Case Study on the applied evaluation of biodiversity

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Biodiversity, Landscapes and Ecosystem Services of Agriculture and Forestry in the Austrian Alpine Region –

An Approach to Economic (E)Valuation

This paper is submitted by the

Federal Ministry of Agriculture,
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The present paper on the applied (e)valuation of biodiversity is submitted to the OECD Working Group on the Economic Aspects of Biodiversity by the Austrian Ministry of Agriculture, Forestry, Environment and Water Management.

The study relates to the evaluation and valuation methods used to identify the economic values of biodiversity as a part of cultivated landscapes and as a main resource for Alpine tourism. It includes values defining Alpine landscape and forestry functions providing protection of water resources and against natural hazards. The authors of the case study are Josef Hoppichler, Federal Institute of Less-Favoured and Mountainous Areas, Vienna, as well as Astrid Blab, Bettina Götz, Horst Nowak, Irene Oberleitner, Monika Paar, Bernhard Schwarzl, and Gerhard Zethner, Federal Environment Agency Ltd, Vienna.

The views expressed in this case study are those of the authors and do not necessarily reflect those of the Federal Ministry of Agriculture, Forestry, Environment and Water Management.

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1 GENERAL DESCRIPTION

1.1 Description of the ecosystem

1.1.1 Natural area

The Alps are a mountain range covering an area of approx. 200,000 km^2 (BRENDEL 1998). The Alpine arc has a length of 1,200 km and stretches from Monaco across France, Switzerland, Italy, and Germany to the eastern parts of Austria including even Vienna. France's Mont Blanc (4,807 m) is the highest peak in the Alps. Major rivers in the Alpine area include the Durrance, the Iseré, the Rhone, the Rhine, the Inn, the Adige, and the Salzach. The biggest lakes at the rim of the Alps are among others Lake Geneva, Lake Constance and Lake Garda.

Austria's Alpine area, determined according to the definition provided in the Alpine Convention, comprises approx. 54,569 km², representing 65 % of the total Federal territory. Mountain areas, as defined by EU Regulation No. 75/268, cover 58,571 km², as they also include the mountain areas found in the Wald - and Mühlviertel regions. In addition, there are slight differences regarding the hilly rim zones of the Alpine area as well as the Klagenfurt Basin and its surroundings, which are not taken account of in the definition of mountain areas.

In Austria, the Alpine area is characterised by pronounced zoning into Northern, Central and Southern Alps. The Northern Alps show both low and high mountain reliefs with limestones and dolomites being predominant. There is a distinction between the flysch or sandstone Pre-Alps forming the Alpine rim, the adjacent southern limestone Pre-Alps and the High Limestone Alps (FINK 1993). The Northern Alps are considered Austria's weather divide. Heavy precipitation occurs quite frequently, especially during the summer, due to the barrier effect. The northern line of longitudinal valleys, a low line dominating the landscape, separates the Northern Limestone Alps from the chains of the Central Alps with their predominantly crystalline rock.

With over 2,500 mm per year, the Central Alps also receive large quantities of precipitation except for protected inner Alpine valleys and basins, like the inner Ötztal and the upper Inn River valley which only see precipitation of up to 700 mm a year (FINK, 1993).

The southern line of longitudinal valleys separates the crystalline Central Alps from the Southern Alps that are abundant in limestone. The inner Alpine basins such as the Klagenfurt basin are embedded in the lines of longitudinal valleys of the Southern Alps. As to their climate, the inner Alpine basins and the adjacent valleys are considered inversion areas featuring low temperatures during the winter and frequent layers of fog.

1.1.2 Historic development of land use

During prehistoric times, almost the entire Austrian Alpine area was covered by forests. As a naturally occurring form of vegetation, forests were only imposed ecological limitations like decreasing temperature with rising altitude (timber line) on the one hand and requirements regarding adequate soil conditions on the other. Basically, only high-altitude regions – the altitude of the timber line used to vary according to the climate –, water surfaces, moor areas, and areas that due to physical factors like the relief, etc. did not permit permanent soil formation were not covered by forests. Altogether, forests covered approx. 90 - 95 % of the area of Central Europe (FIRBAS, 1949, quoted in KRAL, 1994).

Man's interference with forests became visible only during the cultural development that took place when the natives of the Alpine area started to settle at the beginning of the forth century B. C. and forested areas were cleared to reclaim arable land. At that time (the distribution of) forest areas and – with the utilisation of forests (forest pastures) – also the composition of tree species was changed considerably for the first time.

The establishment of the first permanent settlements introduced crop farming to the Alpine area (MESSERLI 1989). At first, cultivated areas were found on the cleared areas surrounding the permanent settlements and were very small. Mountain pasture husbandry, allowing yields (butter, cheese) during the summer grazing period of around 100 days high enough to make it through the long winter months, however, formed the basis for survival in the Alps (BÄTZING, 1984). Permanent settlement areas were established close to the timber line, the highest settlements in the Central Alps being more than 2000 m above sea level (e.g. the Rofenhöfe in the Ötztal, 2010 m) (GRABHERR, 1997). Valley heads, where forests had already been cleared by avalanches, were also used as first permanent settlement areas.

Since the early Middle Ages, the settlement area in the Alps has grown considerably. Depending on the natural area, specific forms of land use developed. In Austria's Alps, where since the end of the Middle Ages livestock husbandry increasingly became the backbone of mountain farming and imparted mountain pasture husbandry a key role, fertile meadows close to the farms as well as intermediate pastures (so-called "Maiensässe") and distant alpine pastures and mountain meadows still constitute typical cultivation biotopes (FINK et al., 1989 in: GRABHERR, 1993). The latter are found on extremely steep slopes and are mown by hand for the production of winter hey. The intensification of settlement activities, however, has considerably altered the ecological balance of many Alpine regions. These changes led to

- the establishment of alpine pastures as cultivated zones through the extension of alpine meadows. Since the Middle Ages, clearing of forests in the sub-Alpine zone and of dwarf shrubs in the lower Alpine zone lowered the timber line by 200-400 meters, which was also to a great extent influenced by the prevailing climatic conditions (KRAL, 1994). These developments led to an enormous extension of the area covered by the original Alpine turf and mountain hey meadows and sub-Alpine pastures – "alpine pastures" – were established.

- a decrease of the forested zone caused by clearing. On shady areas forests were cleared to a small extent, while on sunny areas clearing took place on a large-scale basis; one forested strip was nearly always maintained to serve as a protection area between the alpine pasture and the valley. Diversity in terms of ecology and landscape in this zone was enhanced through mosaic felling of sub-Alpine forests hosting a low variety of species.

- the development of a cultivated zone close to the valley through clearing, and

- the draining of major valley bottoms. This process was the most difficult one and was started slowly in the Middle Ages only. The draining of the major Alpine valleys of the Inn, the Enns, etc. was achieved in the 19th and 20th centuries and was followed by the establishment of new settlements in these areas.

As far as lower mountain slopes and valley bottoms are concerned, forests were completely cleared on areas not at risk of being flooded or becoming marshy, which were then used for cultivation and are still structured by rows of trees, hedgerows and residual rock today. By today, human activities led to a reduction of the total share of forests to approx. 30 % (in the 18th/19th centuries it even declined to 20-25 %). At the same time the composition of tree species changed significantly, showing an enormous increase in the shares of spruce, but also of pine and larch, while the numbers of beech and other deciduous tree species as well as of fir declined (KRAL, 1994). The share of the shade species fir was above all reduced by grazing and clear-cutting, that of stone pine by clearing in the course of mountain pasture husbandry, while beech declined also because it was not suited for drifting, a form of logging of great importance over centuries. In the past 150 years, forest management measures like planting (artificial regeneration) caused spruce to spread far beyond the areas where it naturally occurred. Based on pollen analyses, larch was identified as the tree species showing the strongest relative increase in the inner Alpine area and spruce was found to have strengthened its natural dominance.

1.2 Services provided by ecosystems

1.2.1 Forest ecosystems and their functions in the Alpine area

The Convention on the Protection of the Alps (ALPENKONVENTION, 1999) is applicable to almost two thirds of Austria's Federal territory – this means that the greater part of the approximately 120 forest communities of our country can be classified as mountain forests; the only exceptions thereto are a few forest communities occurring exclusively in Eastern Austria (Pannonian forests), in the Mühlviertel and the Waldviertel (Herzynian forests), and in South-East Austria (Illyrian forests).

According to MAYER (1974) the forest communities of the Alpine area can be roughly classified as follows:

- high sub-alpine *larch-stone pine forests* (approx. 1,800 – 2,200 m above sea level);
- *sub-alpine* (1,300 – 2,000 m above sea level) and *montane* (600 – 1,500 m above sea) spruce forests;
- *spruce-fir forests* of the montane zone (optimum between 800 and 1,300 m above sea level);
- *spruce-fir-beech forests* - occurring on the external rim of the Alps and in the Pre-Alps and closely linked to the
- *beech forests* (altitudes of 400 to 700 m above sea);
- *oak-common hornbeam forests* (colline to planar levels);
- *riparian forest communities, pine forest communities* and various *mixedwood forest communities* (special communities on specific sites).

As a result of their altitude and agricultural use, the Central Alps are today rather poor in forests (only 15 % - 30 % of their area are covered by forests) while the Limestone Alps, which are lower and, because of their steep, rocky ground, were only in few cases fit for alpine grazing or other agricultural uses, show high forest densities (MAYER, 1986). Thanks to the re-afforestation of only marginally profitable agricultural areas and/or the "overgrowing" of alpine meadows the share of forest areas is presently rising again in the entire country. At the regional level, however, the land consumption of touristic institutions (e.g. skiing areas) reduces number and size of forests and compromises their important protective effects.

In a comprehensive research project GRABHERR et al. (1998) examined the degree of naturalness of Austria's forest ecosystems. According to their studies almost 30 % of the Alpine forest areas are natural or near-natural, a percentage higher than the all-Austrian rate (approx. 25 %).

The forest ecosystems of the Alpine area have to fulfil several very important functions:

Apart from representing a significant economic factor (see Chapter 2), one of their key functions is the protection against natural hazards: Intact mountain forests protect against avalanches, mudflows, landslides, and erosion, thus making the Alpine area habitable and passable in its present form. The scope of the present paper does not allow a detailed discussion of the general forest effects such as their positive impact on (micro)climate, water management, the provision of habitats for numerous animal and plant species, their important recreational effect (tourism), air pollution control, and landscape scenery. Nevertheless it should be mentioned that forest ecosystems, and particularly mountain forest ecosystems, are able to fulfil all these functions thanks to their – compared to other forms of land use – relatively high degree of naturalness.

1.2.2 The ecosystems of meadows and pastures and their functions in the Alpine area

Mountain farming fulfils many more functions than just food production (multi-functionality) and therefore represents an integral part of the sustainable development of rural areas. It is

characterised by close connections between the environment and the economic and social activities of its inhabitants.

