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DIRECT PAYMENTS FOR BIODIVERSITY PROVIDED BY SWISS FARMERS: AN ECONOMIC INTERPRETATION OF DIRECT DEMOCRATIC DECISION

CASE STUDY: SWITZERLAND

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FOREWORD

This report was contributed as a national case study to an OECD project on the Applied Evaluation of Biodiversity, being carried out by the Working Group on the Economic Aspects of Biodiversity. It does not necessarily reflect the views of individual OECD Member countries or of the OECD Secretariat. It is published under the responsibility of the Secretary General.

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DIRECT PAYMENTS FOR BIODIVERSITY PROVIDED BY SWISS FARMERS: AN ECONOMIC INTERPRETATION OF DIRECT DEMOCRATIC DECISION[1]

by

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Executive Summary

This case study deals with the preferences for habitat and species diversity that are revealed in (direct-)democratic agri-environmental policy choice and the financial transfers to farmers granted in this domain. The study tries to derive value estimates for various aspects of biodiversity that are promoted by agri-environmental programmes. Biodiversity is understood to be the small-scale species and landscape element diversity at the farm level, which is directly supported by specific voluntary programme payments, but also the larger-scale land use pattern, which is, in addition, influenced by cross-compliance payments and other types of agricultural support.

The major pressures on agro-biodiversity and the resulting ‚scarcities' which were observed after the 1950s are summarised. During the decade from the mid-1980s onwards, there has been an intensive political debate and a number of popular referenda on the future of agricultural policy, focussing strongly on the type and conditionality of transfer payments to farmers. The core elements of re-oriented public spending, agreed upon in 1995/1996, were thus shaped in a sequence of parliamentary debates and decisions and popular referenda. Due to the opportunity of the citizens to repeatedly express their preferences in the decision process regarding a more environmentally friendly agricultural system we suggest that one may, although with several caveats, interpret post 1996 agri-environmental budget items as estimates of the monetary value of biodiversity in this domain. This view is supported by the high agreement on policies in public opinion surveys.

Ecosystems or species studied: agrobiodiversity, that is species and habitat diversity in agricultural landscapes

Valuation method used: public preference as expressed by popular referenda

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Main lesson learned: democratic choice has some advantages and some disadvantages compared with more standard economic valuation approaches such as contingent valuation. On the one hand ”embedding” effects and other potential biases observed in hypothetical markets are absent. On the other hand, it is difficult to derive implicit values of specific measures in support of biodiversity, which are not individually discussed in the democratic process. Also, the Swiss experience suggests that referenda are a powerful tool to effect a relatively rapid policy adaptation towards the recognition of public good aspects of land management.

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Introduction

This case study deals with the public preferences for habitat and species diversity that is revealed in (direct-)democratic agri-environmental policy choice and the financial transfers to farmers granted in this domain. Due to this "political willingness to pay" approach the study does not focus on the annual benefits flowing from a single habitat type. Rather, the study tries to derive value estimates for various aspects of biodiversity that are promoted by agri-environmental programmes. Biodiversity is understood to be the small-scale species and landscape element diversity at the farm level, which is directly influenced by specific voluntary programme payments, but also the larger-scale land use pattern, which is mainly influenced by cross-compliance payments and other types of agricultural support. The latter payments have multiple objectives, with the consequence that the related financial transfers to farmers cannot be unambiguously broken down to isolated single objectives such as biodiversity protection. This is troubling from a cost-benefit analysis perspective. The problem can be traced to the interdependent public and private benefits derived from productive agriculture in a "cultural" landscape as opposed to a landscape in which production and recreational and ecological objectives are spatially segregated. This said, it is hoped that the study will nevertheless provide some useful information on biodiversity values, which is supplementary to that from the more typical environmental economic valuation approaches.

Chapters 1 through 3 describe the pressures on biodiversity and the resulting ‚scarcities' to identify the reference scenario of biodiversity decline which the present agri-environmental programmes are designed to overcome. Chapter 4 interprets agri-environmental budgets as the monetary value of stopping and changing this trend. Chapter 5 addresses policy design and implementation in Switzerland, and Chapter 6 draws some conclusions on the agri-environmental policy process and its economic interpretation.

1. General Description

Switzerland is a landlocked industrial country in the centre of the alpine region. Its topography is hilly to mountainous except for the Central Plateau and few other lowland areas. Laying on a transition area between oceanic and continental climate of the Central European temperate zone, Switzerland enjoys the privilege of regular rainfall (essentially 700 – 1500 mm/y) and moderate seasonal fluctuation of temperature (15-20^{o} C of difference between January and July). Not surprising though that forest and permanent grassland dominate the vegetation aspect.

The surface of Switzerland is 4.13 million ha. 28% are biologically unproductive areas (high mountains and built-up areas), 30% are forests, 4% lakes and rivers, 30% grasslands and 8% arable land, vineyards, orchards and special cultures (SAEFL and FOA 2000). As agriculture occupies almost 40% of Switzerland's surface it carries considerable responsibility for preserving the structured cultural landscape originating from the traditional mixed farming systems. Progress in farming techniques in combination with economical reasons (high protectionism of domestic production) or non-agricultural factors (land conversion for traffic, industry and settlement) were increasingly eliminating this heritage since the 1950s, especially so in the Central Plateau where some habitats like dry meadows or wetlands have decreased to an insignificant fraction compared to the 19th century. In spite of growing awareness of this regrettable tendency in public and science, a strong agricultural lobby was able to obstruct a transformation in agricultural policy from product subsidies towards direct payments until the early 1990's.

Switzerland knows the special feature of regular ballots in the system of political decisions. A rejected bill on sugar production in 1986 was the first big defeat for conservative production lobbies and is widely regarded to be the start of a process to overcome the polarisation between modern farming on the one side and nature and environmental conservation on the other side, opening a new partnership between these poles. It was a completely new and painful experience for farmers to depend on the goodwill of the population that repeatedly refused to approve support to agriculture without well-defined performance in ecological matters. Within merely 10 years of continuos rebuilding of the agricultural policy Switzerland has been replacing its dense regulation system of tariffs, taxes and contingents by more open markets and an increasingly attractive and costly system of environmental incentives.

While ecological data referred to in this study enlighten the situation under the old agricultural policy between 1950 and 1992, the political reactions thereof fall into the period between 1992 and 2000, the time after the turnaround of Swiss agricultural policy in 1992.

2. Identification of causes and sources of pressure

Pressures from sectoral activities

As starting point of the following considerations about sectoral pressures on agro-biodiversity we chose the period beginning after World War II, when agricultural production techniques became more and more sophisticated in Switzerland as was the case all over temperate Europe and ending around 1992 when the new agro-ecological policy was launched. The country has known a considerable prosperity in this time. One indicator of the economical development is the energy consumption that has quintupled between 1951 and 1992. While Swiss population has risen from 4.7 to 7.1 million (Ritzmann-Blickenstorfer 1996 & BFS 2000), people working in agriculture decreased from 326 000 in 1950 to 123 000 in 1990 (SBV 1998).

Even with the constant increase of average farm size from 6.6 ha/farm in 1965 to 11.5 ha in 1990, exploitation units in Swiss agriculture still kept their small-scale character. The average number of plots per farm dropped from 8 to 6 (1955-1990), average plot size increased to 1.9 ha per plot in 1990 (SBV 1996), which means that tendencies towards poor crop rotation systems were mild compared to other European countries. The landscape mosaic remained varied as plots were often further split in order to cultivate more than one crop. Situations where only one kind of agricultural habitat was found on 1 km^2 were very rare (BRP and BUWAL 1994). Grassland, whether permanent grassland or sown meadows, was a regular part of the field production, in higher altitudes over 1000 meters above sea level it is generally the only suitable management system. On the whole, plot size and variety of crops would have been adequate to support high species diversity on agricultural fields. The main pressures were linked with production intensity and the missing network of compensation areas. The continuous demand of land for construction and infrastructure was another pressure on agricultural biodiversity.

Before 1990, management has been intensified in Swiss lowland agriculture close to maximum yields, heavy subsidies rendering intensive production attractive. Even low yielding areas were intensively cultivated, often not corresponding to sustainable use (Thomet et al. 1990). As a consequence, extensively used cultivation areas or buffer zones like unmanaged field margins were lacking in regions with favourable natural conditions, mainly in the Central Plateau. Unspoilt plant communities of dry meadows had suffered a regression of over 90% in the last decades (BUWAL 1997) caused by the application of fertilisers.

For all of Switzerland Lehmann et al. (1995) estimated about 96 000 t of ecologically relevant nitrogen (NH3, N2O, NH4+ and NO3-) to be emitted by agriculture, of which 30-50% could be avoided by technical measures. In some areas of intensive animal husbandry fallout of nitrogen with rain reached 40 kg N/ha/y (BUWAL 1996) whereas the average was 10-20 kg on the whole of the Central Plateau. The import of main nutrients as basic component of animal fodder and fertilisers had increased constantly until the 1970s (Spiess 1999). Nitrogen import was increasing from 12 000 t in 1950 to 75 000 t in 1988 (Gantner 1990). The less mobile main nutrients like phosphorus and sodium had been slowly accumulating in soils for decades as the amount of organic manure produced by cattle had obviously been underestimated, leading to elevated application standards (Gantner 1990).

While using crop varieties with high yielding potential the farmers were encouraged to apply a respective amount of pesticides to stabilise yields. Altered management systems had stopped the upward trend of pesticide consumption in the 80s. Ecological, toxicological and economic aspects were more frequently considered, leading to preventive measures to keep crop healthy and to new kinds of plant protection substances with more specific effects and less input of active substance (Gantner 1990). Besides, the concept of threshold values became more familiar and popular to farmers.

The melioration of land to improve its potential for production is another factor of intensification. Draining of wetlands to allow fenland intensification had been frequent until the 70s whereas afterwards these programmes have been reduced and then completely abolished when in 1986 the people voted in favour of an amendment to the Swiss Federal Constitution supporting a set of laws and decrees for conservation of mires landscapes.

A very important threat to biodiversity was the elimination of obstacles for efficient cultivation. Freestanding trees and hedges, for example, interfere with mechanised cropping. Comparative samples of aerial photographs and maps had shown a decrease of about 30% within 20 years (Ewald 1978). With respect to traditional fruit tree orchards, intensification, governmental support for clearing between 1961 and 1975, cider surplus and pressure from urbanisation are the main factors leading to their reduction Because they are often situated like a belt around existing settlements, they often standing in potential construction zones. A tendency of clearing fruit trees subsequent to low market price in surplus years had been notified; fruits of most traditional orchards are the raw material for mush and cider (apple, pear) and the demand of this drink was in constant decline.

Another pressure results from the demand for land for non-agricultural purposes. In densely populated areas with strong demand for roads, constructions and settlements there is a constant and irreversible transformation of open agricultural land into urban environment. Broggi and Schlegel (1989) estimate a cumulated loss of agricultural land of 134 000 – 144 000 ha between 1952 and 1989 corresponding to 12 000 – 14 000 farms in the lowlands. Land-use planning is offering guidelines for development minimising negative impact on environment by defining land-use restrictions for several zones, however degradation of traditional landscape in the Central Plateau was and still is in progress. Splitting and isolation of natural habitats by roads results in populations often too tiny to survive. It has to be mentioned that the situation in hilly and alpine regions is less severe as tourism with its accompanying infrastructure is the only alternative to agriculture with the possible exception of local industries or water power plants and dams.

