002. Policies for Multifunctional Agriculture. The Trade-off between Transaction Costs and Precision, Department of Economics and Social Sciences, Agricultural University of Norway, 23. Ås.

Weibull, A. C., Östman, Ö., Granqvist, A., 2003. Species richness in agroecosystems: the effect of landscape, habitat and farm management. Biodivers. Conserv, 12, 1335-1355.

Whitby, M., Saunders, C., Ray, C., 1998. The Full Costs of Stewardship Policy. In: Dabbert, S., Dubgaard, A., Slangen, L., Whitby, M. (eds.), The Economics of Landscape and Wildlife Conservation, CAB International, Wallingford, New York, 97–112.

Whittaker, L. M., O'Sullivan, P., McInerney, J., 1991. An Economic Analysis of Management Agreements. In: Hanley, N. (ed.), Farming and the Countryside: An Economic Analysis of External Costs and Benefits. CAB International, Wallingford, 197–214.

Williamson, O., 1989. Transaction Cost Economics. In: Schmalensee, R., Willig, R. D. (eds.), Handbook of Industrial economics. Amsterdam, North Holland, 136–184.

Winter, S. C., May, P. J., 2001. Motivation for Compliance with Environmental Regulations. J Policy Anal Manage, 20 (4), 675-698.

WTO, World Trade Organization. 2009. http://www.wto.org/english/tratop_e/agric_e/agboxes_e.htm

Wossink, A., Swinton, S. M., 2007. Jointness in production and farmers' willingness to supply non-markeded ecosystem services. Ecol Econ, 64 (2), 297-304.

Wossink, A., van Wenum, J., Jurgens, C., de Snoo, G., 1999. Co-ordinating economic, behavioural and spatial aspects of wildlife preservation in agriculture. Eur Rev Agric Econ, 26 (4), 443–460.

Zalidis, G. C., Tsiafouli, M. A., Takavakoglou, V., Bilas, G., Misopolinos, N., 2004. Selecting agro–environmental indicators to facilitate monitoring and assessment of EU Agri-Environmental measures effectiveness. J. Environ. Manage., 70 (4), 315–321.