The goals and functions of mountain farming are listed in HOVORKA (1998):

- Food production
- Design, maintenance and tending of cultivated and recreational landscapes (main touristic resources)
- Conservation of the natural essentials – soil, water, biodiversity (also for the people not living in the Alps)
- Continued settlement as well as the continuation of social and other economic activities of peripheral rural areas
- Development of ecologically friendly forms of management
- Giving a new impetus to economic activities at the regional level
- Protection against natural hazards – continuation of traditional flood and avalanche control measures

The typically small structure of Alpine sites as well as various agricultural use and tending measures (fertilisation or nutrient deprivation) allow the occurrence of numerous most different plants (DIETL, 1995). Many of the ecologically valuable, species-rich mountain areas developed only as a result of agricultural activities: While mountain meadows support approximately 30 - 60 and fertile alpine meadows approximately 30 – 50 species, "only" 20 – 45 species occur on poor wet meadows and traditionally managed fertile meadows and the modern "intensive grassland", whether ploughed up or not, rarely supports more than 10 different species (GRABHERR & REITER, 1995).

Another function of mountain farming is the reinforcement of the grassland sod and soil by means of pasturing (GINDL, 1995). Livestock density as well as the duration, beginning and end of the grazing are decisive factors in the establishment of a dense and species-rich vegetation cover. Understocking, for instance, causes an oversupply of food. Consequently, cattle and sheep systematically eat only the best forage plants so that, with time, only the most robust species survive; this leads to a loss of species diversity and a heavy decrease in the forage value of the pastures. Overgrazing, on the other hand, destroys the vegetation in the case of sheep husbandry; too high numbers of cattle mostly lead to blighted soil caused by trampling damage. From the ecological point of view also grazing by different animal species plays a significant role because different species favour or refuse different sorts of food. For instance, temporal rotation of goat – sheep – cow – horse grazing was practised in the Mölltal (Möll Valley) of Carinthia and proved to have a very positive effect on the ecological stability of the Alpine pasture vegetation (BÄTZING, 1991).

Both the termination of the agricultural use of mountain areas and over-exploitation can affect the natural equilibrium over the long term. At present, the impact of either of the two is obvious: While for example favoured valleys and flat uplands are in most cases managed too intensively, more and more farmers give up their activities on less-favoured sites such as steep slopes, peripheral and high-altitude areas (DAX & WIESINGER, 1999). The maintenance of meadows and pastures depends to a great extent on the maintenance of dairy cattle farming in the Alpine region; the latter is severely endangered by the increasing efficiency of dairy farming: As such improved efficiency requires a higher percentage of concentrates in the feed ration of cows, the share of their basal feed, and thus the significance of grassland management, decreases.

In valleys and basins where grassland is in many cases used very intensely (e.g. intensive meadows, temporary grassland, intensive pastures), river damming and draining are the reasons why only rather small parts of the formerly wide-spread moor-grass meadows, lowland moors and managed meadows have been left (BMLF, Federal Ministry of Agriculture and Forestry, 1998).

1.2.3 Valuation of the Alpine landscapes from the point of view of their naturalness and their importance regarding the maintenance of biodiversity – a non-monetary valuation approach

Apart from the habitats of the Alpine rock and ice regions and the natural Alpine pioneer formations which are too steep to be used for grazing, the landscapes of the Alpine area are characterised by man's economic activities. From the all-European point of view, however, the Alpine area holds a dominant position ecologically, in particular as regards closeness to nature and the maintenance of biodiversity. Hemerobia is a measure of man's influence on ecosystems (the reciprocal of the natural state).

Hemerobia and the need to maintain the biodiversity of cultivated landscapes

The results of a study carried out by the Austrian Federal Environment Agency (WRBKA et al., 2000) reveal a clear hemerobic gradient between the cultivated Alpine landscapes of Western Austria and the forelands and basins of the eastern part of the country.

- Most of the Alpine rock and ice regions were classified ahemerobic - that is, almost completely free from anthropogenic influence. Human interference is mostly observed locally and in isolated cases only, in the form of the touristic development of the Alpine mountain summits. Though of importance in the individual case, it is not relevant statistically.
- Oligo-hemerobic landscape parts, such as the pastures and pioneer formations of the alpine and sub-alpine zones, show only minor impacts of anthropogenic influence. They are characterised by at least temporary, in some areas also clearly visible impacts of extensive grazing.
- Mountain meadows are classified meso-hemerobic. Having been submitted to mild disturbances only, this landscape type was able to support very species-rich ecosystems which however have almost completely disappeared due to labour-intensive management. In the all-European context, the landscapes classified ahemerobic to oligo-hemerobic represent islands of naturalness; in Austria, they cover approximately 12 % of the entire Federal territory and in the western part of the Central Alps (Hohe Tauern, Stubaier Alpen and Ötztaler Alpen) they still exist in the form of large, compact areas.

Also the cultivated landscapes characterised or dominated by intensively used meadows and pastures are considered eu-hemerobic; they include small structures like hedges and field shrubs, but also small rough meadows and extensively managed pastures.

Cultivated landscapes severely influenced by man, such as the crop and forage growing areas of the hilly country or the cleared islands of the external rim of the Alps and the intensively managed cropping areas of the basins, are found mainly in the landscapes outside the Alps because, thanks to their lower intensity of relief, they allow a higher degree of agricultural intensification. Inner-Alpine landscapes with such a high management intensity occur only in the Klagenfurt Basin and in a few valley-bottom areas of the main Alpine rivers (River Inn, River Mur).

Apart from hemerobia, also the "number and size of near-natural landscape components in cultivated landscapes" is considered when evaluating landscapes with a view to their importance to biodiversity conservation. Landscape components playing an essential role with respect to biodiversity comprise the small-structured units of the more intensively used agricultural areas (hedges, edges of arable fields, rivulet shrubs, etc.) as well as large, compact areas with near-natural ecosystems, among them rarely used forest areas, lake bottoms and the alpine/sub-alpine ecosystems. This is another criterion indicating that, following the presence of large, non-dissected and near-natural ecosystems, biodiversity centres are still found in the Alps.

The "replaceability" of landscapes results from the combination of the criteria "age" or "persistence" and "lack of naturalness" or "hemerobia". Old, near-natural ecosystems are not replaceable because they are beyond man's time and planning horizon and cannot be

restored within short periods of time. As opposed to this, the replaceability of very young ecosystems lacking naturalness, among them industrial and settlement areas, ruderal sites and fallow land, is very high due to their dynamic development.

WRBKA et al. (2000) lately aggregated the criteria "replaceability" and "existence/richness of near-natural ecosystems" to one value which is meant to describe the importance of Austria's cultivated and natural landscapes to the maintenance of biodiversity. The outcome clearly indicates that, pursuant to the presence of almost undisturbed landscapes like the Alpine rock and ice regions and the adjacent zone of alpine lawns, alpine pastures and mountain pine shrubs, the landscapes most important in this respect are found in the Alpine area. Cultivated landscapes highly significant for the maintenance of biodiversity occur primarily within the external rim of the Alps but also on inner-Alpine slopes; they comprise grasslands still endowed with a large number of structural elements where not the entire area has been subject to the intensification of grassland utilisation yet. The forest-dominated benched slopes and hilly areas of the Alps are of medium importance to the maintenance of biodiversity because they are usually very strongly affected by human interference. Cultivated landscapes presently of minor importance to biodiversity conservation include forage growing landscapes such as the maize growing areas of the Klagenfurt Basin.

Consequently, the need to protect landscapes results from the "importance to biodiversity maintenance" and the "sensitivity" of the respective areas. It is highest in areas of rare, small-structured landscapes or in landscapes important to the maintenance of biodiversity.

The cultivated and natural landscapes with the highest need for protection include the Alpine summits slightly impaired by man as well as the extensively used alpine pastures. Most of the cultivated landscapes with high need for protection are located in the grassland-dominated mountain areas, that is the traditionally managed settlement areas of mountain farmers found in the inner-Alpine slope zone and in the slope zone of the external rim of the Alps. Taking account of the above-described factors, the intensively used grassland areas of valleys and the major part of the forested landscapes are characterised by a medium need for protection.

Hemerobia of forests

In a comprehensive research project GRABHERR et al. (1998) studied the hemerobia, respectively the naturalness, of Austria's forest ecosystems. Consideration of the individual investigation areas allowed a clear delimitation of Austria's Alpine area as well as statements on the "true" mountain forests. Accordingly, natural and near-natural forests have a share of approximately 30 % in the Alpine forest area, a percentage much higher than the respective all-Austrian rate (approx. 25 %).

The percentage of near-natural forests increases the closer we come to the west, to the Central Alps and the Inner Alps; it is higher also in the Carnic Alps and in the Karawanken. Apart from other factors, the degree of anthropogenic influence appears to be particularly closely linked to the accessibility of forests. This assumption is supported by the fact that the most seriously affected forest areas of Austria are the ones outside the Alpine zone (Pre-Alps, Waldviertel and Mühlviertel). Moreover, also the clearly positive correlation between the percentage share of natural and near-natural forests on the one hand and higher altitudes and slope gradients on the other seems to confirm the above assumption.

2 IDENTIFICATION OF CAUSES AND SOURCES OF PRESSURE

2.1 Sectoral activities and resulting pressure

2.1.1 Demographic development and settlement activity – Effect of economic and traffic-related factors

In Austria, Alpine areas host approx. 38 % of the total population. Between 1870 and 1990 the overall population of the Alps increased by approx. 60 %, in the Austrian part of the Alps, however, this figure even amounts to 96 %, which means that the number of inhabitants of the Austrian Alps almost doubled in the past 120 years.

In relation to the total area (cadastral area), the population density in the Alpine area would appear to be very low (58 inhabitants/km²). But if we put the number of inhabitants in relation to the permanent settlement area (not including waste land, waters, forests, and alpine pastures), which equals a reduction of the area to open valley and slope areas, the Alps show a population density of 261 persons/km² and thus exceed the Austrian average (240 persons/km²). In the Tyrol and Vorarlberg, Austria's western Federal Provinces, the population density even amounts to 340 and 482 persons/km² respectively. They thus figure among the most densely populated regions in Europe.

This high degree of utilisation of permanent settlement areas in Western Austria becomes even more apparent when differentiating by the communities' altitude and adding the number of tourists of the month showing the highest figure of overnight stays to the regular resident population (indicator: maximum population density in permanent settlement areas). It can be seen that with 450 persons per km², communities situated over 1,000 meters above sea level – at least in the winter peak season – almost reach the figures of communities situated in valleys (580 persons/km²) and that in this community category the population density is more than doubled by tourism (SCHINDEGGER et al., 1997).

The strong rise in the population of Alpine areas was followed by vigorous construction activity and is connected with strengthened economic dynamism. For the period from 1971 to 1991 the increase in built-up net building area in Austria's total Alpine area is estimated at 35 %, while it was only 26 % in non-Alpine areas (SCHINDEGGER et al., 1997). Although with a net building area consumption per habitant and workplace of approx. 170 m² due to the relative scarcity, figures for the western Federal Provinces (Vorarlberg, the Tyrol, Salzburg, Carinthia) are rather below average, the share of identified permanent settlement areas already amounts to 7.9 % (see ÖROK 1996).