Identification of underlying causes of biodiversity loss

Agricultural policy during the 1980s was lagging behind a rapid development of public preferences regarding the relative importance of different policy goals. From a welfare economic perspective the policies did not achieve an appropriate balance between the production of crops and environmental services. In other terms, much of the agricultural land may not have been allocated to the use, or production systems, which yielded highest total social benefits. This situation can be attributed to policy failure or to a lack of institutions such as benefit compensation schemes that would ensure such optimal allocation (Ostrom 1990). Before turning to these institutions, the main benefits deriving from agricultural biodiversity in Switzerland shall be outlined shortly. These can be divided into private benefits and public-good benefits.

Major private benefits of agricultural biodiversity, i.e., benefits that can be appropriated by individual agricultural land owners, are wind-breaking effects of hedges, reduced insect pests through birds and predatory or parasitoid arthropods, or a decreased incidence and economic risk of crop diseases through crop diversification in space and time (Schläpfer and Schmid 1999). However, some of these private benefits of biodiversity are marginal because they can easily be substituted by relatively low-cost pesticides and crop-insurance (Göschl and Swanson 2000). A second category of private benefits can be reaped by farmers who sell niche products such as ‚holidays on the farm' that are dependent on diversified farm structures. Private appropriation of recreational or scenic benefits of the agricultural landscape is generally not possible because a dense system of streets and trails ensures public access to agricultural land and after harvest open access to fields and meadows is granted by the law. Non-exclusiveness and hence a strong public-good character of agricultural diversity is given.

The public-good benefits accruing from agricultural biodiversity are not principally different from those in other OECD countries (OECD 1996) and include the well-known array of passive-use values of landscape and species patterns for recreation and education and existence values. However, the magnitude per unit land of these public-good benefits is comparatively higher in Switzerland. Firstly, due to a high population density and standard of living the diverse landscape mosaic with its wild species and domesticated varieties is valued more highly (in monetary terms) by the public than in other countries (Roschewitz 1999, p. 150-153) and secondly this diversity is the basis of a tourism industry which generates private benefits (Pruckner 1995).

In turning to failing institutional arrangements it is helpful to view the situation from a property rights perspective (Bromley 1991). Apart from the mentioned public access to agricultural (and forest) land and common-property regimes for pasture land, the Swiss have traditionally sanctioned far-reaching private property rights to agricultural land. Farmers have produced crops on their land with increasingly high use of inputs and increased yields solely according to their private objectives. The state influenced these private objectives only in terms of securing a market where producers could sell their products at prices that, as a rule of thumb, should enable them to make a living comparable to that of an average employee. Landscape and species diversity was maintained as a by-product of private benefit maximisation of individual farmers until technological changes in land management began to increasingly lead to a reduction of this diversity. The public started to perceive this development during the 1970s. Because the property rights problem was not properly analysed at the time, farmers were increasingly perceived by the public as responsible for contaminated drinking and surface waters and species extinction.

Originally, only grave negative, externalities' leading to health risks were prohibited by regulations intruding into farmer's presumed property rights. Discontinuation in private production of agricultural biodiversity was obviously not among these negative externalities. Biodiversity conservation was confined to a system of nature reserves. Until the late 1980s the loss of species and landscape diversity was regarded as an irrevocable consequence of technological progress. While a concept of negative externalities had become established and the problem was solved by regulatory approaches, a concept of positive externalities of agriculture did not take a foothold in Switzerland for a long time. Only in the late 80's three NGOs initiated a programme ‚conservation and agriculture from farmer's hand' in which they offered financial incentives to producers who contractually agreed to promote biodiversity through special management of part of their productive land (Bosshard et al. 1992). This programme can be seen as a precursor of the state institutions that later became established and today pay public money to private providers of the public good agricultural biodiversity.

In summary, the underlying causes of biodiversity loss have been (1) a de-facto initial assignment of property rights in which farmers were assigned almost unrestricted use of their private land, (2) a lack of public awareness and thus of demand for public environmental goods in an early stage of biodiversity loss and, as this demand arose, (3) a lack of conceptual understanding and imagination to devise the institutions that can provide socially optimal levels of biodiversity. However, one can hardly speak of market-failure in this case of biodiversity loss because a market did not exist for public-good aspects of biological resources (Vatn and Bromley 1997). In Switzerland as well as in most other OECD countries property rights for several important aspects of biodiversity such as macro- and micro-faunistic diversity in soils are still not clearly defined.

Identification of adverse incentives with negative impacts on biological diversity

As in other OECD countries, agriculture in Switzerland has been heavily assisted by the state during the past decades. Policy measures to support agriculture included price support, trade barriers, quantitative restrictions on outputs, subsidies to inputs, and direct income payments. These common measures will not be detailed here (see, e.g. OECD 1996, OECD 1998). The support was justified by a number of widely accepted national policy objectives which explicitly included the security of supply with agricultural goods, decentralised settlement of the county, the maintenance of the natural life-support system and a 'healthy peasantry'.

A deeper analysis of adverse incentives with negative impacts on biological diversity in Swiss agriculture would need to proceed with caution. The analysis is problematic because the outcomes of national policies strongly differed between regions due to the geographic diversity of the country. Typically, policies that produced incentives to intensify production and therefore tended to reduce biodiversity in core areas and sites of agricultural production have, at the same time, allowed continued farming on marginal lands. While the abundance of butterflies in the Swiss Plateau was drastically reduced (SBN 1987), farming in mountain regions for example promoted a large-scale pattern of landscape diversity with high scenic value on which recreational use of the mountain landscape strongly depend (Jäggin 1999). Moreover, such marginal lands include meadows on steep slopes which harbour a particularly high species richness. The alternative to agricultural production in these areas is usually the spontaneous development into woodland which in fact happened to an important share of the agricultural surface in the southern Alps in spite of the support offered. Similarly a change of management from diverse agricultural production on terraced slopes to pure dairy farming in the rest of the mountain zone of the Alps was not prevented.

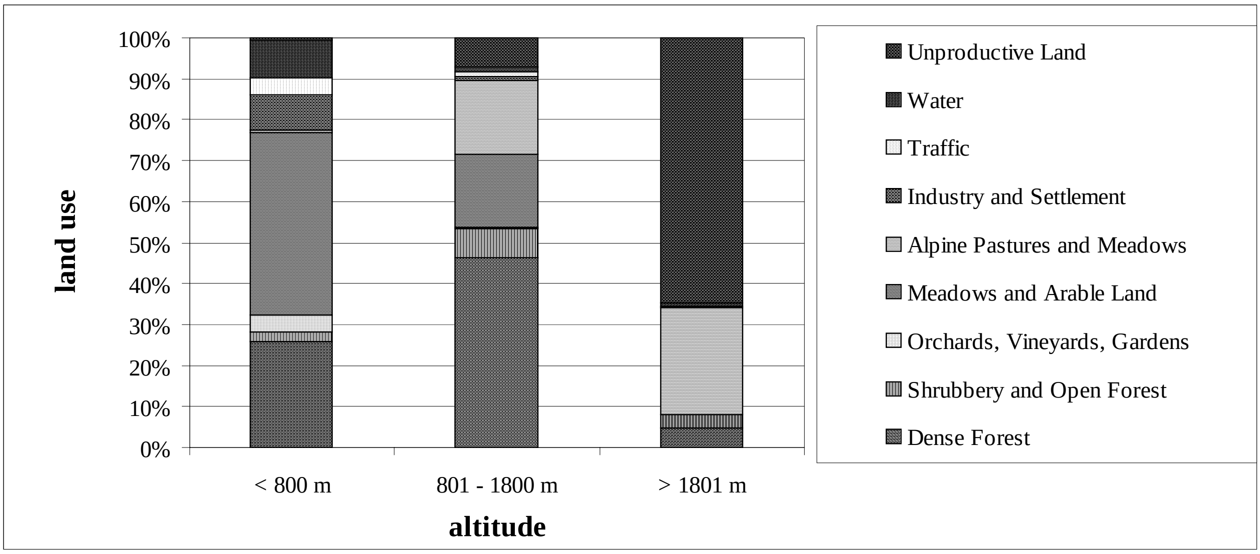
A critical assessment of the positive and adverse incentives therefore strongly depends on the frame of reference. Which scenarios do we compare? It is certain that the large-scale land use diversity in Switzerland would be diminished much more today if agriculture had not been assisted at all. Given a policy of the time that did not explicitly support the production of ecological services the policy outcome may even have been quite favourable regarding the maintenance of biodiversity as a by-product of agricultural activity, at least in the mountain production zone. Obviously, this positive bottom line on past agricultural policy does not hold if we choose for a reference a modern, well-designed system of incentives for the production of biodiversity as a public environmental good in its own right, which was beyond the imagination of that time. This question of reference will be taken up again in section 4 on valuation.

3. Impacts on ecosystems

Switzerland unifies a very wide spectrum of different ecosystems due to distinct topographical differences that alter local climates within a relatively small area. It comprises four distinctively different topographical regions, the Jura (low mountain chains and high plains up to 1600 meters above sea level), the Central Plateau (essentially hilly between 300 and 800 m.a.s.), the Pre-Alpine and Alpine Region (essentially between 1000 and 3000 m.a.s.) and the Southern Valleys (between 100 and 800 m.a.s.). These zones are not homogeneous themselves, they further split into 10 specific biogeographical regions (Gonseth and Mulhauser 1996) with fairly distinct regional characteristics. While higher regions essentially consist of unproductive land and alpine pastures with very little human infrastructure, lower areas, especially those below 800 m.a.s., are the primary areas of human activity, resulting in a differentiated land use pattern and stronger land-use conflicts (see Fig. 3.1). The dense population of > 300 people/km^2 concentrates in the Central Plateau, a landscape band stretching from south-west to north-east Switzerland. Here, farmland is closely interspersed with settlement and traffic areas.

In this chapter we try to summarise the evolution of agricultural biodiversity between World War II, when the pace of agricultural intensification accelerated, and the early 1990s when the damage to natural resources and namely the loss of biodiversity had become so manifest that the public called for a turn–around in politics. Still, scientific evidence in the form of comprehensive monitoring programmes is scarce. Obviously such programmes were only started in the late 20th century when the awareness for the vulnerability of the resource base has developed. Therefore, the assessment of the impact of the former (agricultural) policy will be based on general information on the evolution of land use, on the inventories of endangered wildlife species and on punctual information from selected types of habitats (traditional orchards, low intensity arable land, low intensity meadows, wetlands) and related species groups.

Figure 3.1 **Land-use patterns in Switzerland depending on altitude; lowlands, pre-alpine and alpine regions**



Source: BFS (1993), summarised.

The landscape structure has changed rapidly since World War II. Hence data about the landscape dynamics have only been registered locally, leaving considerable gaps in reference data. Land-use statistics based on comparative analysis of signatures of official maps give an idea of landscape change in the Central Plateau's rural landscape since the 1970s (Table 3.1). Throughout the period, covering and straightening rivers was far more important than restoring those in poor ecological shape. Another striking fact is the constant net increase of settlement areas and roads. While the data indicate a less obvious net loss of fenlands, it must be stressed, however, that a considerable transformation has occurred already before this period.

Table 3.1 **Annual change of landscape elements in the Central Plateau in two periods (BRP and BUWAL 1994)**

Element	1972-1983	1978-1989
New Hedges	30.8 km	Not investigated
Hedges Cleared	8.6 km	Not investigated
Rivers covered or straightened	63.0 km	64.0 km
Rivers re-opened	1.4 km	12.6 km
Drained fenland	24.7 ha	15 ha
New fenland	11.7 ha	4.4 ha
New settlement area	588.9 ha	735.2 ha
Abandoned settlement area	2.7 ha	16.3 ha
New roads	95.5 km	54.9 km
Abandoned roads	1.0 km	7.2 km

Endangered species

From the 1960s onwards inventories of wildlife species were conducted and it was assessed which species were in danger of extinction. The resulting comprehensive Red Lists of bryophytes (Urmi 1994), vascular plants (Landolt 1991) and animals (Duelli 1994) reflect the crucial situation linked with qualitative and quantitative habitat degradation for species with high habitat specificity. Table 3.2 shows a considerable share of endangered species in all major groups, roughly reflecting the situation in the early 1990s. A regional specification comparing the Central Plateau with other biogeographical regions can be set up for vascular plants and birds, groups more intensively recorded than most others (Table 3.3).