In addition, we need to consider the public traffic areas providing access to local and regional infrastructure and important for supra-regional traffic. Alpine areas prone to extremely heavy traffic – the Inn valley, the Arlberg region, the Brenner, the Klagenfurt basin – host traffic areas with densities, related to the permanent settlement area, equalling those of big urban economic centres outside the Alps (see BITTERMANN, 1990a). In the Alpine western Federal Provinces, another 6.6 % of the permanent settlement area are identified as traffic areas.

According to SCHINDEGGER et al. (1997), settlement dynamics is characterised by the following aspects:

- Strongly growing urbanisation in the Austrian Alps.
- Strong demographic and economic dynamics clash with a poor settlement area potential in particular in the Alpine area of Western Austria.
- Pressure on land use is strongest in the valleys. Building and traffic areas in communities below an altitude of 700 m already cover 18 % of the permanent settlement area.

- The greater demographic dynamics in higher altitudes (over 1,000 m above sea level) is reflected by enormous increases in the number of households and flats.
- Land consumption in the western Alpine area is already reaching its limits.
    - Due to unplanned settlement in the open country, it has already become difficult for new enterprises to settle.
    - Housing supply is scarce and prices have gone up extremely.
    - If the trend towards land-intensive tourism continues in particular in higher Alpine areas, countermeasures have to be taken to ensure comprehensive landscape and environment conservation.

These issues alone entail a considerable potential for land use conflicts involving agriculture, trade, the tourist service sector as well as nature conservation requirements.

2.1.2 Agriculture

Agricultural structure

According to the results of the 1997 Farm Structure Survey, the total number of agricultural and forestry holdings managed in Austria amounts to 252,110 (or 243,647 farms managed by natural persons). 36 % of these holdings are located in mountain areas characterised by natural handicaps influencing yield, by difficult climatic conditions, poor soil quality, steep slopes, and, in some cases, by poor traffic connection. 49 % of all holdings and 57 % of the total utilised agricultural area [UAA] are found in designated mountain areas (specified in EU Directive No. 950/97); as a result, Austria has one of the highest proportions of mountain areas in the EU (DAX, 1998).

Mountain farmers manage 44 % of the agricultural area and over 50 % of forests. Farm activities focus on grassland utilisation and cattle husbandry: 66 % of the cows, 62 % of the cattle, 50 % of the horses, 68 % of the sheep, but only 9 % of Austria's pig population are reared on mountain farms.

Mountain farms rearing cows on average hold only 8 cows, the percentage of mountain holdings with more than 30 cows is as low as 0.7 % (ÖSTAT, 1997). While overall cattle husbandry is on the decline in Austria, it is relatively stable in Alpine areas, as these mostly lack other possibilities of agricultural utilisation. A slight shift from dairy cattle husbandry to sheep husbandry can be observed in certain Alpine areas. In Alpine regions, the standardised grassland area per animal amounts to between 2 and 4 hectares (WAGNER, 1999).

Most mountain farms are mixed forage growing farms managing a small share of forest area. As many as 60 % of the mountain farms are managed on a part-time basis – showing a tendency to rise –, many of them hold shares in common alpine pastures. The percentage of farm heads aged over 65 is slightly higher in Alpine areas than in the other Austrian regions (WAGNER, 1999). The average holding size of mountain farms is only 13 ha agricultural area (of which 10 ha grassland) and 10 ha forest (HOVORKA, 1999).

The structural change taking place in mountain farming (shift from full-time to part-time farms, from dairy cattle husbandry to suckler cow husbandry) also leads to changes in mountain pasture husbandry: e. g. alpine pastures for young cattle instead of pastures for dairy cattle, role of dairy processing, alpine pasture management by the holding of origin (POSCHACHER, 1998).

Changes in land use

During the last decades, Austria also witnessed regional specialisation characterised by substantial changes in land use simultaneously with structural changes, intensification and business specialisation in agriculture (see Table 1). For example, the decline in arable land and in the total utilised agricultural area (minus 15 % since 1960) affected above all Alpine and mountain areas; in agriculturally favoured areas, a less pronounced change was

recorded (e.g. Lower Austria, Federal Province with key agricultural activity: minus 6 % and minus 11 % respectively).

Table 1: **Changes in land use, bread grain yields and agricultural holdings in Austria 1960 - 1995**

	Lower Austria (example of an agriculturally favoured region)	Carinthia, Salzburg, the Tyrol, Vorarlberg (examples of mountain areas)	Austria as a whole
Arable land	- 6%	-48%	-15%
Grassland (meadows, pastures)	-24%	-13%	-21%
Utilised agricultural area [UAA]	-11%	-17%	-15%
Utilised forest area	-2%	+6%	+5%
Yield of bread grain t/ha	+98%	+115%	+106%
Agricultural holdings	-46%	-26%	-35%

Source: ÖSTZ 1961, ÖSTAT 1995

At the same time, above average proportions of grassland have concentrated in mountain areas - in spite of a considerable 21 % reduction in Austria as a whole. Currently some 82.5 % of Austrian grassland is found in mountainous regions (DAX 1998). On the one hand, the general decrease in utilised agricultural area has led to an expansion of forest land (plus 5 %); on the other hand, it reflects the enormous demand for land for residential and commercial activities that developed over recent decades (cf. ÖROK 1996).

Endangerment of plant genetic resources

None of the “major” arable crops has its origin in the Alps. The Alpine area is described as secondary gene centre, which means that plants introduced from external sources have developed independent new combinations under the extreme conditions prevailing on the site as well as under human influence. The most frequently used example is the great number of different land varieties of cereals found in the Alpine area. Cultural crops in the Alpine area need to be adapted to short growing seasons under intensive insolation and to tolerate heavy, long-lasting frost and snow cover and/or late and autumnal frost. In mountain areas, adapted management methods are even more important than in valleys. Generally speaking, the numerous different human cultures inhabiting the Alpine area and maintaining close contacts with their neighbouring regions for centuries certainly contributed to the development of highly diverse arable crops (PRO SPECIE RARA, 1995).

Due to their lacking competitiveness with specially selected varieties in terms of traditional characteristics, *in situ* cultivation and thus conservation of regional and local arable crop varieties is mostly only done on a small-scale basis in holdings with specific management methods (BMLF, 1996). ÖPUL (the Austrian agri-environmental programme) encourages the cultivation of rare arable crops; for winter wheat (Triticum aestivum) and winter rye (Secale cereale) the list of varieties comprises eight local varieties each. The number of local varieties certainly was much higher in the past as the replacement process in the field of agricultural plant production led to a rapid restriction of the number of local varieties (PRO SPECIE RARA, 1995).

In order to prevent genetic loss of agricultural breeding and variety material, genetic material (recent and older breeding varieties, local varieties, breeding strains) of the agricultural crop species existing in Austria is included *ex situ* in a comprehensive network of public gene banks covering the entire territory (BMLF, 1996).

In the course of a study on the current situation of farm kitchen gardens in the East Tyrol, data on the species and varieties used in such kitchen gardens were collected. A total

number of 587 cultural crop species and 132 weed species were identified on 196 holdings. The study thus emphasised the importance of "kitchen gardens" of family farms in Alpine areas to the conservation of the cultivated landscape as well as to the protection of old varieties. The structural change in agriculture might also threaten the continuation of kitchen-garden management. The future of kitchen gardens, traditional management methods, traditional species, and old varieties is closely related to the continuation of family-farm agriculture and the successors' willingness to take over their parents' holdings (VOGL-LUKASSER, 1999).

In the Alpine area, regional varieties and forms of mature scattered fruit-trees represent an important gene pool, as is also demonstrated by current varietal surveys (NOWAK & SCHRAMAYR, 2000). Moreover, old fruit-trees provide documentation of the breeding history and of native species that used to exist in former times. Old fruit varieties like the Stanzer plum have adapted their quantity and diversity to the local ecological conditions but still have a certain value in terms of self-sufficiency and on the market. They cannot be replaced by newly bred varieties that are not adapted to the ecological conditions of the biotope. The biodiversity of fruits in the form of old varieties would be irretrievably lost in the case of large-scale clearing, e.g. due to a potential outbreak of fire blight. A destruction of the fruit species would represent an irreparable loss to the biodiversity of the Alpine area and an impoverishment of the landscape attributes.

Endangerment of animal genetic resources

As the Alpine area is characterised by a highly diverse landscape structure and in some respect by less favourable production conditions, it led to the development of a great diversity of breeds and varieties of production animals that can be described as extremely modest and robust and that have adapted to high altitudes, intense insolation and short growing seasons. If we take cattle for instance, the remoteness of numerous valleys allowed a huge diversity of old robust breeds to develop that also thrive on poor-quality forage and are better adapted to steep slopes and rough climate than modern high-yield breeds (PRO SPECIE RARA, 1995).

Reasons for preserving these old indigenous breeds are among others (WÜRZNER, 1996):

- the conservation of genetic diversity (also for performance characteristics such as milk with a high protein and fat content or premium quality beef);
- positive characteristics that contribute to the diversity of species and landscape management in mountain areas like:
  - resistance to low temperatures and dampness,
  - sure-footedness on uneven ground,
  - ability to feed on roughage,
  - ease of calving,
  - fecundity as well as
- the conservation of a living cultural heritage.

Since 1986 the Federal Ministry of Agriculture and Forestry has provided funding to farmers holding cows that belong to endangered breeds, and since 1995 breeds threatened with extinction have been subsidised in line with EU Regulation No. 2078/92 within the framework of ÖPUL (the Austrian agri-environmental programme). In addition to the focus on *in situ* conservation, a gene database is being developed at the Institute of organic farming and biodiversity of the Upper Austrian town of Wels in order to be able to cover also the field of *ex situ* conservation of genetic resources in the future (BMLF, 2000).

With about 3,800 herd book cows, the populations of the "Original Pinzgauer" and "Tiroler Grauvieh" cattle breeds are stable at present, owing to the aid payments granted under the ÖPUL scheme. All other breeds of cattle (Waldviertler Blondvieh, Kärntner Blondvieh, Tuxer,

Murbodner, Jochberger Hummeln, Original Braunvieh, Ennstaler Bergschecken, Ungarisches Steppenrind, and Pustertaler Sprintzen) still have to be classified as highly threatened despite steadily rising populations (BMLF, 2000). Also all autochthonous sheep and goat breeds – with only a few exceptions (Tiroler Steinschaf, Sannenziege) – are to be classified as highly endangered (BMLF, 2000).

Aid payments granted within the framework of the ÖPUL programme contribute to the conservation of local breeds with a low economic performance and of small holdings located in mountain areas as well as to the tending of alpine pastures and slopes. At the same time, however, economic pressure on the other cattle breeds is aggravated tremendously and the required dairy performances by far exceed the quantities that can be achieved by grazing on grassland and can only be attained through an enormous use of feed concentrate (GALLER, 1999). It appears that this feed concentrate is inexpensive because the price does not cover the environmental expenses incurring from its use.

2.1.3 Forestry and hunting

In the Alpine area, forests have constituted an important economic factor for centuries. They provide a secure source of income and living to many people, be it directly (forest management) or indirectly (timber management: e.g. sawing and wood processing industries). With ATS 13.52 billion, forestry contributes approx. 0.3 % to Austria's gross domestic product, a figure which has been on a steady decrease for years (STATISTIK ÖSTERREICH, 2000). The number of persons directly active in forestry or in related administrative establishments (forest workers, employees and civil servants) has also fallen continuously and amounted to around 9,000 in 1996 (BMLF, 1998).

Just like in all other economic sectors, high labour costs have a negative effect on yields, the resulting pressure for streamlining often leads to machinery-intensive management methods that may have negative ecological consequences.

The intensity of forest management in the Alpine area used to be and still is strongly determined by orographic features like slope gradient and remoteness. The opening up of forests by means of forest roads and the possibility to use fully or partly mechanised forest machinery on steep grounds (mountain harvesters) directly affect the ecological structure of forests and their closeness to nature (see sections **Error! Reference source not found.** and 1.2.3). Once a forest area has been opened up for forest management, the type of silvicultural measures taken, however, influences the degree of human influence and the intensity of ecological impacts *inter alia* on biodiversity:

- selection of management method (coppice stands – uneven-aged forest),
- natural regeneration – artificial regeneration,
- selection of tree species (regeneration/pre-commercial thinning/thinning),
- type of thinning (selective thinning, high thinning, low thinning),
- timber harvesting technologies (skyline crane, harvester, etc.).

2.1.4 Tourism and agriculture

Austria in general and the Alpine region in particular are amongst the most intensively used tourist regions in Europe. The mountainous landscape offers the climatic and ecological conditions required for bi-seasonal tourism, summer tourism being more related to the quality of residential areas and cultivated landscape than winter tourism. Around 85 % of the value added of the tourism sector are contributed by the Alpine area, tourism density being low in the east and usually high in the western parts of Austria starting from the Salzkammergut, the Styrian Enns valley and the Carinthian lake district (BERNT, 1998).

The interdependence and mutual usufruct existing between the two economic sectors of agriculture and tourism are considerably high. Without the input provided by agriculture, Austria's tourist industry would not be in the position to offer its major asset, a well-tended cultivated landscape, in a competitive way. Without the value added created by tourism,

agriculture, in particular in numerous mountain farming areas, on the other hand, would presumably be exposed to an even substantially higher economic pressure and consequently to a higher rural exodus as is already the case (REST, 1994). With its unique high-quality products, agriculture in turn contributes to the image of regions, which play a key role in tourist marketing (BAUMGARTNER, 2000).

2.1.5 General environmental pollution and direct utilisation of biodiversity

Within the framework of this study, it will not be possible to discuss the general effect of pollution on biological diversity in greater depth because the analysis relates to the entire Federal territory and the presentation of these problems would be too broad and complex. However, in this context, reference should be made to the comprehensive literature provided by the Austrian Federal Ministry of the Environment (BMUJF, 1988; UBA, 1996a) and to the analyses presented in the National Environmental Plan (BMU, 1995).

2.2 Identification of causes and sources of pressure

2.2.1 Missing markets and non existing property rights

If one considers the socio-economic background of the technological effects of modern farming methods, one is necessarily confronted with the failure of the information system operating between environmental requirements and the markets for agricultural products and the associated production systems.

Rather like air and water, biodiversity exhibits the typical characteristics of common property; similarly, biodiversity represents a fundamental condition for human life on earth.

If biodiversity is defined as common property, certain difficulties arise by comparison with classic notions of property. Biodiversity, as the name indicates, is extremely diverse and varied. Its actual scope has only been researched in limited areas; the active mechanisms and consequences of its loss are only understood in a rudimentary way. It is unclear also whether biodiversity should be defined at the level of genetic variation or more recently, on the basis of genetic engineering and its uses, even at the level of genes, or whether the diversity of species and ecosystems - i.e. the synergistic, combined effect of organisms - should also be included. Another characteristic of biodiversity is that - with the exception of the few useful organisms - it reproduces itself with or without human intervention and moves dynamically and interactively with the changing environmental conditions through time and space.

Viewed as economic property, therefore, biodiversity, unless linked with land and soil-related property rights, is extremely difficult to classify or to allocate to economic factors. Property rights and the associated rights of use, markets and values cannot be determined for biodiversity if it is regarded as a whole with all its identifiable characteristics including the diversity of landscapes.

- “Copyright on nature”

An approach to react on the lack of property rights and of the resulting markets for biological diversity may be to define the copyright not only in relation to the reproduction (image, film) of biological diversity, ecosystems and landscapes, but also in relation to the natural original *per se*. In Austria, economists already started discussions on this issue. This means that every person who films live organisms (with the exception of human beings), biological diversity or landscapes with predominantly animated nature and who commercially uses or copies the photographic or film material – except for private and scientific purposes – is to pay a certain copyright fee, which is still to be determined, to an international fund (e.g. GEF). Funding provided under this international fund should be earmarked to be used for the protection and conservation of biological diversity. Other forms of differentiation regarding the allocation of the funds could also be proposed, i.e. splitting part of these public revenues by large and small regions.

Such a system would, however, have a tremendous impact on the photo, film and TV industries. Whether this “copyright on nature” – which would have to cover the use of live organisms as public symbols and trademarks – could also be used for the protection and conservation of biodiversity in Alpine and mountain areas, would depend on the international agreement to be reached and/or the selected system. Such a system, however, does not appear to be infeasible, further theoretical and practical deliberation in that respect would be worth undertaking. But it has also to be noted that the tourist industry has already earned a considerable amount of money by copying and graphically reproducing the biodiversity of Alpine and mountain areas for free, thereby conveying potential guests graphic information on what they are to expect.

- Effectiveness of property rights:

Another danger to biodiversity arises from the context of rights of ownership over land and soil, and from the effectiveness of such rights. In many cases observed so far, the danger to biodiversity in Austria is not attributable to the deficient depth of action of ownership rights; on the contrary, it is attributable to their far-reaching exploitation. The question of the depth of action of property rights is one of the key points in the general debate on sustainable development, especially with reference to the attempted economic solution under discussion.

- Too much or too little market?

One essential incentive towards business and regional specialisation as well as towards intensification results from the dynamics of agricultural markets. While the relatively high-price policies of the 1980s created a strong pressure in favour of the intensification of agricultural production, this type of policy did allow production to be maintained from an economic point of view even under relatively unfavourable natural yield conditions. By contrast, the severe decline in agricultural prices in the 1990s almost to the level of world market prices brought about a slight relaxation in intensity per unit area, but was accompanied by a parallel tendency towards operational and regional specialisation (tendency towards narrow crop rotations and even monocultures) combined with a tendency towards a threatened agricultural production in less-favoured areas. In other words, the dynamics of national and international agricultural markets as a whole - regardless of whether the aim is a high-price strategy based on market regulations or the freest possible market pricing - produces increased pressure to simplify, linearise and streamline agricultural techniques; it therefore also tends to work against the existing basic conditions for biodiversity.

Moreover, the unprecedented expansion of world agricultural markets in itself seems to have a negative impact on biodiversity as countries with a low level of economic activity (many developing countries) are introducing large-scale intensification and specialisation measures. (Precisely the same phenomena posed a threat and led to the loss of biodiversity in the northern industrialised countries.) At the same time, in countries with a high, general economic level, favourably priced agricultural products in the world market provide an incentive for building up specialist production in animal breeding which is largely independent of the soil, and concentrating on a limited range of profitable field crops. Intensification and specialisation have become global problems, while agriculture and the various associated cultivation conditions in regions with threshold yields (such as mountainous areas) are placed under continued pressure to achieve profitability. This raises the question of whether moving towards a dual agricultural structure in industrialised countries, i.e. localised, conservational agriculture encouraged by special subsidies in less-favoured areas and intensive and specialised agriculture in favoured locations - is not directly connected with a threat to biodiversity in developing countries, prompted by the growing dynamics of world agricultural markets.

This global and regional failure of the market has been discussed extensively at a theoretical level, especially with reference to the occurrence of positive and negative external factors. However, theoretical discussion has contributed little in practical terms to concrete market realities. Even the few practical attempts to combine nature conservation and tourism have

shown that these new markets also develop their own inherent dynamics with positive and negative external factors.

2.2.2 Information failure

The systematic collection of knowledge about biodiversity and the increasing awareness of its importance have been evident for around 30 years only. Initially, discussion was primarily limited to closed scientific circles. For a long time, the idea that the intensive use of a range of industrial inputs and certain agricultural techniques could lead to serious secondary changes in biological diversity was denied by both agricultural specialists and practitioners.

In addition, there has traditionally been little mutual understanding between agriculture and nature conservation at local, administrative or legal levels (DAX & WIESINGER, 1998). On the one hand, agriculture is largely excluded from nature conservation (with the exception of the construction of roads or paths, land combination or when valuable biotopes are involved); on the other hand, all the measures associated with the protection of nature and the landscape lead to relative restrictions on land use and narrow the scope for economic manoeuvre, - at least, this is how the situation is perceived by farmers.

This traditional conflict between conservation and agriculture has caused many farmers to adopt a negative attitude towards the requirements of conservation as a matter of principle; in the past, ignorance and misunderstanding often predominated even up to the level of administrative institutions. This misunderstanding was characterised by fundamentalist positions and a reluctance to make compromises both on the part of conservationists and agriculturalists.

As a result, farmers exhibited a low level of awareness of ecological matters and conservation services; this was largely attributable to inadequate communication between farming and conservation organisations and between the corresponding administrative bodies. An improvement in understanding did occur in as much as the tourist demand for varied cultivated landscapes was recognised as a secondary benefit or in as much as it was realised that consumers were prepared to pay more for products produced in an environmentally compatible manner (such as organic farm products). The introduction of environmental programmes, too, has led to the initiation of a positive dialogue between agriculture and nature conservation (see also section 5.3). After environmental issues had come to be regarded as major social problems in the late 1980s (i.e. highest priority ratings in opinion polls), the arguments in favour of environmental protection became an essential component of public political discussion and were no longer limited to agricultural policy.

2.3 Identification of adverse influences

2.3.1 Subsidies and market price support

Austrian agriculture in the 1970s, 1980s and even at the beginning of the 1990s was characterised by a high-price policy rather, which above all was associated with a strong tendency towards intensification. The origins of this policy were to be found in the agricultural strategies following World War II, when the primary objective was to resolve failing supplies of food and to achieve a relatively economical supply to the markets in spite of the fragmentary structure of agriculture. Alongside the goal of providing an income for farmers, the pricing policy was intended primarily to create competitiveness with the assistance of structural measures (cf. 1976 Agricultural Act).

Agricultural funding focused mainly on the improvement of agricultural business structures (opening up traffic access, regional funding) and subsidies for sales and utilisation measures, but, in particular, included also so-called productivity enhancements. During the period from 1960 to 1980 and even in the first half of the 1980s, considerable public funds were made available in the fields of land adjustment, land combination and productivity enhancements for plant cultivation and livestock breeding.