About one third of the species of the groups for which information is available, were 'extinct in the wild' or 'critically endangered' or 'endangered' or 'vulnerable' or 'threatened at lower risk' (categories corresponding to those of IUCN 1994). The regional assessment shows that relatively more species were endangered in the Central Plateau, the region with the highest population density and the most intensive agricultural practices. In Germany, agriculture is the cause of the threat to about 70 % of the vascular plant species (Red List categories mentioned above) (Korneck & Sukopp 1988 in Landolt 1991). In Switzerland this number might be similar especially in the Central Plateau region. With respect to mammals, agriculture is a main cause of the threat of 4 species, namely the hare and 3 bat-species (derived from Duelli 1994). To judge from a pilot study undertaken in northern Switzerland on an area of 3350 km^2 characterised by settlement and agriculture, efforts in conservation have already shown traceable effects documented in a so-called "Blue List" of successfully supported species from the Red Lists (Gigon et al. 1996). 54% of Red List species of the test area were promoted in the test area of three Cantons by conservation measures within a period of 10-15 years.

Table 3.2 **Number of Red List species in Switzerland**

Category	Number of species	Number of endangered species	Percent of endangered species	Source
Bryophytes	1030	401	39	Urmi (1994)
Vascular plants	2696	658	24	Landolt (1991)
Vertebrates	376	181	48	Duelli (1994)
Invertebrates[1]	2369	957	40	Duelli (1994)
Total	6471	2197	34	

Note:
1. Only categorised invertebrate species. Total amount of known species is around 20 000.

Table 3.3 **Regional differentiation of Red Lists. Percentage of endangered vascular plants and birds (summarised from Duelli 1994).**

Category	Jura	Central Plateau	Northern Alps	Central Alps	Southern Alps
Vascular plants	37.7	49.0	28.0	24.9	29.4
Birds	48.8	54.7	45.4	44.8	41.4

Traditional orchards and tree nesting birds

Fruit orchards with standard fruit trees on grassland are a prominent traditional land-use type in Switzerland. They contribute not only to agricultural biodiversity but are also an important cultural element attracting public attention due to the aesthetic role of trees in landscapes (Herzog 1998, Herzog and Oetmann 2001). The particularly high biodiversity can be explained by the numerous physical gradients (for example dry/moist, shaded/sunny) that occur when trees and annual plants are interspersed. Orchards receive special attention for their potential to host birds, including numerous species whose populations are declining or endangered (Duelli 1994, Jedicke 1997). Woodpeckers, nuthatches (e.g. *Sitta europea*) and tree creepers (e.g. *Certhia brachydactyla*, *C. familiaris*) feed on insects in the trees' wood and bark. Holes or crevices in older trees provide nesting opportunities for birds that nest in caves (Mader 1982, Zwygart 1989).

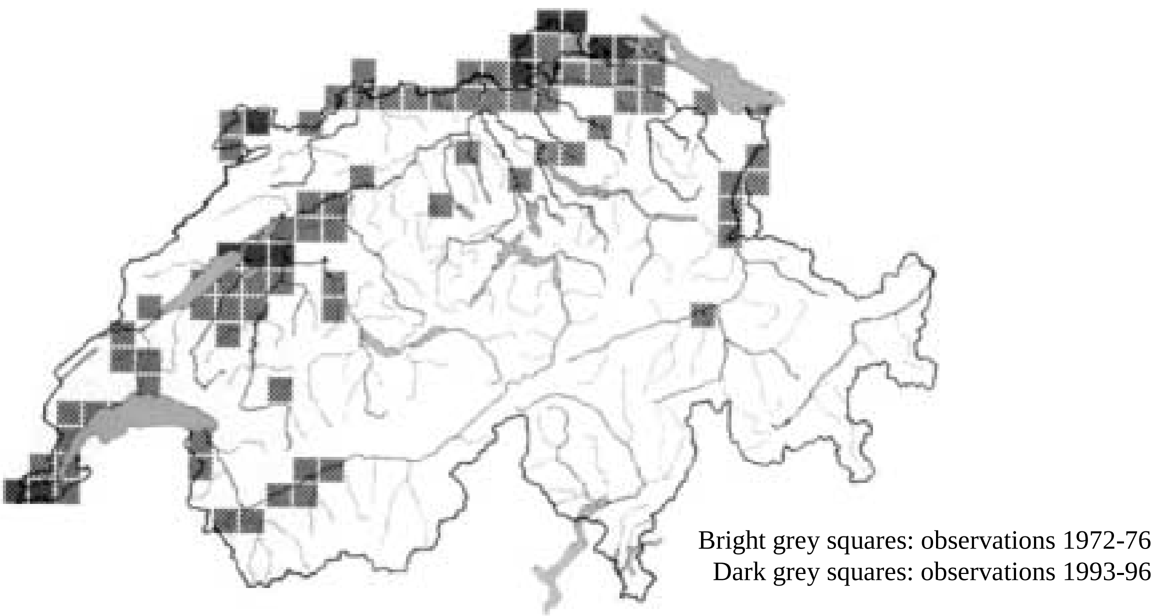
Still, between 1951 and 1991, the number of standard fruit trees has been reduced from about 14 million to 5.5 million (Ritzmann-Blickenstorfer 1996). By revising existing inventories, Müller (1988) found hardly any orchards with an increasing number of trees, whereas 70% of orchards lost trees between 1977 and 1987. An over-ageing of trees and a reduction of tree density was most common as orchards were not regularly complemented with young trees. The same inventory showed in 51% of the cases a decline of bird species. Namely the woodchat shrike (*Lanius senator*) and the hoopoe (*Upupa epops*), both breeding in traditional orchards, were likely to get extinct (Zbinden 1989).

Low intensity arable land and soil breeding birds

Arable land which was not intensively managed has become increasingly scarce until 1990 due to progressive intensification of arable farming. Weed communities range among the most threatened plant communities with over 50% endangered species in the Central Plateau (Landolt 1991). Monotonous cropping habitats are unfavourable breeding sites for several soil breeding birds. The lapwing (*Vanellus vanellus*) had shown flexibility when wetlands became rare, shifting its hatchery to arable land. There, however, mechanisation and lack of fodder lessen the breeding success (Zbinden 1989, Schmid et al. 1998). The biggest Swiss lapwing colony near Grenchen (140 pairs in 1970) dropped to 36 pairs in 1995 (Christen 1996), the total population in Switzerland being halve the number 20 years ago. Although still frequent, the skylark (*Alauda arvensis*) is confronted with intensified tilling and mowing cycles that render repeated hatching useless (Jenny 1990).

The grey partridge (*Perdrix perdrix*) is another example of a bird suffering from agricultural intensification (Fig. 3.2). This species is rather immobile and highly depending on extensive margins and uncultivated areas. It did not find adequate substitute habitats when the low intensity arable land with its abundance of insects and weed seeds was replaced by intensive cropping. The proper population of partridge which was estimated 15’000 - 19’000 pairs in 1960 (Müller 1992) is extinct and remaining individuals have been set out in specific partridge programmes.

Figure 3.2 **Localisation of the grey partridge (*Perdrix perdrix*)**



Source: Schmid et al. 1988.

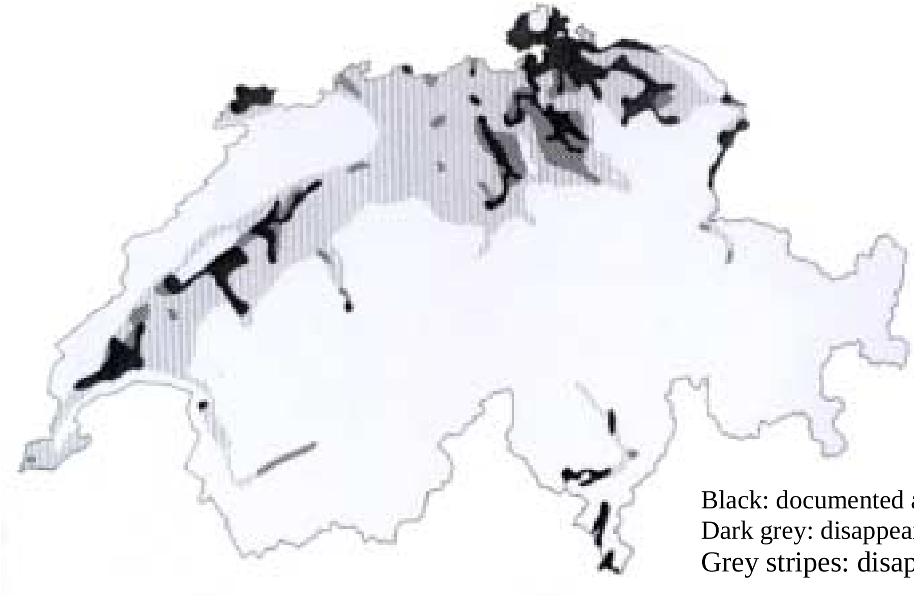
Extensively managed meadows and butterflies

Almost all traditional meadows and pastures of the Central Plateau have been intensified since the 1950s (BRP and BUWAL 1991). Intensification leads to a reduction of the lavish invertebrate fauna of dry meadows (Curry 1994). An alarming 69% of butterflies of the Swiss lowlands were considered to be endangered in the early 1990s (Erhard 1995). Experts estimate that the overall abundance of butterflies in the Central Plateau has been reduced by 99 percent during the 20th century (SBN 1987). When dry meadow are fertilised, 80-90% of all plant species disappear within a short time and with them the phytophagous insects, at first place butterflies and grasshoppers (SBN 1987). Several dozens of butterfly species formerly present throughout the plateau survive only in tiny scattered colonies of sometimes barely more than a few square meters. The small pearl-bordered fritillary (*Clossiana selene*) has vanished from the former grassland of the plains along Lake Biel, nowadays the primary vegetable producing area of Switzerland. Here, only 15% of the original butterfly diversity can be (still) declared safe, but 40% - 33 of 79 species - were definitely extinct in the 1980s (SBN 1987). Detailed long-term data from three other well documented areas (Geneva, Bern and Thurgau) reveal a similar situation for species with a narrow ecological behaviour. Since 1950, the entire spectrum of butterflies except ubiquists and migratory species was severely touched.

Wetlands and amphibians

Unmanaged dynamic wetland habitats suitable for a diverse amphibian community have become very rare in the Central Plateau. The loss of naturally flowing rivers, wet meadows and mires exceeded 90% (Grünig 1994). Changes of landscape based on comparisons of maps documented a decrease of these water bound habitats in the Central Plateau to 1% between 1800 and 1988 (Broggi and Schlegel 1989). The surface of sites with populations of common tree frogs (*Hyla arborea*), indicator species of warm, fish free ponds in old gravel pits or fenland, have diminished by half from 1970 to 1980 (Figure 3.3, Grossenbacher 1988). Common tree frogs depend on shrubbery or a belt of dense swamp grass close the water and on areas rich in insects like extensive wet meadows. Common tree frogs have not been abundant in this century and it is estimated that their spread is limited by climatic restrictions anyway (lowland species). They have reacted quite sharply on a deteriorating structural network, although the reasons for the dramatic decline are difficult to trace in detail. It seems that isolated populations had less chance of surviving at medium terms than populations with intact opportunities of species exchange. Agriculture along the main rivers of Switzerland is an important factor influencing the habitat connectivity and habitat loss of tree frog populations. Therefore in several programs arable land was and will be converted into tree frog habitats.