Although not all of the resources used in this manner can be classified as having a clearly negative effect on the diversity of the ecosystem, it is possible with hindsight to identify an error in controlling with regard to the protection of biodiversity as a whole. This effect was not slowed or halted until the 1980s. It is also evident that politics failed to respond until the increasing problems of surplus supply resulting from the high-price policy came into conflict with the concurrent subsidisation of productivity enhancement.

From 1978 onwards, the milk production of the individual farms was subjected to quotas; subsequently, upper limits for livestock per farm were specified within the framework of the Market Regulation (e.g. 400 fattening pigs) in order to apply a brake to the structural dynamics of regulated markets. In order to handle the growing problems of financing agricultural surpluses, and also to respond to the causes of increasing environmental problems, a re-orientation of agricultural funding was introduced from 1986 onwards. The focus of this agricultural counteraction included the subsidisation of alternative agricultural production methods, the taxation of fertilisers and high-yield maize seed, the support of extensive livestock production, green fertilising and setting aside of arable land, as well as the increased funding of organic farming (see Table 5 based on GROIER & LOIBL, 1997).

By comparison with other European countries, and especially the EU, Austria reacted very quickly to the problems of intensive agriculture. Even before 1990, within the framework of the anticipated results of the Uruguay round of the GATT talks, the funding system was re-orientated from product funding or productivity funding towards the funding of environmentally effective measures. Measures such as the strong promotion of organic farming, the limitation of numbers of livestock per farm and the taxation of fertilisers were indeed exemplary in their environmental impact and internationally unique. However, within the context of Austria's accession to the EU, the latter two of these measures had to be withdrawn for reasons of competitiveness, whereas continued subsidisation of organic farming was possible within the framework of EU Regulation No. 2078/92 and therefore within the context of the ÖPUL programme. Overall, it is clear that the high-price policy alone was not the cause for the loss of species and the threat to biodiversity, but that these tendencies are a general phenomenon within a modern agricultural system which is under competitive pressure.

Intensification, specialisation, dependence on chemical and, in future, biotechnological inputs, rationalisation, and dualism in the agricultural structure are characteristics of agriculture in industrialised countries which also prevail under conditions of free world trade. However, it is evident that with a generally low agricultural price level, the farmers' acceptance threshold for alternative forms of production will be lowered, especially in less-favoured locations. This means that subsidies for environmentally benign measures will be more effective and can be arranged to be more cost-effective.

It should also be noted that there is a certain amount of competition and indeed substitution among individual subsidies. For example, in arable areas, the market-regulating equalisation payments of the EU lower the acceptance of environmental subsidies or limit their relative priority, unless they are associated with set-aside restrictions or other production limitations (cf. BALDOCK & MITCHELL, 1995).

3 IMPACTS ON ECOSYSTEMS

3.1 Mountain farming

3.1.1 Changes in land use: Extensification and intensification

In the mountainous regions of the Central and Eastern Alps soil erosion, increased avalanche occurrence, land slips, over-exploited forests, the destruction of slope terraces, and especially the loss of various landscape elements and valuable habitats are frequently observed (DAX & WIESINGER, 1998).

The underlying causes of this development may be land abandonment, associated with population decline, as well as the more advanced age of farm managers so that steep slopes and high-altitude meadows are sometimes no longer mown or more labour-extensive land management systems are introduced in extremely mountainous regions (e.g. largely irreversible conversion of meadows into pastures within small regions or Alpine valleys). In view of the required protection against natural hazards such as avalanches and mudflows, the need to keep landscapes open through grazing, and the preservation of alpine plant ecosystems the management of these highly sensitive ecosystems by mountain farmers is of major importance not only to tourism but also to society as a whole (HOVORKA, 1998). Because of the natural yield conditions, however, land use is more and more intensified in areas accessible to mechanisation and suitable for fertiliser application (DAX & WIESINGER, 1998).

GRABHERR (1993) states that large areas of certain Alpine pastures are affected by excessive exploitation and over-fertilisation. In some places, the frequent use of manure and the grazing of too many and too heavy animals have greatly increased trampling damage and the frequency of landslides, they have led to the aggravated eutrophication of poor fens and to more heavy spring water and groundwater pollution (DIETL, 1995). Damage caused by trampling is partly a result of the increasing live weight of the cows: For the time before 1850 there is documentary evidence stating an average weight of Tyrolean and Styrian breeds (Alpine breeds) of about 297.5 kg. Taking all Austrian data available for the period between 1860 and 1880, the live weight of cows averaged 408 kg in Austria and between 1960 and 1980 it was already 550 kg, a weight gain meaning a 25 % higher soil stress (1.35 kg/cm^2 vs. 1.08 kg/cm^2) (ONDERSCHECKA & SCHLEGER, 1986).

In addition to the effects of non-agricultural factors the principal cause for the changes in land use appears to be the overall competitive pressure of regional and supra-regional agricultural markets. However, the dynamic development of the agricultural sector is itself influenced by the forceful changes and economic conditions emanating from other economic sectors.

3.1.2 Destruction and modification of habitats – loss of species diversity

For thousands of years biodiversity benefited from extensive management, especially from the extensive management of meadows, alpine pastures and forest pastures traditionally mown once or twice a year. Within a few decades, not only the number of annual mowing operations has considerably increased, but also new types of seeds have been introduced, which resulted in the development of meadows supporting only few grass species. Most of the typical meadow species do not survive such intensive use. While in traditional meadows and pastures the number of plant species varies between 30 and 60, there are often no more than 5 species in levelled grassland (GEPP, 1994; ELLMAUER, 1993).

The commercial goals of traditional mountain farming frequently entail a loss of species diversity and landscape structures. Abandonment of land leads to a succession, which results in the development of dwarf shrubs and, ultimately, of secondary forests, thus causing a decline of species diversity and structural richness (TASSER et al., 1999).

3.1.3 Case study on the Lilienfeld region in the Northern Pre-Alps – Strategies and instruments supporting the sustainable development of cultivated landscapes (ex ÖVAF, 1996)

Almost 80 % of the Lilienfeld region are covered by forests, with clear landscape development towards overgrowing forests; the region is on the one hand dominated by agriculture and forestry, on the other by its tradition of being an old industrial area (metal industry) and in some of its parts also tourism represents an important economic factor and a promising perspective.

The agricultural sector pursues the goal of maintaining farm holdings, a practise considered to a high degree environmentally benign. The numbers of abandoned farms increase both in the smallest (up to 10 ha) and in the second smallest farm size group (10 – 30 ha); in 1990, the share of part-time farmers was 43.3 %.

In general, the higher agricultural production costs in less-favoured regions make the complicated management of many areas and holdings unprofitable. Most of the relevant strategies are agreed on the fact that open Alpine grassland is in danger of not being tended any more. Not only is the management of steep slopes (gradients of more than 35 %) much more labour-intensive than the management of flatter meadows, the lack of special machines also means a dramatically higher need for manual work as well as an increased accident risk. Moreover, the areas concerned frequently contain scattered fruit trees or shrubs so that they have to be mown manually, which again complicates their management. The low utilisation intensity of such meadows leads to considerably smaller yields than those achieved on flatter meadows – not even quite generous subsidies can compensate the difference. The danger that the ecologically desired mountain meadows are gradually being replaced is thus relatively high.

However, we are not only faced with the risk of increasing landscape impoverishment and the loss of numerous animal and plant species that depend on agricultural use; rather, a development like the one described will probably also have several undesired social and economic consequences such as the loss of infrastructure or rural exodus.

If no far-reaching changes in the economic framework conditions are initiated, the livelihood of farmers will have to be secured largely via direct payments. For holdings depending on grassland use, these payments represent an indispensable part of their income as well as an important compensation for their high production costs, while for farmers managing mainly forestry-dominated holdings, they are often the major incentive not to further reduce their agricultural activities. In addition to direct payments, it is planned to take initiatives promoting the attractiveness of farm life - for instance in the form of temporary helpers allowing farmers to enjoy leisure and vacation activities, occupational challenges involving alternative products and marketing strategies, vertical and horizontal co-operations, and the organisation of additional occupations suiting the requirements of agriculture.

The future of landscapes will be directly linked to the future of agriculture and agricultural policy. Abolishing the direct payments, which in the case of the investigated organic farms ensure 98 % of the agricultural income on average, would not only cause fundamental changes in Austria's landscape features but would also seriously affect the social structure of our rural areas. Many holdings would be abandoned; less-favoured sites would overgrow or be converted into forests. Parts of the most favoured production areas would be utilised also in the future, they would however be economically optimised by means of permanent extensification or intensification and amalgamated to form a small number of large units. In areas where that represents a realistic alternative, agricultural use would to a high degree be replaced by forestry. This would lead to a decline of habitat diversity and, consequently, also to species loss; depending on altitude, different natural forest communities would develop.

The services provided by agriculture and forestry can, and certainly are to, go beyond their productive effect, but where the beneficial land enhancement function does not constitute an operational necessity of the normal production process the artificial character of such

measures becomes obvious. To continue the management of mountain meadows in order to receive a premium, although there are no ruminants kept on the farm that would eat the hay is probably out of the question for most farmers.

3.2 Forestry and hunting

Forest management measures, only briefly discussed in section 2.1.3, influence ecosystems in numerous ways, always depending on the intensity of their implementation as well as on the local and time-related framework conditions. Mountain forests usually respond more sensitively to forest measures and are more seriously endangered by irreversible processes than commercial forests outside the Alps.

Mountain forests are severely impaired by game management via hunting. Hunting rights are linked to land ownership and for many of the bigger forest enterprises constitute an essential part of their operating income. Hunting is both of economic importance and firmly rooted in traditional practises, a combination regionally resulting in excessive numbers of hoofed game more or less strongly affecting the ecological processes of forest ecosystems. The most important factor in this context is damage caused by browsing as it endangers, and frequently even impedes, the natural regeneration of forests. Consequently, ageing forest stands may become over-mature and break down, thus impairing the protective and recreational effects of forests and their abundance of biodiversity. Selective browsing results in the loss of ecologically valuable tree species (fir and broadleaved trees), followed by the separation of natural forest communities and all ecological consequences associated therewith. As particularly in the Alpine regions of Western Austria forest areas are frequently used as pastures, the following figures include browsing by grazing animals. This type of browsing may in certain regions be of higher significance than browsing by huntable game but, altogether, the latter clearly prevails. Among other things, the report on damage caused by game compiled by Austria's Federal Ministry of Agriculture and Forestry (BMLF, 1999) informs also about the share ecologically balanced areas have in protective forests; an important aspect in this context is that especially in mountain areas the percentage of protective forests is exceptionally high. Data are based on information provided by the district forest inspections; as regards their quality, it should however be taken into account that they reflect the opinions and awareness of different district and provincial authorities with respect to game damage (BMLF, 1999; MOSER, 1999; VÖLK, 1998). The results of the above-mentioned report allow the conclusion that without the use of protective measures only a 30 % regeneration of the silviculturally necessary tree species will be possible in protective forests. Accordingly, 70 % of all protective forests need protective measures to regenerate with their original species mix; 26 % are not at all able to regenerate within the necessary period without human influence.

3.3 Tourism and commercial leisure activities

The developments in the tourism and leisure industry have exerted a powerful impact on the environment. They are the reason why especially during the main tourist season habitats, and frequently also sensitive zones such as mountain and lake areas, water resources, infrastructure facilities, and ultimately waste disposal facilities and water treatment plants are subjected to considerable stress. In addition to the problem of waste caused by refuse and water pollution, the changes in the cultivated landscape caused by the tourist infrastructure and the use of land for sports and leisure amenities, intensive tourism also has a negative impact on the natural equilibrium and the individual ecosystems. The following problems were addressed in the context of the analysis of the National Environmental Plan (BMU, 1995):

- Tourist traffic: Damage to the natural eco-balance through driving on forest roads and unpaved roads, and the parking of vehicles on grassland.
- The heavy increase in sports and leisure activities in the open countryside has caused a dramatic reduction in places of refuge and rest for wild animals and in naturally wild

areas. Frequently, important conflicts of interests can be observed between the preservation of natural resources and ecosystems completely excluding the public and people's increasing demand for experiences of nature.

- Depending on the extent and intensity of the individual intervention, mass skiing activities on levelled and prepared ski-pistes (ski-motorways) have caused serious changes and stress of the soil. The operation of pistes with too little or uneven snow affects soil and vegetation and permitting the preparation of pistes in woodlands and steep slopes of the High Alps results in damage to trees and young plants.
- Especially in alpine regions, the large numbers of hikers and mountaineers on paths and open terrain sometimes cause irreversible damage to vegetation and soil.
- In addition, nature impairment through mountain biking, new types of water sports (rafting, canoeing, kayak), hang gliding and paragliding, motor sports in the open countryside, and even riding repeatedly are the subject of critical discussion.

However, considering the impacts of tourism and the leisure industry on ecosystems, it must also be pointed out that the enthusiasm and appreciation of tourists for the diversity of nature is partially transferred to the population as a whole and to individual farmers and foresters, thereby encouraging communities and tourist associations as well as farmers themselves to become active in nature conservation. If the people concerned are responsible for and enjoy the benefits of tourist development, the general economic advantages of tourism will indirectly support and promote this incentive. In the intensive tourist areas of Western Austria, certain services desired by tourists are provided by farmers in accordance with individual private agreements, thereby ensuring the maintenance of traditional and diverse forms of management.

3.4 Impacts of traffic and industry on the biological diversity and, in particular, on the forest ecosystems of the Alpine area

Apart from energy consumption, adverse health effects, air and noise pollution, the impacts of traffic on biodiversity include:

- Intersection effects: Traffic facilities restricting the area of action for both humans and animals
- Highways, accidents, leaking tanks, abrasions from tyres, scattered salt (particularly in areas subject to heavy snow fall), waste oil, abrasions from highway surfaces and traffic-related "acid" rain containing SO_x and SO_2 contaminate surface water and consequently lead to soil and water pollution;
- Loss of game, songbirds, small mammals, amphibians, reptiles, and insects;
- Impaired appearance of landscapes.

Compared to other vegetation types forests and, in particular, forest soils are unmatched in their pollutant filtering and storage capacity, which improves the atmospheric quality but, on a long-term basis, also stresses the ecosystem through the accumulation of numerous anthropogenic pollutant emissions. Eutrophicating nitrogen and acidifying sulphur compounds, heavy metals and long-living organic compounds with high hemeroby levels resulting from the industrialisation of our environments are emitted to forest ecosystems and, depending on their structure, can more or less heavily change or damage them. These types of pollution are of special importance to Alpine mountain forests because the latter constitute a natural barrier against air masses naturally transported over long distances and thus a sink for a large number of long-distance air pollutants. Based on the data of the Austrian Forest Soil Monitoring MUTSCH (1992) proved that stress due to the heavy metals plumbum and cadmium increases with altitude and is therefore a result of long-range pollution. Various authors came to similar conclusions also for other groups of pollutants (WEISS, 1998).

Another pollutant representing a particularly heavy stress on mountain forests is ozone. As in mountain areas ozone concentrations decline considerably less during the night than in other

places, the stress on mountain forests is significantly higher than it is on all other, also equally stressed, Austrian forest areas: In 1993 and 1994, the Critical Levels for ozone for the vegetation type “forest” were exceeded in nearly all parts of Austria’s Federal territory (SCHNEIDER et al., 1996) and it is improbable that this situation of stress has eased off in the course of the past years (SCHNEIDER, 2000, verbal statement).

3.5 Reduced resilience of ecosystems due to erosion, loss of resources and water-related problems

Especially in alpine zones not only avalanches, torrents and floods present natural hazards to settlement areas and the environment but also, and in particular, mass movements, namely all types of mudflow, landslide and rockfall.

Mass movements are due to the steep topographic relief of the Alps (overly steepened slopes) resulting from the combination of continued mountain formation and changes in the geomorphological features originating from the Ice Age. Since the retreat of the glacial ice the natural erosion of mountain crests and the filling-in of the big Alpine valleys have permanently continued primarily in the areas where the huge morainic sediments left by glaciers still constitute dangerous bedload sources for mudflow-prone brooks. In the Alpine zone, the danger of erosion therefore varies in different areas.

Because of their labile eco-balance, mountain flanks are particularly susceptible to torrents and mudflows. On unstable mountain slopes, vegetation and technical measures can be applied in order to retard slope movement, there is however no way to prevent them and especially heavy rains frequently lead to enormous debris accumulation.

In this context it should also be mentioned that the efficiency of the Alpine ecosystem is essential also for the environs. Severe flooding of the Pre-Alpine rivers, for example, in most cases has its origin in the Alpine area because the rivers streaming down from the Alps transport their own flood waters to the natural flood areas of the valleys (AULITZKY, 1994).

8,935 torrents and 4,570 avalanche tracks are currently registered in Austria. The hazard zone plans worked out for individual communities by the Forest Engineering Service on Torrent and Avalanche Control contain the data on torrents and avalanches as well as information on areas prone to floods and mudflows and on acute slope movements required for adequate building measures. To ensure exact information on the parameters concerned (e.g. air-pollution inputs into protection forests or effects of the control construction work), these plans must be permanently up-dated. Today, especially older buildings (e.g. bridges and power plants constructed in times when the pragmatical values of earlier centuries were not yet sufficiently taken into account) are in many cases extremely dangerous; earlier failure in spatial planning is the reason why natural events may eventually become natural disasters.

Mass movements

Especially in the Alpine area the continued use and maintenance of our living environment is endangered or greatly restricted by natural (e.g. rockfall) and man-made mass movements.

Acute anthropogenically caused mass movements such as slope slides or slope collapses may be the result of inadequate procedure in the arrangement of communications, in housing development as well as in the construction of pipelines and ski-pistes. Regions with poor natural slope stability are particularly prone to such risks.

Erosion

Apart from the naturally occurring dangers of erosion, such as the watershed areas of torrents and gills which contain a very high risk potential in combination with bedload sources (morainic material or protective cover), there are also other, man-made erosion risks. The latter result from inappropriate ski-piste and road construction as well as from inadequate agricultural and forestry use and may ultimately cause debris flow deposition, slides and, in many cases, even deep-reaching erosion types (rill erosion and filing erosion). Vegetation

engineering on ski-pistes and technical structures using non-indigenous seeds can provide only temporary protection against damage by erosion. After a few years the turf will break, thus leading to even more severe landscape damage.

Moreover, the inadequate execution of water management measures in alpine river and valley areas may cause embankment collapses as well as river bank and stream bed erosion.

As regards agriculture, the overstocking of alpine pastures, a consequence of the increasing weight of the cattle, leads to severe turf damage, to scarring of the sod and, finally, to huge slides and serious erosion damage. At the same time, if put at rest, erosion and landslide scars allow the development of new pioneer areas on grass-covered and herbal layers.

Abandoned mountain meadows require special protection (gentle utilisation – biennial mowing) because they are characterised by an extraordinarily diverse vegetation cover and when abandoned become the sources of landslides and erosion channels. Both on abandoned and over-exploited alpine pastures and mountain meadows water runs off more rapidly than it usually does. When such pastures or meadows are no longer grazed or mown stemmy grass develops, turns downward during the winter and is snow-frozen. Consequently, the surface litter combines more easily with the above snow, which leads to a growing number of snow slides and avalanches (DAX & WIESINGER, 1998). In wintertime, “snow creep” occurs, a phenomenon defined as the slow downward movement of the snow cover on slopes. On steep slopes, grasses and their roots are pulled out from the soil; this causes open spots on the alpine pastures, the so-called “plaiken” (BÄTZING, 1991), which in the case of heavy rainfall in summertime increase the frequency of earth slide and mud flow events.

With a view to agricultural intensification many of the large number of wetlands and marshy areas occurring at the lower level of valleys have been drained so that they can no longer fulfil their function as decentralised, local water retention basins. The result are sometimes extremely high runoff peaks to lakes and rivers.

4 IMPACTS ON THE ECONOMY AND WELFARE – RATIONALE FOR THE VALUATION METHOD

4.1 Approaches to valuation – Valuation method

4.1.1 Valuation objectives

Approaches to valuation hitherto made in Austria in connection with the use of biodiversity in the Alpine and mountain area will be described in the following chapters. They are indirect valuations of ecosystem functions, landscapes as consumer goods or of conservation areas as a value-added factor. Any monetary valuations made are stated briefly. However, they should not be regarded as items which can be added up, as the various valuation attempts overlap owing to the different methods applied and also the complex ecological relationships and multiple economic links.

In stating these values, our aim is to explain and emphasise the importance of conservation and protection measures in the Alpine and mountain area relative to its current economic uses. We make no claim to completeness or determination of a "total economic value" (according to PEARCE, 1989). But we shall specifically consider the quality of option values of possible future use and possible impact factors of an existence value, insofar as statements can be made about these.

Limits to valuation, and open questions:

There is a basic duality in economic treatment and valuation of biodiversity:

- It is clear that biodiversity is increasingly becoming an economically relevant asset owing to its obviously beneficial character and its scarcity. The use, preservation and protection of biodiversity are linked with regional and supra-regional, even global economic processes, which they make possible or at least stabilise. It seems inevitable that this resource should be valued.
- Yet biodiversity as an economic asset defies economic valuation owing to its inherent properties of variety and natural dynamism (life). As it is essential to the life of future generations, it always has to be determined in both society and politics. Biodiversity is also a "social construct".