Figure 3.3 **Habitats of the common tree frog (*Hyla arborea*)**



Black: documented after 1980
Dark grey: disappeared between 1960 and 1980
Grey stripes: disappeared before 1960

Source: Grossenbacher 1988.

4. Impacts on economy and welfare: Rationale for the valuation method chosen and results

The valuation method

Valuation of biodiversity

It is common for environmental resources to exist in the form of ‚multidimensional packages' (Perman et al. 1996). This becomes particularly apparent in the valuation of biodiversity. Biodiversity in a region may yield various non-marketable public and marketable private benefits at the same time, arising from diversity at various spatial scales. Further, the components of diversity depend on each other in complex ways. One cannot evaluate arbitrary changes in biodiversity but must refer to changes that are related to specific land-management change (Montgomery et al. 1999). The complexity of the ‚biodiversity objective function' is a heavy obstacle to the design of useful biodiversity indicators (OECD 1999) and to economic valuation. Among the conventional methods for monetary valuation only direct measurement of preferences by contingent valuation methods can theoretically capture all value categories of the public good aspects of biodiversity (Mitchell and Carson 1989). Contingent valuation surveys, however, encounter several problems related to the construction of the hypothetical market (Diamond and Hausman 1994). There is a broad consent that the most reliable measures of value are produced when randomly chosen respondents are confronted with specific, realistic questions which frame the valuation as voting in a referendum, in a dichotomous choice format (Arrow et al. 1993, Hanemann 1994).

In Switzerland two recent contingent valuation surveys on the monetary value of aspects of biodiversity meet these requirements at least partly. Jäggin (1999) surveyed the willingness to pay (WTP) for species conservation programmes in the managed agricultural land of part of the Jura mountains region. The author offered a three- (scenario 1) and a five-fold (scenario 2) increase in the extensively managed agricultural surface that corresponded, respectively, with the states of nature in the 70s ("thus saving all except few species") or 50-60s ("thus saving all species") and used two elicitation methods (Table 4.1). Aggregated for all persons seeking recreation in the region and related to the land surface these estimates imply benefits of CHF 6'000 per year and hectare of managed land (Jäggin 1999, p. 102).

Table 4.1 **Average individual WTP in CHF per year for increase in non-woodland natural areas in Jura mountains to protect species diversity**

Protection programme	**Scenario 1**	**Scenario 2**	**Scenario 2**
Elicitation method	Payment cards	Payment cards	Referendum [1]
Population seeking recreation	252	396	528
Town population	264	456	276

Source: Jäggin 1999.
Note:
1. "Minimum legal willingness to pay".

Roschewitz (1999) used a closed, iterative referendum format to elicit WTP to protect or improve an agricultural landscape (Table 4.2). When this WTP is again aggregated and related to the agricultural land area, resulting per-hectare benefits are about additional CHF 600 per hectare and year for protection and another CHF 180 for ‚improvement' of the traditional landscape. Yet it is not clear if the WTP relates to the total WTP or if the interviewed persons were willing to add these sums to regular taxes.

Table 4.2 **Average individual WTP in CHF per year for protecting or improving the rural landscape in the Weinland region**

Sample/protection programme	**Protection**	**Additional improvement**
Local rural population	402	245
Nearby urban population	409	242

Source: (Roschewitz 1999).

The average individual WTP for protection was very similar in both studies and for all surveyed populations although, from the point of view of the respondents, objects of valuation differed. In the Weinland study, the similar WTP in local and nearby town populations indicates a possible embedding effect, i.e., the commonly observed phenomenon that stated WTP is unresponsive to the magnitude of the good or service being valued (e.g., Desvouges 1993, Diamond and Hausman 1994, Svedsäter 1998). While the Weinland is the only local recreation area for the rural population, the nearby town population may in fact have similarly valued a mentally constructed good "local rural landscapes" instead of only "the Weinland landscape", a problem that is acknowledged by the author (Roschewitz 1999, p. 148). Moreover, the Jura study illustrates the sensitivity of results to the elicitation method (see Table 4.1).

Embedding effects and other problems of hypothetical markets are avoided in indirect valuation methods (i.e. techniques to derive preferences from observed choices) because the individual has the opportunity and incentives to acquire the information necessary for a decision (Frey 1994, 1997). Indirect measurement of preferences for public goods can use information from market choices as well as political choices (Pommerehne 1987, Blankart 1998). Observing political willingness to pay may be one approach to measure preferences for biodiversity. It may be expected that potential policy failures would defeat such an approach. However, in the direct-democratic context of Swiss agricultural policy reform people have and make use of the possibility to directly engage in a collective choice of public goods. As a decision mechanism, referenda have advantages over democratic decision via representation because they avoid the principle-agent problem. Besides, the constant challenge by potential popular referenda has also a disciplining effect on representative democratic decisions (Pommerehne 1978, Frey 1994). Environmental values implicit in Swiss agri-environmental policy choice are therefore potentially less biased than in purely representative systems. The goal of the following chapter is thus to seek information on the value of biodiversity in the agricultural landscape from recent political choices.

Political willingness to pay

Political outcomes depend on the institutional structure of a democracy. Two basic approaches have been used to characterise preferences for public goods based on choices in the political domain. The 'median voter model' describes the budget process in a representative democracy or a town-meeting type democracy, where a political proposition can be easily adjusted, thus ideally leading to a decision that follows the intentions of the median voter (Tullock 1967, Borcherding and Deacon 1972, Pommerehne 1987). If a number of assumptions are met (Blankart 1998, p. 110) the model can be used empirically to estimate the aggregated demand for public goods. A second approach is the analysis of direct-democratic referenda (Pommerehne 1987). Here, the government and public administration, or in the case of popular initiatives a group of citizens, make a fixed proposition and leave voters usually only two options: approval or rejection. Models of direct democratic decision require less restrictive assumptions. Particularly, they do not require an equilibrium situation for an identifiable individual as in the median voter model. In special cases where voters can choose among different propositions or levels of expenditure referenda allow a monetary valuation of the public service in question (Pommerehne 1987). Direct-democratic decisions involve allocative as well as distributional aspects and are in general not Pareto efficient. This is troubling from an economic perspective but the problems of aggregating individual demands are not unique to majority decision rules.

The policy process of the last ten years that led to the present agri-environmental policy in Switzerland combines features of representative democracy with direct-democratic elements. The administration proposed a programme of agricultural reform in 1992 but fundamental decisions on financial incentives for ecological services were made by direct popular decision. The further details of agri-environmental policies were specified by the national parliament and by administrative units. The procedure in this section is to (1) provide a brief chronology of the policy process, (2) examine the popular voting decisions, and (3) present results of a recent opinion poll on national agricultural policy as evidence that also budgetary decisions made by the parliament are not far from public preferences. In the section that follows political willingness to pay for agri-environmental policy elements is used to estimate the value individuals place on the related aspects of biodiversity.

Traditionally there had been little public criticism about agricultural policy until in a referendum decision in 1986 the public rejected a law to support domestic sugar production. For the first time the market support policy defined by the Swiss Farmers' Union and a large agribusiness lobby was seriously called into question (see e.g. Hofer 1998). In 1995 the public had to decide on a constitutional article proposed by the Swiss Farmers' Union (and amended by the parliament) "for an environmentally sound, competitive, farmer-based agriculture" that was to become the basis of new agricultural laws and ordinances. This initiative, in spite of its label, did not contain a binding paragraph on minimum ecological management preconditions for direct income payments to farmers. Nor did it mention other urgent policy measures such as the reduction of market support envisaged by the reform program "Agrarpolitik 2002" of the Federal Office for Agriculture. A large majority in the parliament, a majority of the political parties and around ninety percent of the farmers supported the constitutional article. Meanwhile a group of nine large national consumer and environmental organisations criticised that it would in fact continue the old scheme of an uncompetitive agriculture that is expensive without producing sufficient public ecological benefits. The majority of voters agreed with these latter arguments and the proposed article was rejected in the referendum held in March 1995. The popular verdict clearly implied the mandate for a more relentless pace of agricultural reform regarding both ecological incentives and market orientation (GfS 1995). In a December 1995 draft the national council tied direct income payments to basic ecological management requirements and thus reached a “historical” compromise in the formulation of a revised constitutional article (Neue Zürcher Zeitung 7.12.1995). This compromise was to hold also in the State Council and later found a large (78%) majority in the popular referendum in June 1996. Based on this constitutional article a revised agricultural law was enacted in 1998.

Voting outcomes and voter motives obtained from surveys provide a basis to examine how well the direction of the reform, and particularly its ecological component, are rooted in the public preferences. Only if a broad consent on these policies can be demonstrated may budgetary decisions be interpreted as a measure of aggregated private willingness to pay for the public goods provided by agriculture, or as a measure of the value people place on these policies. The details of the political process strongly support the view that the population wished to explicitly support and pay for ecological services. The inclusion of binding ecological management requirements for direct income payments was crucial for the public support of the reform. A follow-up survey to the 1995 decision found that 77% of the opponents agreed with the sentence “The new article should take the environment more seriously into account.” (17% did not). Among those willing to accept the 1995 proposition there were still 57% who consented on the same critique, while 35% did not (GfS 1995). Regarding the popular acceptance of the new agricultural law of 1998 and the specific reform measures based on this legislation a survey investigated in 2000 whether changes in ecological management are being perceived by the public. More than half of the respondents attested agricultural policy an increasingly positive effect on environmentally sound forms of production (GfS 2000). A 1999 survey study on the public support for present policies in various sectors affecting the environment reports a high acceptance for public environmental protection measures in general and for agricultural policy measures in particular (GfS 1999; Table 4.3).

Table 4.3 **Public perception of different policies affecting agricultural biodiversity (percent of the population)**

Area of public policy	“just right”	“more should be done”	“less should be done”
Measures for an environmentally sound agriculture	52	40	8
Nature and landscape protection	49	37	24

Source: GfS (2000).

This at least supports the view that the budgetary expenditures for agri-environmental measures, including those in favour of biodiversity, are currently well founded in public preferences. Budgetary decisions may approximately follow the intentions of the median voter. Tax shares appear to be within the range of individuals’ maximum willingness to pay (or reservation price) for the public environmental goods provided by domestic agriculture. Based on this interpretation the following section examines values of the public good biodiversity which are revealed in political choice.

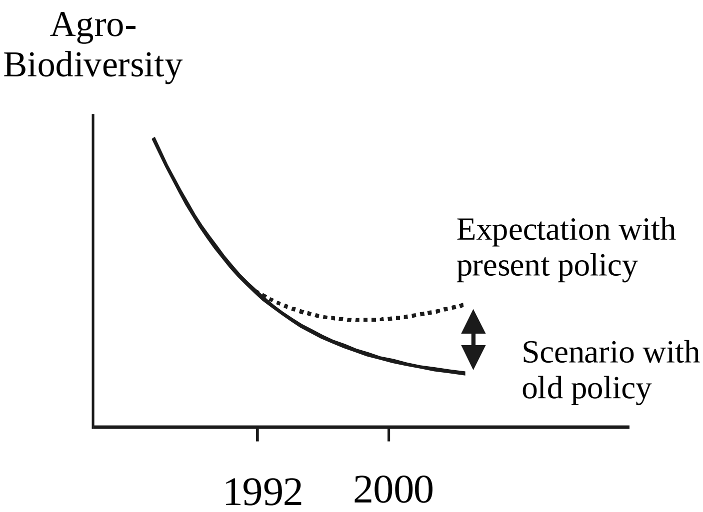
Budget expenditures as estimates of monetary value

Agriculture provides an array of public benefits which are subsumed under the term "multifunctionality" in the constitutional article accepted by referendum. Deriving implicit willingness to pay for specific public benefits therefore involves a difficult decomposition problem. It is likely that some voters had quite different things in mind when they agreed on a stronger recognition of the environmental objectives among the multiple functions of agriculture. Further, a smaller or larger number of budget items may be related to the biodiversity objective of agricultural policy, depending on the definition of biodiversity adopted. In the following, it is nevertheless attempted to relate different agricultural budget items to their (expected) positive effects on the public good biodiversity, and it is examined which annual values these imply per capita of the population.