In the absence of economic or political and social valuation, there are a number of other characteristics and open questions (according to GEISENDORF et al., 1998):

- Its public character: Is biodiversity a public or a private resource? Can private property claims be defined at all, and if so, to what extent? What would be the causes and effects of defining them? Who makes a profit from using biodiversity, and who pays for its preservation or even remedial treatment? Who uses the ecosystem functions, and who helps to maintain them? Could biodiversity not be defined as global public property, which is made available free of charge for use by the private sector but taxed globally in some of its aspects as a means of financing global protection? (See "Copyright on Nature" for commercial use of picture and film material, section 2.2.1).
- The irreversibility of losses - existence from one generation to another: Losses and resultant ecosystem disturbances and damage to resources have to be assessed as irreversible within several generations. Benefits and consequential costs do not appear at the same time. How can this problem be settled between generations? How is a potential irreversible loss to be valued?
- The difficulty of substituting or supplementing: How is an extinct species to be replaced? How does one repair an ecosystem which has stopped functioning? How many functions are actually fulfilled by the diversity of species and ecosystems? Who is to provide a multifunctional replacement, and how?

- There are also values which are not dependent on use. What do aesthetic values, existence values, cultural values, experience values mean to a socio-economic environment?
- A complete market valuation is not possible. Biodiversity and its functions are linked with market products in many ways. Yet these properties do not impart the products their market value, or they play an insignificant or marginal direct part in pricing. Can an actually non-existent market or a market representing only minor aspects really be simulated? In a conflict between the social preference for conservation, which is hard to justify economically, and use with simultaneous destruction and damage to biodiversity through a private property claim, how can possible destruction be prevented? Are payments to the potential user for non-use actually ecologically neutral relative to taxing for use (or other compensation of the injured party by the user)? What is the long-term significance of paying "environmental rent" for private property claims to society and the economy?
- Inequality of distribution and local scarcity: This is both a global and a local problem. Where should economic development take place, and where should we forego it to protect and conserve the environment? Which persons and places are advantaged or disadvantaged, and how can "just" compensation measures be developed?

Many of the above questions would require specific economic analysis, particularly in respect of the natural resources of mountain areas (cf. NEUNTEUFEL, 1998a). They also raise economic and social questions about the future, which will be of immediate concern when other (new) natural resources (such as drinking water) are developed for the market economy (see section 4.5).

4.2 Conservation of biodiversity and landscapes as a part of the ecological accounts

The environment has been specifically covered in Austrian statistics since the mid-eighties, and the Central Austrian Statistical Office (renamed Statistics Austria in 2000) has been calculating expenditure on environmental protection since 1985. Intensive work has subsequently been done on elaborating principles for ecological accounts, covering material flow accounts, natural resources accounts and environmental indicators in particular. The natural resources accounts section contained a land consumption survey (built-up areas, the transport infrastructure, leisure facilities) and a survey of flora and fauna (bird species, mammal species, cattle breeds, cultivated plant varieties) (cf. BITTERMANN, 1990abcd, 1991ab, 1992, 1993, 1994, 1995; GERHOLD, 1995). It is very difficult to build up a consistent data frame.

Since 1994 Austria has developed a system of environmental indicators following the OECD's pressure state response initiative and the EU guidelines (GERHOLD & PETROVIC, 1997). A separate set of indicators for loss of species diversity has been drawn up, and part of it is included in the OECD publication "Environmental Indicators for Agriculture", chapter 11 (OECD 1999).

4.2.1 The Environmental Protection Expenditure Account (EPEA)

As the Austrian Environmental Protection Expenditure Account was not compatible with the EU's SERIEE system, it was converted to that system from the mid-nineties. EPEA accounts include any measures and activities aiming to avoid, reduce and eliminate environmental impacts and damage (KRANVOGEL & AICHINGER, 1997; GERHOLD, 1998).

In accordance with the "Uniform European Standard System of Environmental Protection Activities (CEPA)", the 1996 "biodiversity and landscape protection" account contains the following ratios for public-sector environmental protection activities (MILOTA & AICHINGER, 1998):

- Production value ATS 1.6 billion
- Receipts (mainly transfers between local authorities) ATS 2.1 billion
- Investment grants (about 50 % consist of biodiversity-relevant subsidies to farmers and companies) ATS 6.4 billion

The direct production value for biodiversity protection is thus only about 6 % of all public environmental protection activities totalling ATS 27.4 billion. At the same time, 13 % of direct transfers to local authorities and other organisations and associations and 60 % of investment allowances (including subsidies) to private companies come under the heading "biodiversity and landscape protection". This shows the special importance attached to nature conservation and landscape protection in Austria.

As a rough estimate, assuming that the amounts will be distributed according to both area and location, excluding large towns, about 40 to 50 % should be allocated to the Alpine and mountain region. However, the scale of this public expenditure hardly amounts to 1 % of the government budget (e.g. expenditure in the 1996 federal budget: ATS 885 billion).

The Environmental Protection Expenditure Account also includes private households' expenditure on environmental protection. Out of about ATS 22 billion in 1996, however, only ATS 114 million can be attributed directly to "biodiversity and landscape protection". Yet the expenditure account statistics may possibly include other amounts which are allegedly (i.e. only indirectly) spent on biodiversity and landscape protection.

4.2.2 Eco-industries

According to PETROVIC (2000), the output of the so-called eco-industries in 1998, as recorded by Statistics Austria, was ATS 91 billion just for environmental protection management (Core Set Account A), or ATS 55 billion for sales of environmentally friendly products (Account B). Taken together this would represent about 7 % of the gross domestic product. Although this figure cannot be attributed directly to biodiversity and landscape protection, a considerable part of the demand for environmental protection services and environmentally friendly products may well be motivated by consumers' positive attitude towards habitat and landscape protection.

4.2.3 Recording natural assets

Another essential part of the ecological accounts deals with the recording of natural assets. These include the soil and its condition, the flora and fauna, forest areas and their condition, timber stock, mineral resources, water, and air quality (see GERHOLD, 1995). The question of air quality cannot be discussed in greater detail, but some data on pollution in the Alpine region, particularly with respect to nitrogen oxide concentrations (NO_2 and NO_X) is available (cf. UBA, 1999).

4.2.3.1 Area reports

It is difficult to obtain a consistent record of purely natural resources area by area from the land statistics. This is because the definitions in the individual sets of statistics vary, the data may not be up to date, they may only cover very small areas, or statistics relating to a business may concern the domicile of the owner of the business; there may also be insufficient breakdown in the case of land used for building and transport. Thus, according to BITTERMANN (1990a), reports in the literature of loss of agricultural land in the seventies and eighties vary between 14 and 63 hectares per day, and reports of the increase in drained land since 1945 vary between 12 and 20 hectares per day, according to the statistics used and the category of land referred to. Reportable changes in land use throughout quite a large geographical area can thus only be roughly assessed; an accurate assessment is only possible for one set of statistics or one category.

No further description will be given here of agricultural and forestry areas, the flora and fauna or forest resources, as most of the data on these are contained in Chapters 1, 2 and 3. The following item will deal only with land consumption by tourism and natural water resources.

4.2.3.2 Land use for tourist facilities

The natural resources account for land also included land use for tourist facilities insofar as this could be recorded.

According to the 1991 houses and apartments statistics, Austria has 163,214 residential buildings with holiday apartments and 21,974 hotels, inns and boarding houses. These take up development areas of 171 km^2 with buildings covering 18 km^2, respectively 44 km^2 with buildings covering 9.2 km^2 (BITTERMANN 1994). Especially hotels, inns and boarding houses involve a large amount of building, taking up 21 % of the real property area. Further information on the use of the Alpine area for tourism is contained in the annual accommodation record in the tourist statistics (cf. STATISTIK ÖSTERREICH, 2000a). Whereas commercial businesses and letting of private rooms showed a slight to sharp decline in the nineties, there was a boom in the letting of holiday homes. Between 1984 and 1995, the number of beds offered in holiday apartments in the Provinces of the Tyrol, Vorarlberg, Salzburg, and Carinthia increased from 85,000 to 155,000. These Alpine Provinces of Western Austria offer 800,000 beds, about 73 % of the total number of beds available (ÖROK, 1999).

Although there has been no increase in the number of overnight stays in tourist accommodation or in the number of services offered to tourists in recent years, the extension of so-called high-quality tourism and the wider range of amenities provided per guest have resulted in more land being used for tourist facilities.

The most striking example of this is the use of land for golf. According to ÖROK (1999), a boom in golf courses started in 1988, after which the number of courses rose from 35 to 97 (1997) and the number of club members from 9,190 to about 40,000. Although land use is highest in areas outside the Alps, there is enormous pressure in Alpine tourist regions to open up the limited space in permanent residential areas for golf. In the Tyrol, the Province with the most active tourist industry, there has been a new golf plan since 1997, under which approval procedures for 5 new golf courses are currently under way (ÖROK, 1999).

Another important land use parameter is the ski-run area and the number of cableways and other forms of mountain transportation (cf. BITTERMANN, 1993). The areas used for skiing in the Alps are increasingly being moved up out of the valleys (ÖROK, 1999). Some of the and cableways and other forms of mountain transportation lower down the slopes are being closed and replaced by new installations higher up in the forest and mountain pasture region.

Example: the Tyrol

In the Tyrol there were hardly any changes in ski-run areas between 1990 and 1997, and the number of installations even dropped from 1,262 to 1,187. On the other hand, the transport capacity increased by 13 % in the same period. About 8,100 hectares of ski-run are distributed within the 47,500 hectares of the skiing region as follows (ÖROK, 1999):

- permanently settled agricultural area (valley floors): 23 % (tendency to decrease)
- forest region: 22 % (tendency not to change)
- mountain pastures, waste land: 55 % (tendency to increase)

The reduced economic stress on regions used for agriculture tends to cause an increase in the ecological stress on high Alpine areas.

Another characteristic of this development is the increasing use of snow guns to snow over the lower parts of pistes. In Austria there are 300 snow machines which can cover an area of about 3,800 hectares (1996 figures), that is 54 % of all the snow machines in the Alps. The number has almost doubled since 1990 and more than trebled in the Tyrol, from about 30 to 98 (SIEGRIST 1998). The causes are not only the mild winters of recent years but also the

"qualitative" extension of tourist amenities with guaranteed snow, capital-intensive ski-lift companies, and increasing competition among winter tourist regions in Europe. Since 1995/1996, chemical additives have been used systematically with the artificial snow in order to produce larger amounts. So far there is little scientific understanding of the environmental impact of chemical additives (SIEGRIST, 1998).

4.2.3.3 Natural assets – water

Austria is a country rich in water. Taking account of the influx from other countries, total annual water resources, based on the annual average figures obtained between 1961 and 1991, amount to approximately 127 billion m^3 (GERHOLD, 1995). If evaporation is deducted, there is a renewable amount of water of about 84 billion m^3 per annum.

On the other hand, the total annual demand from households, agriculture, trade and industry, and various other uses (excluding cooling water for power stations) is about 2.6 billion m^3. The amount taken from ground and spring water is 1.1 billion m^3 per annum, about 700 million m^3 of which are used as drinking water. Half of this is thought to come from spring water, a valuable source of drinking water found largely in the Alpine region.