On a broadest basis all agricultural expenditures *contribute* to the continued existence of a pattern of diverse agricultural production at the regional and national scale (total of market support, specific voluntary programme payments and cross-compliance payments; for definitions see OECD 2000a). It is assumed that withdrawal of agriculture from mountain and concentration in plateau regions occurs rapidly if agriculture is not assisted by the public, although the extent of withdrawal in mountain areas may strongly differ according to regional economic profiles (Rieder et al. 1999, Baur 2000). Area-related payments linked with restrictions on chemical use or minimum set-aside requirements can be considered as *targeted partly* at the provision of increased biodiversity as a public good (cross-compliance payments and specific voluntary programmes). The appropriate reference scenario is assumed to be the Swiss agricultural policy of the 1980s (Fig. 4.1). Finally, the support of local species richness within farms through the specific voluntary incentive programmes can be *unambiguously related* to the biodiversity goal.

Thus, domestic agriculture as a whole, including all benefits, from food supply security to landscape-aesthetic, cultural, social, and ethic values can then be interpreted to produce annual benefits of about CHF 4700 per hectare of agricultural land corresponding with a mean individual WTP of CHF 1000 per capita of the population (Table 4.4).

Figure 4.1 **Expected biodiversity scenario change (arrow) implicitly valued in budget expenditure for specific voluntary programme payments**



The benefits of a relatively environmentally sound type of domestic agriculture supporting some typical adapted wildlife populations (secured by cross-compliance payments) contributes about one third or about CHF 1400 per hectare and CHF 300 per capita to this annual value (Table 4.4). The additional voluntary programme payments aimed specifically at an increase of the biologically diverse areas within the agricultural surface amount to CHF 25 per capita Under political equilibrium assumptions, payments to farmers for these landscape elements may, if expressed per hectare, be interpreted as their marginal value (Table 4.5). The national budgets provide an estimate of the annual benefits of increased farm-level species diversity, which is a relatively modest CHF 115 per hectare of the total agricultural surface and year (Table 4.4).

Table 4.4 **Agri-environmental payments interpreted as willingness to pay for the maintenance of the present agricultural landscape pattern and regional diversity (in order of increasing specificity to biodiversity goals)**

Payments class	National budget (mio. CHF, 1999)	CHF per hectare of agricultural land[1] ('marginal WTP')	CHF per capita[2] ('total individual WTP')
Total producer support estimate (various goals)	7'366	4'658	1'009
Market price support (various goals)	4'474	2'829	612
Payments for other than environmental purposes	654	414	91
Total of agri-environmental payments	2'238	1'415	306
Cross-compliance payments (biodiversity and other environmental goals)	2'055	1'299	281
Specific voluntary programme payments (mainly biodiversity goal)	183	115	25

Source: OECD 2000a, 2000b.

Notes:

1. based on utilised agricultural area of 1.6 mio. ha (including alpine pasture).
2. based on population of 7.1 mio.

Individuals' mean contribution, or tax payment, for the different types of compensation areas may be interpreted as an estimate of the value for an individual person/taxpayer of maintaining these landscape elements. A mean individual tax payment of CHF 5 is for instance spent for maintaining extensive meadows and fruit trees and CHF 0.40 for hedges (Table 4.5). However, part of the cross-compliance budget also contributes to biodiversity through the 7% set-aside requirement for cross compliance payments. (chapter 5.1).

Following the interpretations and assumptions above it could be tentatively concluded that of the CHF 7.3 billions of total public benefits generated by domestic agriculture (according to WTP for related expenditures), 1.5% (CHF 183 mio) are due to increased species diversity at the farm level, 30% (CHF 2.2 billions) are linked specifically with the production of a healthy environment and farm-scale land-use diversity, and the remaining 70% are due to a variety of other perceived benefits. The latter part also includes important aspects of diversity such as the aesthetic value of maintaining the present pattern of forested and open land, the beauty of regional farm architecture, and a diversity of local rural lifestyles. These figures may not be viewed in isolation as the public would, for example, have a different willingness to pay for the targeted voluntary programs if there were no cross-compliance payments with some of the same positive effects on biodiversity.

According to their total budgetary expenditures for agriculture the Swiss may value their rural landscape even higher than the survey estimate presented at the beginning of this chapter (Roschewitz 1999), although it is difficult to compare these figures.

Table 4.5 **Specific voluntary programme payments offered as incentives to enhance biodiversity within specific land use forms in 1999**

Payment class	Payments (mio. CHF)	CHF paid per hectare [1]	CHF paid per capita[2]
Extensive meadows	34.9	450–1500	4.78
Meadows of low intensity	18.4	300–650	2.52
Litter meadows	4.5	450–1500	0.62
Hedges and rustic groves	2.8	450–1500	0.38
Traditional orchard trees	36.9	15 per tree	5.05
wild flower strip	2.2	3000	0.30
Short term fallow	0.8	2500	0.11

Source: BLW 2000a.
Notes:
1. Payments depending on elevation zone
2. Based on population of 7.1 mio.

Per hectare values can be interpreted as the aggregated marginal willingness to pay for these landscape elements. Per capita values are an approximation of the individuals' mean tax payment for the cost-sharing programme.

The role of information and uncertainty

Reliable information on the valuation of biodiversity by the public is necessary for the design of agri-environmental policy. The previous chapter showed a surprising degree of public consent on national agricultural policy in Switzerland. However, this consent relates primarily to the direction of a process. It proves agreement on a first step in agricultural policy reform. It appears that on the way towards a more market- and ecologically orientated agriculture the mix of instruments chosen, and the implicit values of biodiversity, correspond rather well with public preferences. As new information will enter the policy arena the measures will have to be re-evaluated. For instance there is today very little information available on the effects of policy reform on biodiversity and ecosystem services, although there are some success stories (Weibel 1998, Herzog et al. 2001). If the expected improvements due to policy reform will not materialise, the present consent (Table 4.3) could melt away rapidly and thus necessitate a change of policy. An adaptive policy development that takes the incoming information into account is therefore imperative. A quantity change in ecological compensation area – if it should prove necessary – could, e.g., be achieved by a relative change in specific voluntary programme payments and other agricultural support (Baur 1998, 1999).

More definite statements on the valuation of biodiversity in the agricultural landscape in Switzerland are problematic, as the public attitude towards agriculture and preferences about biodiversity protection through agriculture must be expected to evolve at a fast pace. Present efforts to provide improved information on the biological effects of reforming agricultural policy include the specific projects for the evaluation of agri-environmental measures set up by the Federal Office for Agriculture (Forni et al. 1999), and the national biodiversity monitoring program (BUWAL 1999) and applied university research projects such as some projects in the Swiss Priority Programme Environment funded by the Swiss Science Foundation.

For an efficient allocation of public funds into biodiversity in agricultural systems the costs should be carried by those who obtain the benefits. Citizens should be taxed according to their individual marginal willingness to pay. An important step towards the principles of equivalence and institutional congruence (Blankart 1998) is envisaged in the "eco-quality" order that is presently under review and will be enacted in 2001 (BLW & BUWAL 2000). With this new agri-environmental policy instrument new incentives (for producing compensation areas of special quality in terms of botanical composition and connectedness of habitats) will be offered on a regional basis. The criteria for supplementary quality payments will be determined by the cantons, based on minimum requirements defined by the federal authorities. This innovation will also lead to new opportunities for popular participation in the design of agri-environmental policy.

Regarding the valuation method applied in the previous chapter it is cautiously concluded that an implicit valuation by direct and indirect democratic adaptive policy choice is appropriate for a public good whose value cannot be determined based on expert knowledge. However, major uncertainties of interpreting budgetary expenditures as political willingness to pay regard the assumption of a voter population that is reasonably well informed about the costs and effects of present and alternative policies and a political equilibrium situation in parliament and administration. Conservative agricultural interests are over-represented in the Swiss parliament as the recent referenda proved. Budgetary expenditures may therefore be a lower-bound estimate of actual willingness to pay. An improvement of direct-democratic "biodiversity policy" choice could, and in fact will, be sought in increased federalistic elements in agricultural policy which will be closer to citizens' regional preferences and will allow a regional adaptation in the magnitude and design of specific voluntary programme payments (Minsch 1998, Anwander 2000, BLW & BUWAL 2000). Compared with referendum decisions, survey approaches may be more easily conducted, yet they replace the political context by an artificial environment in which only an interviewer and the respondent interact making surveys often suspect for policy recommendation.

5. Design of policy responses

Identification of incentive measures

The actually implemented mix of measures mirrors the main targets of Swiss agricultural policy, namely a) to weaken the incentives for intensive agricultural production without threatening farmers' existence, b) to avoid negative impacts of agricultural production on the environment with appropriate law enforcement, c) to raise the number of extensively managed plots and ecological compensation areas with financial incentives and d) to maintain international competitive capacity of Swiss agriculture in spite of ecological regulations (Anwander 2000).

The most precious habitats for conservation (mires, fenlands, river meadows) are inventoried and enjoy special protection status defined in the respective order based on Art. 18a, paragraph 1-3 in the Federal Law of Nature and Heritage Protection (NHG) 1966 (Anonymus 1966). The Cantons have to enforce the appropriate measures for protection and upkeep of a defined object. Agricultural activities may not interfere with protection targets but are restricted to management measures indispensable for protection and promotion of typical plant and animal communities. Confederation and Cantons share the costs of management agreements with farmers. The surface of farming locations with management contracts for nature conservation is added to ecological compensation when it comes to reach the minimum share of 7% of ecological compensation areas (ECA) on agricultural land (see below).

Little is left today of the various market interventions (fixed prices, guaranteed sales) and support of land conversion (field amelioration projects) of the 1950s to 1980s. As increased cost efficiency and expansion of farm size did not balance the decreasing benefits per unit in most production segments, the majority of farmers – to make a living - are driven to join the programme “Proof of Ecological Performance” (ÖLN) that sets minimum standards for direct payments listed in the “Order of Direct Payments” (DZV) (Anonymus 1999). The farm is thereby regarded in its integrity and has to fulfil every single standard in plant production, animal production and ecological compensation in order to get direct payments - not only ecological payments but also basic payments not linked to a special performance (see table 4.4). The global standard can be further supplemented by arable low-input programs, quality labels of organic farming and animal friendly husbandry which actuate additional payments.

In the catalogue of requirements there are elements in ÖLN that are aimed at improving living conditions for wildlife by reducing inputs into production areas. There are minimum standards for crop rotation which must be kept and the share of one crop is limited to what seems bearable at longer term. Fertiliser use especially for nitrogen and phosphorous, must be balanced with nutrient uptake of plants and nutrient export.

Restrictions for categories of plant protection products are listed in detail for each crop and grassland and - where applicable - farmers are supposed to use chemicals only after having judged potential damage in the field. Chemical plant protection products are considered only as second choice when natural regulation mechanisms fail and cost-benefit ratio justifies application.

On a structural level, ecological compensation has three different goals; (1) conserving valuable habitats, (2) valorising those deteriorated and (3) creating new habitats. Each farmer has to assign at least 7% of his agricultural area for compensation in order to participate in ÖLN. The catalogue of ecological compensation areas encompasses extensively cultivated meadows and pastures, hedges and field wood with buffer zones, solitarily standing trees, traditional orchards, compensation areas in arable land and other linear or punctual elements of ecological infrastructure like ponds or stonewalls (Table 5.1). Far away from being functionally complete, this growing “network” of old and new habitats is aimed at stopping the loss of biodiversity linked with agriculture.

While generating the public benefit of biodiversity, most ecological compensation areas continue to be used by agriculture and therefore, at the same time, also yield private benefits to farmers. The ecological direct payments (EDP) are intended to cover part of additional costs or loss of benefit.

Table 5.1 **The catalogue of ecological compensation areas (UAA: utilised agricultural area)**

Type and Name	Main Requirements	Special Requirements	EDP 2000[a]
Low intensity meadows	• Size; ≥ 5 acres • Duration; ≥ 6 years • Mowing is compulsory	• No fertilisers • Specific punctual herbicide treatment against problematic weeds granted when mechanical control is insufficient • Mowing at least once a year, no earlier than indicated for the respective production zone (e.g. for lowlands 15th June). • Only mowing, no grazing except for the last use in autumn (e.g. for lowlands no earlier than 15th September) • Use of officially certified seed mixtures for creation of new meadows	450 – 1500 CHF/ha[b]
Low intensity pastures	• Size; ≥ 5 acres • Duration; ≥ 6 years • Grazing at least once a year	• No fertilisation apart from manure of grazing animals • Only punctual herbicide treatments • No areas dominated by ubiquists and nutrient indicators	Only counting for 7% share of ECA on UAA
Wooded Pastures	• As low intensity pastures	• As low intensity pastures. Specific fertilisers (no nitrogen) and application of plant treatment products may be granted by cantonal forest authorities	Only counting for 7% share of ECA on UAA
Meadows of little intensity	• As low intensity meadows	• As low intensity meadows, except for fertilisers. Organic manure up to 30 kg N/ha allowed after first cut	300 - 650 CHF/ha[b]
Litter areas	• Size; ≥ 5 acres • Duration; ≥ 6 years	• No fertilisers and plant treatment products • Mowing once a year after 1st September • Litter for use as straw	450 - 1500 CHF/ha[b]
Low intensity cropping strips	• Lowland area • Width of 3-12 m • In cereals, rape, sunflowers and leguminoses	• No insecticides and no fertilisers containing nitrogen • No mechanical and extended chemical treatments against weed • In two consecutive main crops on the same place	1000 CHF/ha
Wild flower strip	• Lowland area • 3 m width • Arable land or permanent crops before fallow • Duration 2-6 years	• Use of appropriate officially certified seed mixtures of wild domestic plants • No fertilisers and plant treatment products • Specific punctual herbicide treatment against problematic weeds granted when mechanical control is insufficient • Mowing half of the surface possible from 2nd year on between 1st October and 15th March	3000 CHF/ha

(*Table 5.1 continued*)

Rotational fallow	• As wild flower strip, but size is ≥ 20 acres and ≥ 6m wide • Duration 1-2 years	• Use of officially certified seed mixtures of wild domestic plants • No fertilisers and plant treatment products • Specific punctual herbicide treatment against problematic weeds granted when mechanical control is insufficient	2500 CHF/ha
Traditional orchard trees	• Fruit and nut trees with stem height >1.2 m	• No herbicides to control the vegetation underneath except for trees younger than 5 years	15 CHF/tree[c]
Single trees and alleys	• Domestic trees locally adapted	• Distance between trees >10m	Only counting for 7% share of ECA on UAA
Hedges, field and riverside wood	• Size; ≥ 5 acres • Duration; ≥ 6 years	• Grassland buffers zones of >3m on both sides (adjacent to roads, walls or rivers on one side) • Mowing of buffer zone at least every third year with similar restrictions of earliest mowing like extensive meadows and pastures • Management only outside growing season	450 - 1500 CHF/ha[b]
Water ditches and ponds	• Open water-runs and stagnant water on agricultural area	• No fertilisation and plant treatment products • No agricultural use • Grassland buffer zone of 3m	Only counting for 7% share of ECA on UAA
Ruderal areas	• Shrubby areas, tips, pile of rubble	• No fertilisation and plant treatment products • No agricultural use • Grassland buffer zone of 3m	Only counting for 7% share of ECA on UAA
Loose stonewalls		• No fertilisation and plant treatment products • Grassland buffer zone of 0.5 m on both sides • Height 0.5 m	Only counting for 7% share of ECA on UAA
Naturally covered field track		• No fertilisation and plant treatment products • Grassland buffer zone of 1m on both sides • Covered with grass, earth or gravel	Only counting for 7% share of ECA on UAA
Species rich vineyards	• Soil covered with local flora	• Organic fertilisation • Only contact herbicides for specific use against problematic weeds, only biological methods against insects and fungi	Only counting for 7% share of ECA on UAA
Others		• Cantonal regulations	Specific for each case

Source: DZV (1999).
Notes:
a Ecological Direct Payments per unit in 2000.
b Range of payments according to production zone (lowland, mountain).
c Total of ≥ 20 trees required.

Process of implementation and distributional effects

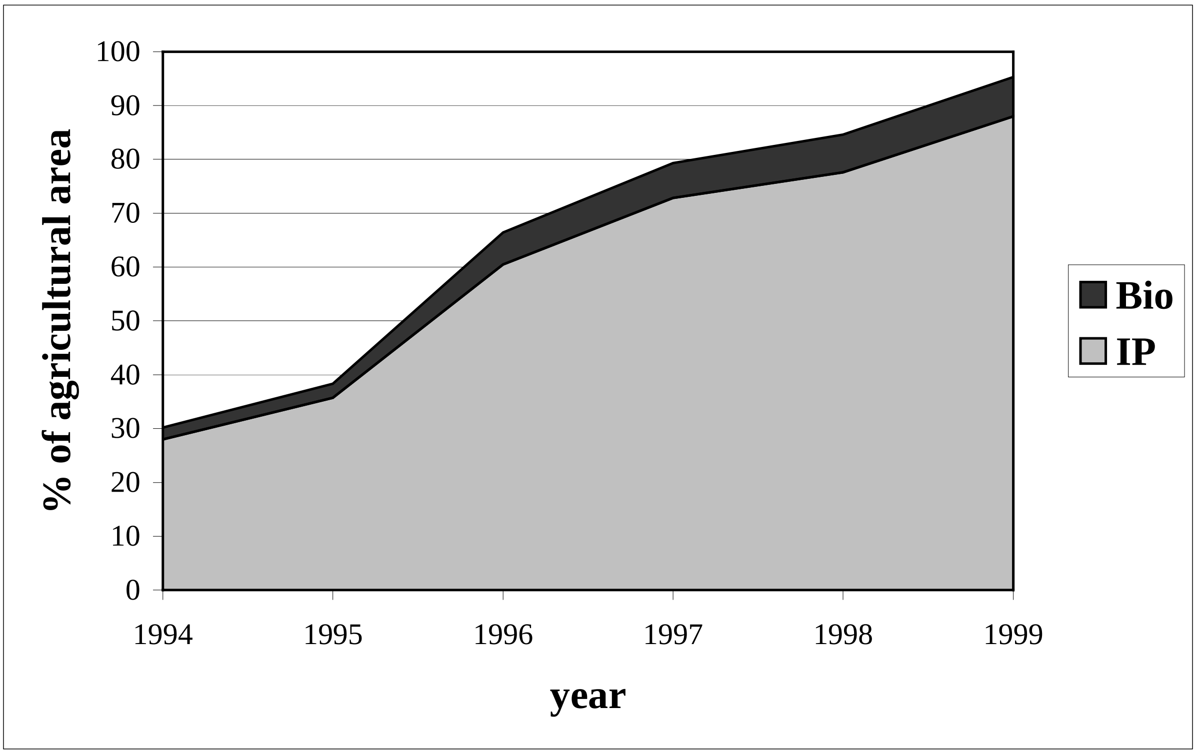
The method of financial incentives not linked with the high price policy had been used sporadically in the period of 1950-85, and if so, at the expense of agricultural biodiversity. For example, subsidies were granted between 1961-75 for planting dwarf orchard trees and cutting high growing fruit trees (Thomet and Thomet-Thoutberger 1990). An important indirect incentive were land amelioration programmes without compulsory measures for nature conservation, paid largely by the Confederation and the Cantons with only minor direct financial contribution of farmers (Anonymus 1992). It was only around 1985 when pioneer cantons started to make individual contracts with farmers for the protection of dry and wet meadows (Meier and Meier 1989, Roux 1990). 10 out of 26 cantons dealt with these kinds of contracts in 1990 (Thomet et al. 1990). The legal basis for more generalised support of ecological compensation was enacted in 1988 with Art. 18b, paragraph 2 of the Federal Law of Nature and Heritage Conservation (NHG) and Art. 15 of the Order of Nature and Heritage Conservation (NHV). Art. 15 NHV, paragraph 1, says: “Ecological compensation aims in particular at connecting isolated habitats, if necessary by creating new habitats, promoting species diversity, achieving a sustainable soil management, strengthening nature within settlement areas and vivifying the landscape”.

The next step forward was made by enacting Art. 31b of the Law of Agriculture (LwG) and the Order of Ecological Payments (OeBV) in 1993, allowing direct payments for agriculturally used areas, existing locations valuable for protection and new compensation areas by listing 15 different categories (see Table 5.1). From then on, direct payments for Integrated Production (IP) were linked with compliance of 5% of compensation areas within the agricultural land. This share was risen in a single separate revision to 7% in 1997. The last and most strict regulation was the “Proof of Ecological Performance” (ÖLN). Art 104, paragraph 3a of the Federal Constitution enacted in 1999 says: “The Confederation supplements farmers’ incomes with direct payments to reach an adequate remuneration for their services on condition that a “Proof of Ecological Performance” is made”. Farmers are not paid for effects on environment and nature conservation but for their actions assumed to have positive effects on ecological targets (Anwander 2000).

Regular controls are carried out by cantonal servants or certified private organisations. All farms claiming direct payments for the first time and all farms that showed faults in the prior check have to be controlled. Additionally, 30% of the remaining farms are selected at random for a control. The required standards for the payments are controlled in the appropriate season. There are attempts to standardise control and sanctions on a national level. Art 70, paragraph 1 of DZV says that payments are reduced or refused a) when farmers make wrong indications intentionally or carelessly, b) checks are hindered or not admitted, c) agriculturally relevant paragraphs of laws on the sectors of water protection, environmental protection or nature conservation are not fulfilled and d) the “Proof of Ecological Performance” is not made, or the standards for ecological payments are not kept. Since 1999 cantons have to notify the indicated faults and the applied sanctions to the Federal Office of Agriculture in order to standardise execution of the regulations. In former years, different cantonal practise in execution gave way to criticism. Credibility of policy and readiness to pay depends on the success on excluding “black sheep” among the farmers from transfer payments and to detect a positive effect of important environmental indicators at medium range (Anwander 2000). The concept of global farming standards and controls in combination with considerable financial income transfers has lead to a quasi-total participation in either ÖLN or organic farming programs (Bio) (Fig. 5.1).

The participation in the specific types varies according to the natural conditions and the farmers’ preferences. Table 5.2 indicates that the farmers almost exclusively decided to organise their ecological compensation on permanent grassland and adjacent areas whereas compensation areas on arable land (fallow and crop strips), although rapidly evolving, are still secondary. Farmer needed some time to get familiar with these types of Ecological Compensation Areas that have only been clearly defined a few years ago and have - in a narrow sense - no historic precursor.

Figure 5.1 **Participation in ecological programs Integrated Production (IP) and Biological Production (Bio)**



Source: BLW (2000, 2000a).

Table 5.2 **Participation in ecological compensation 1999**

	Number of farms	Surface in ha	Surface in % of UAA
Low intensity meadows,	33 401	34 148	3.4
Meadows of little intensity	31 244	40 388	4.1
Hedges and field wood	8 731	2 283	0.22
Litter areas	5 342	4 713	0.47
Wildflower areas	1 616	1 074	0.1
Low intensity crop strips	245	59	<0.01
Orchard trees	37 048	2 463 234[a]	

Source: BLW 2000a.
Note: a = number of trees.

Most ecologically relevant payments relate proportionally to the area put at disposal. Contributions linked with the surface have a conserving effect on farming structures because small farmers that normally would give up still keep on cultivating their own land instead of renting or selling it (Anwander 2000). Art. 17-19 of DZV indicate exclusion criteria for direct payments that are aimed at opposing this effect (minimum surface and working input, maximum age of the farmer). Another issue leading to unequal attractiveness of programs for different farms are payments graded according to agricultural area, number of cattle, total income and property in addition with upper limits per manpower unit (Art. 20-23 DZV). Those farmers entitled to direct payments get an important share of their revenue from direct payments (Table 5.3). Farms in higher altitude rely considerably stronger on direct payments as their income capacity is far more limited by natural conditions compared to the lowlands.

Table 5.3 **Average share of direct payments (%) of gross revenue of farms 1999 according to production zones and farm size**

Classes of farm size	Lowland Zone	Colline Zone	Mountain Zone 1	Mountain Zone 2	Mountain Zone 3	Mountain Zone 4
10-20 ha	14.0	19.3	24.5	31.0	43.3	48.6
20-30 ha	15.1	20.0	24.1	32.0	42.3	47.3
30-50 ha	16.9	24.8	26.4	33.3	44.0	46.7

Source: BLW 2000a.

There has been a tradition to notably support mountain farms due to figures showing that the average daily income of a mountain farmer could not keep up with reference wages of a qualified industrial worker, which on the other hand was the case for lowland farmers up to 1989. This reference has lost its former political importance but the underlying reasons for especially supporting this group (e.g. decentralised settlement) have remained valid.

Framework and context of implementation

The explicit legal framework concerned with the new incentive measures consists of a constitutional article amended by popular decision in 1996 (Art. 104), the federal law on agriculture enacted by the parliament in 1998, and a number of orders, issued by different administrative units, on “direct income payments to agriculture” (1998), “evaluation of sustainability in agriculture” (1998), “organic farming” (1997), etc. The Federal Office for Agriculture co-ordinates the evaluation of agri-environmental policy measures (Forni et al. 1999). Specific biodiversity enhancing management programmes are developed by the new expert group “National Forum for Ecological Compensation”. The Federal Research Station for Agroecology and Agriculture is in charge of monitoring and evaluating effects on biodiversity at large scale. The Federal Research Station for Agriculture and Agrotechnology continually reports on farmer participation and effects on farmer income (Forni et al. 1999).

One way to create markets for biodiversity is to define product labelling requirements. Therefore, the agricultural law (section 2) set up rules regarding the declaration of production systems such as of “organic production”. Controlled labels allow consumers to follow their preferences for specifically produced goods on the market. “Organic production” for example requires that the whole farm is tended according to the requirements of this label, which includes a percentage of ecological set-aside areas and restrictions on pesticide use and thus has a favourable effect on biodiversity. Labels of geographic origins may, apart from the strict processing prescriptions, also include certain requirements at the production level. They can therefore help to create markets for biodiversity, too.

Social constraints to the implementation of biodiversity-increasing incentive measures are formidable. As explained in chapter 2 former policy had ensured an income to a medium size farm, which was comparable to an industry employee's (so called parity wage principle) unconditionally of ecological services produced. Thus, tying income support to clearly defined basic conditions – however justified from the public perspective – was equal to a withdrawal of rights (or more precisely: privileges, as there were no formally established rights to, e.g., pollution) and caused great discontent among producers. In other words, the new incentives for the provision of biodiversity, on which most farmers now depended, were not perceived as an offer, but as restrictions to their prior freedom (Jurt 1998). In this difficult situation the referendum of 1996 was helpful for policy implementation because the factual change in rights was well sanctioned by the public.

In the course of the reform process the effects of agri-environmental policy are continuously communicated to the wider public. This helps to maintain general as well as specific environmental support measures (Anwander 2000, BLW 2000a). Agri-environmental programmes will be adapted on a regular basis. It is likely that in the future the present property rights situation will be further changed to increase the public services provided by farmers. The initiated step-by-step procedure in reforming policy seems to be appropriate to address farmer acceptance problems. Moreover, it ensures a higher predictability of policy outcomes and allows for a review of these outcomes by the institutions mentioned above. Apart from these institutions environmental NGOs are likely to continue to play a role in reporting progress, or any lack thereof, to the public.

6. Policy relevant conclusions

Lessons learned

- The only recently perceived value of biodiversity created by farmers is part of a larger set of values of other, more traditional public benefits that are generated by a productive agriculture. These benefits include regional land use and landscape diversity which are also encompassed by a broader definition of biodiversity.

- Only the specific voluntary programme payments (equivalent to an average tax burden of about CHF 25 per capita) can be unambiguously attributed to the species diversity goal. However, also the cross-compliance payments (CHF 300 per capita) are aimed at the maintenance of biodiversity through reduced pesticide application and the 7% set-aside requirement for these payments and may therefore be interpreted as a political willingness to pay for these goods.

- Democratic choice has some advantages and some disadvantages compared to more standard economic valuation approaches such as contingent valuation. On the one hand "embedding" effects and other potential biases observed in hypothetical markets are absent. On the other hand, it is difficult to derive implicit values of specific compensation measures, which are not individually discussed in the democratic process.

- Because the success of the present measures to support agro-biodiversity is still uncertain, but also because social values perpetually evolve, the agro-environmental policy will have to be re-evaluated continuously. Likewise, present budgetary expenditures can only represent a preliminary estimate of willingness to pay.

- To better account for regional differences in the demand for agro-biodiversity, the new "eco-quality" order (to be enacted in spring 2001) will differentiate specific voluntary programme payments not only according to the ecological quality of compensation areas but also according to regional (or cantonal) demands.

- The stepwise policy of constant tightening of ecological compliance measures was a ridge walk as far as acceptance by farmers is concerned. Basically, the overwhelming majority of farmers has less and less choice whether to participate or not in ÖLN. However, farmers do resist to be considered as "landscapers" and creators of biodiversity. The identification with their physical yields and products remains strong.

- Revalorization of the landscape does not necessarily yield immediate results, but it is important that a change is visible here and there for the people. Voters and consumers register the changes in their surroundings. Therefore information about the transitional process has to flow constantly to obtain approval for policy.

Transferability of the experience

- It is primarily by the help of popular voting decisions that the ecological dimension of reform in Switzerland was strengthened against the opposition of the traditionally conservative agricultural lobby. The Swiss experience thus suggests that referenda are a powerful tool for the public to express their demand for public goods such as biodiversity. It also limits policy failure effectively. It may thus be helpful in other contexts where environmental policy change to the benefit of the public has to be implemented against strong and well-organised private interests.

- Other economies might develop similarly structured incentive programs at lower costs as opportunity costs of agricultural labour in Switzerland are particularly high.

Possible policy advice for implementation

- A gradual and well-communicated shift from the traditional multi-objective support towards targeted payments for the provision of well-defined public goods is important to maintain farmer motivation.

- The most obvious outcome of the valuation exercise is the fact that political willingness to pay for agricultural biodiversity (in its widest sense) is surprisingly high. Nevertheless it must also be noted that most of this present willingness to pay seems to concern the maintenance of a diverse pattern of agricultural production rather than specifically an increase in species diversity.

References

Anonymus (1966). Bundesgesetz über den Natur- und Heimatschutz (NHG). SR 451.

Anonymus (1992). Siebter Landwirtschaftsbericht über die Lage der schweizerischen Landwirtschaft und der Agrarpolitik des Bundes.

Anonymus (1999). Direktzahlungsverordnung (DZV). SR 910.13.

Anwander S. (2000). Ökologisierung der Agrarpolitik in der Schweiz. Studie im Auftrag des Bundesamtes für Landwirtschaft, Institut für Agrarwirtschaft, ETH Zürich.

Arrow K., Solow R., Portney P.R., Leamer E.E., Radner R., Schuman H. (1993). Report of the NOAA panel on contingent valuation. Federal Register, Vol. 58, pp. 4601–4614, Government Printing Office, Washington D.C.

Baur P. (1998). Ökologischer Ausgleich durch Direktzahlungen - Denkanstösse für eine zielgerechte Weiterentwicklung. Schriftenreihe des Instituts für Agrarwirtschaft 5/98, ETH Zürich.

Baur P. (1999). Agrarstrukturwandel in der Schweiz. Dissertation ETH Zürich.

Baur P. (2000). Agrarstrukturwandel - das Ergebnis von Druck oder Sog? Schweizer Agrarforschung 7(2): 76 – 81.

BFS (1993). Arealstatistik 1979/85. Bundesamt für Statistik, Bern.

BFS (2000). Statistik Schweiz, Bundesamt für Statistik, Bern.

Blankart, C.B. (1998). Öffentliche Finanzen in der Demokratie. 3rd ed. Vahlen, Munich.

BLW and BUWAL (2000). Verordnung über die regionale Förderung der Qualität und der Vernetzung von ökologischen Ausgleichsflächen in der Landwirtschaft. Draft November 2000.

BLW (2000). Schweizerische Landwirtschaftspolitik und Direktzahlungen. Foliensatz.

BLW (2000a). Agrarbericht 2000. Bundesamt für Landwirtschaft, Bern.

Borcherding T. E. and Deacon R. T. (1973). The demand for the services of non-federal governments. American Economic Review 62: 891–901.

Bosshard A., P. Thurston et al. (1992). Landwirtschaft und Naturschutz aus Bauernhand. Schlussbericht des CH'91-Pilotprojektes auf 9 Bauernhöfen im Kanton Zürich 1989-1991. Zürcher Vogelschutz, Zürcher Naturschutzbund, WWF Zürich und Zürcher Bauernverband, Zürich. 58 pp.

Broggi M.F., Schlegel H. (1989). Mindestbedarf an naturnahen Flächen in der Kulturlandschaft; Bericht 31 des nationalen Forschungsprogramms "Boden", Liebefeld-Bern.

Bromley D.W. (1991). Environment and Economy: Property Rights and Public Policy. Blackwell, Oxford.

BRP and BUWAL (1991). Landschaft unter Druck, EDMZ, Bern.

BRP and BUWAL (1994). Landschaft unter Druck, Fortschreibung. EDMZ, Bern.

BUWAL (1996). Strategie zur Reduktion von Stickstoffemissionen, Schriftenreihe Umwelt Nr. 273.

BUWAL (1997). Umwelt in der Schweiz 1997. Daten, Fakten, Perspektiven. EDMZ, Bern.

BUWAL (1999). Biodiversitäts-Monitoring Schweiz. Bundesamt für Umwelt, Wald und Landschaft, Bern.

Christen W (1996). Die Vogelwelt der Aareebene westlich von Solothurn. Mitteilungen der naturforschenden Gesellschaft Solothurn 37: 9 – 118.

Curry J.P. (1994). Grassland Invertebrates. Chapman & Hall, London.

Desvouges, W. H. (1993). Measuring natural resource damages with contingent valuation: tests of validity and reliability. In: J. A. Hausman [ed.] Contingent valuation: a critical assessment. North Holland Press, Amsterdam.

Diamond P. A. and Hausman J. A. (1994). Contingent valuation: is some number better than no number? Journal of Economic Perspectives 8: 45 – 64.

Duelli P. (1994). [ed.] Rote Liste der gefährdeten Tierarten in der Schweiz, Bundesamt für Umwelt, Wald und Landschaft, Bern.

Erhard A.(1995). Ecology and conservation of alpine Lepidoptera. In: Pullin A.S. [ed.] Ecology and conservation of butterflies. Chapman & Hall, London.

Ewald K. (1978). Der Landschaftswandel. Zur Veränderung der schweizerischen Kulturlandschaften im 20. Jahrhundert. Bericht 191 der Eidg. Anstalt für das Forstliche Versuchswesen, Birmensdorf.

Forni D., Gujer H.U., Nyffenegger L., Vogel S., Gantner U. (1999) Evaluation der Ökomassnahmen und Tierhaltungsprogramme. Agrarforschung 6:107 – 110.

Frey B. S. (1994). Direct democracy: politico-economic lessons from Swiss experience. American Economic Review 84: 338 – 342.

Frey B. S. (1997). Evaluating cultural property: the economic approach. International Journal of Cultural Property 6: 231 – 246.

Gantner U. (1990). Dynamik der landwirtschaftlichen Bodennutzung. Themenbericht des nationalen Forschungsprogramms “Boden; Liebefeld-Bern.

GfS (1995). VOX-Analyse der Volksabstimmungen vom 12. März 1995. Publikation Nr. 56. GfS-Forschungsinstitut und Institut für Politikwissenschaft der Universität Genf, Adliswil/Bern.

GfS (1999). UNIVOX Umwelt 1999. GfS-Forschungsinstitut, Adliswil.

GfS (2000). UNIVOX Landwirtschaft 2000. GfS-Forschungsinstitut, Adliswil.

Gigon A., Langenauer R., Meier C., Nievergelt B. (1996) Blaue Listen der erfolgreich erhaltenen oder geförderten Tier- und Pflanzenarten der Roten Listen. Technology Assessment 18. Schweizerischer Wissenschaftsrat, Bern.

Gonseth Y., Mulhauser G. (1996). Bioindication et surface de compensation écologique, Cahier de l'environnement 261, Office fédéral de l'environnement, des forêts et du paysage, Bern.

Göschl, T. and Swanson, T. (2000). Analysing the relationship between development and diversity: the case of crop genetic resources. Working paper Cambridge University.

Grossenbacher K. (1988). Verbreitungsatlas der Amphibien der Schweiz. Documenta faunistica helveticae 7, Schweizerischer Bund für Naturschutz, Basel.

Grünig A. (1994). Mires and mire landscapes in Switzerland and their need for conservation. In: Grünig A.[ed.] Mires and Man. Mire conservation in a densely populated country - the Swiss experience. Swiss Federal Institute for Forest, Snow and Landscape Research, Birmensdorf.

Hanemann W.M. (1994). Valuing the environment through contingent valuation. Journal of Economic Perspectives 8: 19 - 43.

Herzog F. (1998). Streuobst: a traditional agroforestry system as a model for agroforestry development in temperate Europe. Agroforestry Systems 42; 61 – 80.

Herzog F., Oetmann A. (2001). Communities of interest and agro-ecosystem restoration: Streuobst in Europe. In: Flora C. [ed.] Interactions between agro-ecosystems and rural human community. CRC Press (in press).

Herzog F., Günter M., Hofer G, Jeanneret P., Pfiffner L., Schläpfer F. , Schüpbach B., Walter T. (2001) Restoring agro-biodiversity in Switzerland. Third International Conference on Ecosystems and Sustianble Development, 6-8 June 2001, Alicante, Spain (Proceedings, in press).

Hofer E. (1998). Direktzahlungen und die aktuellen Spannungsfelder heute. Agrarwirtschaft und Agrarsoziologie 2/98: 23 – 41.

IUCN (1994). IUCN Red List Categories. IUCN, Gland.

Jäggin B. (1999). Der monetäre Wert der Artenvielfalt im Jura. Dissertation Universität Zürich.

Jedicke E. [ed.] (1997). Die Roten Listen. Gefährdete Pflanzen, Tiere, Pflanzengesellschaften und Biotoptypen in Bund und Ländern. Ulmer, Stuttgart.

Jenny M. (1990). Territorialität und Brutbiologie der Feldlerche *Alauda arvensis* in einer intensiv genutzten Agrarlandschaft. J. Ornithol. 131: 241 – 265.

Jurt L. (1998). Ich darf nicht mehr schön finden, was mir gefällt. Ästhetische Vorstellungen von Bauern und deren Bedeutung für die Biodiversität. Agrarwirtschaft und Agrarsoziologie 2/98, 125 - 137.

Landolt E. [ed.] (1991). Rote Liste der gefährdeten Farn- und Blütenpflanzen in der Schweiz, Bundesamt für Umwelt, Wald und Landschaft, Bern.

Lehmann B., Häfliger M., Keusch A., Thomi H.P., Wolf H.P. (1995). Projektgruppe Stickstoffhaushalt Schweiz: Anpassung landwirtschaftlicher Betriebe zwecks Abbau der N-Emissionen. Technischer Bericht, Institut für Agrarwirtschaft der ETH Zürich, Zürich.

Mader H.J. (1982). Die Tierwelt der Obstwiesen und intensiv bewirtschafteten Obstplantagen im quantitativen Vergleich. Natur und Landschaft 57 (11); 371 – 377.

Meier R., Meier H. (1989). Ökologisierung der Landwirtschaft. Semesterarbeit. Institut für Agrarwirtschaft, ETH Zürich.

Minsch J. (1998). Direktzahlungen aus Sicht der ökonomischen Nachhaltigkeitsforschung. Agrarwirtschaft und Agrarsoziologie 2/98: 65 - 88.

Mitchell R. C. and Carson R. T. (1989). Using surveys to value public goods: the contingent valuation method. Resources for the Future, Washington D.C. John Hopkins University Press, Baltimore.

Montgomery C. A., Pollak R. A., Freemark K. (1999). Pricing biodiversity. Journal of Environmental Economics and Management 38: 1 – 19.

Müller W. (1988). Die Obstgärten und ihre Vogelwelt im Kanton Zürich 1977-1987. Unveröffentlichter Bericht. Zürcher Vogelschutz, Zürich.

Müller W. (1992). Natur in Wiese und Acker, Schweizerischer Vogelschutz, Zürich.

OECD (1996). Saving Biological Diversity. Economic Incentives. OECD, Paris.

OECD (1998). The environmental effects of reforming agricultural policies. OECD, Paris.

OECD (1999). Environmental indicators for agriculture. Volume 2. Issues and Design. The York Workshop. OECD, Paris.

OECD (2000a). The classification of policy measures addressing environmental quality in agriculture. In: Agricultural Policies in OECD Countries: Monitoring and Evaluation 2000. OECD, Paris.

OECD (2000b). The classification of policy measures addressing environmental quality in agriculture. COM/AGR/ENV/EPOC(2000)51/REV1. OECD, Paris.

Ostrom E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press, New York.

Perman R., Yue M., Mc Gilvray J. (1996). Natural resource and environmental economics. Longman, London.

Pommerehne, W.W. (1978) Institutional approaches to public expenditure. Evidence from Swiss municipalities. *Journal of Public Economics* 9: 255 - 280.

Pommerehne, W.W. (1987). Präferenzen für öffentliche Güter. Ansätze zu ihrer Erfassung. J.C.B. Mohr, Tübingen.

Pruckner, G. (1995). Agricultural landscape conservation in Austria: an application of the CVM. European Review of Agricultural Economics 22, 173 – 190.

Rieder P., Anwander Phan-huy S., Flury, C. (1999). Handlungsspielräume zur Beeinflussung der Beschäftigung im ländlichen Raum. Agrarwirtschaft und Agrarsoziologie 2/99: 117 – 150.

Ritzmann-Blickenstorfer H. [ed.] (1996). Historische Statistik der Schweiz. Cronos.

Roschewitz A. (1999). Der monetäre Wert der Kulturlandschaft. Eine Contingent Valuation Studie. Wissenschaftsverlag Vauk Kiel kg, Kiel.

Roux M. (1990). Vom Inventar zum Biotopschutz – Modellfall Zell. Naturschutz in der Gemeinde. Dokumentation des Zürcher Naturschutzbundes, Zürich.

SAEFL and FOA (2000) Swiss agriculture on its way to sustainability. Swiss Agency for the Environment, Forests and Landscape/Swiss Federal Office of Agriculture, Bern.

SBN (1987). Tagfalter und ihre Lebensräume. Schweizerischer Bund für Naturschutz, Basel.

SBV (1996). Eidg. Betriebs- und Landwirtschaftszählungen. Schweizerischer Bauernverband, Brugg.

SBV (1998). Landwirtschaftliche Bevölkerung. Schweizerischer Bauernverband, Brugg.

Schläpfer F. and Schmid B. (1999). Ecosystem effects of biodiversity: a classification of hypotheses and exploration of empirical results. *Ecological Applications* 9: 893 – 912.

Schmid H., Luder R., Naef-Daenzer B., Graf R., Zbinden N. (1998). Schweizerischer Brutvogelatlas. Verbreitung der Brutvögel in der Schweiz und im Fürstentum Liechtenstein 1993-1996. Schweizerische Vogelwarte Sempach.

Spiess E. (1999). Nährstoffbilanz der schweizerischen Landwirtschaft für die Jahre 1975 bis 1995. Zürich-Reckenholz, Schriftenreihe der FAL 28.

Svedsäter H. (1998). Contingent valuation of global environmental resources: tests of perfect and regular embedding. Paper presented at the EAERE Conference, Oslo 1999.

Thomet P., Schmid W., Roux M. (1990). Erhaltung von artenreichen Wiesen, eine neue Aufgabe für die Landwirtschaft. Landwirtschaft Schweiz 3; 605 – 609.

Thomet P., Thomet-Thoutberger E. (1990). Vorschläge zur ökologischen Gestaltung und Nutzung der Agrarlandschaft. Themenbericht "Natur-Landschaft-Landwirtschaft" des nationalen Forschungsprogrammes "Nutzung des Bodens in der Schweiz. Liebefeld-Bern

Tullock G. (1967). Towards a mathematics of politics. Ann Arbor 1967.

Urmi E. [ed.] (1994) Rote Liste. Die gefährdeten und seltenen Moose der Schweiz, Bundesamt für Umwelt, Wald und Landschaft, Bern.

Vatn A. and Bromley, D.W. (1997). Externalities - a market model failure. Environmental and Resource Economics 9: 135 – 151.

Weibel U. (1998). Habitat use of foraging skylarks (*Alauda arvensis L.*) in an arable landscape with wild flower strips. Bulletin of the Geobotanical Institute ETH, 64: 37 – 45.

Zbinden N. (1989) Die Entwicklung der Vogelwelt in der Schweiz, Schweizerische Vogelwarte, Sempach.

Zwygart D. (1989) Obstgärten. In: Imbeck-Löffler P. [ed.] Natur aktuell: Lagebericht zur Situation der Natur im Kanton Basel-Landschaft im Jahr 1988 - Grundlagen für ein Natur- und Landschaftsschutzkonzept. Verlag des Kantons Basel-Landschaft, Liestal.