There are also the water reserves: glacier ice (25 billion m^3), soil moisture (20 billion m^3), lakes (18 billion m^3), ground water (15 billion m^3 non-usable, 15 billion m^3 usable).

4.3 Direct use of biodiversity in the Alps by agriculture and forestry

Up to the twentieth century, the organisation of agriculture and forestry as self-sufficient industries with limited market contact was the prevailing economic system in Alpine regions, and some remote valley communities still had an economy of the same character and basic structure until after World War II.

Only with economic development, the tourist boom and the extension of the infrastructure were Alpine farming and forestry re-defined as part of the market economy. Large numbers of mountain farms, like those in favoured areas, adopted intensive, mechanised methods by purchasing inputs, and specialised in beef and dairy cattle husbandry in view of the natural conditions on their land. To keep pace with the developing prosperity, mountain farmers at first mainly followed the strategy of financing the necessary modernisation by using forest resources and additional employment opportunities outside agriculture on a part-time basis. When this was not enough to obtain a satisfactory income, many small farms were closed down, leased and in some cases even sold, or the buildings were converted into accommodation for the booming tourist industry. This development has been accompanied by a continuing retreat of Alpine farming from marginal soil and extensive meadows, by conversion into extensive pastures or forest areas with simultaneous intensification of grassland farming in favoured areas.

4.3.1 "Devaluation" of Alpine agriculture and forestry

The essential reason for this development is that, particularly in less-favoured Alpine locations, the returns from land use and animal husbandry are far lower than those in favoured areas. Thus the accounts averaged for 1995 to 1997 show that farms falling under the highest natural handicap category (no. 4) earn ATS 178,000 from primary agricultural production, which is only 40 % of the returns of category 1 farms (with little handicap) and only about 25 % of those of lowland farms (BMLFUW, 2000a). The differences are even more striking when comparing the agricultural returns per hectare of utilised agricultural area (UAA). Category 4 farms suffering severe natural handicaps earn only 14.6 % of the returns of lowland farms per hectare of UAA, or the total earnings of mountain farms are only 45 % thereof.

Even if these low returns from agriculture are supplemented by income from forestry, tourism and secondary agricultural activities, and even if commercial activities, secondary earnings and social subsidies are added, the earnings per worker in mountain farms are still about 10 % below those in lowland farms, and in farms suffering severe natural handicaps about

20 % below. However, the fact that the differences in income are reduced by secondary activities and earnings shows that the existence of a regional economy capable of development makes a fundamental contribution to maintaining agriculture and forestry in these regions.

The importance of special subsidies:

The subsidies and direct payments specially adapted for these holdings play an important part in the economic stabilisation of mountain farms. Although the proportion of public funding - mainly compensation for the mountain location and environmental programmes - in the total income of mountain farms from agriculture and forestry is no higher than that for lowland farms, these direct subsidies have been an important factor in the successful maintenance of mountain farming structures and thus of the traditional cultivated landscape in past decades (see HOVORKA, 1998).

Direct payments include subsidies relating to the natural handicaps of a farm and in particular specially adapted items in agri-environmental programmes such as alpine husbandry and mowing premiums. These play an important part in maintaining the ecosystem functions of the cultivated landscape.

Special measures to improve the environment, such as engaging in organic farming or not using inputs anywhere on the farm, are very important in the mountain region. Today, organic farming in particular offers mountain farmers good prospects. 86 % of the approximately 20,000 organic farms in Austria are mountain farms, and about 17 % of the approximately 90,000 active mountain farms have already converted to organic methods (GROIER, 1998b).

As assessed by the Austrian agri-environmental programme (BMFL, 1998), alpine husbandry premiums are very effective in maintaining an ecologically correct cattle density and keeping the grassland in extensive form. They are paid to about 7,000 farms with an alpine husbandry area of about 735,000 hectares (total amount of subsidies in 1999: ATS 279 million). A moderate effect is also expected as regards the preservation and enlargement of the size of ecologically valuable areas. Alpine husbandry also allows payment to be made for safeguarding and developing the diversity of farm animals and arable crops. About 61,000 farms throughout Austria, with an area of 231,000 hectares, have worked on mowing steep areas (total amount of subsidies in 1999: ATS 607 million). This is expected to have similar effects, although the work is mainly designed to maintain grassland and keep an open landscape.

Subsidy payments under the agri-environmental programmes for mountain farmers plus the compensatory allowance total ATS 5.2 billion (1999). These two categories of direct payment cover about 70 % of all state subsidies and compensation payments for such farms. Measures to support agriculture and forestry in the mountain region also make an important contribution towards strengthening the economy in rural areas and peripheral districts and have a stabilising effect on the local labour market (HOVORKA, 1998).

Value added from agriculture and forestry (direct use of biodiversity):

However, the support measures described and all the value added from agriculture and forestry in the Alpine area are only of very marginal importance compared with other economic factors.

In 1991, the gross value added in the Alpine Provinces of Western Austria (Vorarlberg, the Tyrol, Salzburg, and Carinthia) amounted to approx. ATS 500 billion. The proportion for the primary sector - i.e. agriculture, forestry and also mining - was only about ATS 9.2 billion or 1.8 % (calculated according to HLAVA et al., 1997). (The proportion in Vorarlberg was not more than about 1.1 % of the regional gross value added.) At the same time, the tertiary sector in the main tourist areas of the Alpine region covered 60 to 70 % of the gross value added.

SCHINDEGGER et al. (1997) characterised this development as follows: *Industrialisation and tertiarisation have successively ousted agriculture. Agriculture has lost its preponderance as a source of income in the Alpine region of Austria.* In 1991, only 2 of a total of 53 districts had between 10 and 20 % of their inhabitants employed in agriculture or forestry. On the other hand, 16 districts had over 10 % of their inhabitants engaged in tourism, and 10 districts had over 40 % in the services sector.

That is why direct valuation of biodiversity via agriculture and forestry - and the same applies to other commercial secondary uses, too - can hardly prevail against the use for industry or tourism when there is competition for space. Cost-benefit analyses, when calculation only includes sales which can be valued directly by markets, therefore give preference to industrial projects, development of transport and other infrastructures and major tourist developments, to the detriment of the use of natural resources and also to the detriment of the requirements for maintaining ecosystems.

Option value:

If the direct use of biodiversity by agriculture and forestry in the Alpine regions is still of particular importance, this is

- in order to produce high-quality food and natural products by extensive and sustainable farming methods (see organic farming);
- in order to act as a model region for sustainable development;
- as an option or insurance value, in order to ensure a basic supply of food and natural products for the densely populated Alpine regions in times of crisis.

Appreciation – existence value:

A high existence or traditional value is often attributed to the traditional cultivated landscape and especially to traditional agriculture and forestry by the local inhabitants, as this way of using nature made sense and was fundamental in the past and is expected to do so in the future. The special appreciation of traditional agriculture and forestry, which often have to be practised out under severe natural conditions, is one reason why the reduction in the number of mountain farms in recent decades has not been much greater that that of lowland farms, and why the number of mountain farms suffering extreme natural handicaps has had a lower reduction rate than that of lowland farms (cf. DAX, 1998).

One could thus describe mountain farms and their ways of using nature as being relatively stable and also as having a “fragile stability” in view of the enormous social and economic changes. “Fragile” owing to the social and economic conditions, yet still “stable” owing to the high esteem of local communities for cultivated landscapes and traditional agriculture and forestry.

4.4 Indirect use of cultivated landscapes for tourism

4.4.1 Features of cultivated landscapes

Agriculture and in some cases also forestry have extensively structured and thus formed the landscape of the Alpine region. The opening-up of forest areas has also produced a richly varied landscape, with forest-meadow transition zones which are important for biodiversity and with many landscape features.

In addition, the cultivated and natural elements have been combined in such a way that the soil is made as stable as possible to prevent erosion and landslide and its hydrology is stabilised. Not until the twentieth century, mainly after World War II, was there any major interference with this cultivated ecosystem: moist meadows and pastures in the valleys were drained to provide additional arable land for intensive cultivation.

Another serious ecological intervention in the Alpine region was the opening up of all villages and mountain farms with roads and tracks, and the opening up of alpine pastures and forests

by forest tracks. The main reason why this was necessary was to enable people to take part in the economic development without de-populating the peripheral areas. The network of tracks and roads in turn led to the opening up of vast areas of the Alps to tourists.

4.4.2 Landscape tourism

It is difficult to estimate what economic contribution the rich cultivated landscape and the related cultural diversity make to the development and continued existence of the Alpine tourist industry, owing to the indirect relationships and many side-effects. There is only a rough statistical survey showing a breakdown of the tourist industry into hiking, cultural activities and sports (popular sports). And even merely sports-based tourism is in many ways connected with the cultivated landscape, its functions and its infrastructures, not least because tourism basically provides an experience value.

In 1999, the Austrian tourist industry had a total turnover of ATS 201.9 billion (BMLFUW 2000b). About 80 % of it (i.e. about ATS 160 billion) was produced in the Alpine region. Austria has 30 % of the visitors, 27 % of the overnight stays and 37 % of the value added from the tourist industry throughout the Alps. This in turn represents about 17 % of the whole tourist industry throughout Europe.

Direct connection between agriculture and tourism:

In Austria, 4.4 % of the 112 million overnight stays are on farms, which offer 8 % of the total number of beds available. More accommodation has been offered in recent years, especially in holiday apartments on farms. The direct connection between agriculture and tourism has been strengthened by serving local speciality food and drinks. Preference is given to local products, and these are particularly popular with the visitors.

However, the use of diversity in agriculture and the landscape goes far beyond the direct connection provided by farm holidays and the local supply of high-quality natural products.

The cultivated landscape and tourism:

A record of Austrians' travelling habits made by the microcensus gives an approximate indication of their main motives in taking holidays in their own country (ÖSTAT 1999; STATISTIK ÖSTERREICH, 2000b). Thus in 1998, 17 % of the Austrians interviewed stated hiking as their main reason (20 % in 1999); only 1.1 % stated mountaineering. Hardly any hiking holidays were taken abroad. Although hiking holidays are becoming less important than sports holidays, they are a feature of the Alpine region of Austria.

It is roughly estimated that the main motive for about 20 to 25 % of tourist visits to the Alps is to enjoy the natural and cultivated landscape. Calculated from the turnover for tourism, this brings in about ATS 30 to 40 billion. In addition, hardly any tourism is purely based on sports; landscape tourism is always part of the experience. However, it is impossible to state what tourism would be like if the cultivated landscape were not used, maintained and properly managed.

In any case, some tourist municipalities with large numbers of tourists pay additional alpine husbandry and mowing premiums to local mountain farmers in order to prevent the experience value from being lost by neglecting the natural surroundings. The cultivating work and resultant cultivated landscape thus provide a fundamental experience value, which in turn is essential to the entire tourist industry and its development.

The longer-term question is still how to combine sustainable and extensive agriculture and forestry with the basic requirements for protecting biodiversity and with a tourist industry which protects natural resources, in order to ensure lasting, stable development in the mountain and Alpine region. In this connection, consumer pressure from tourists also plays an important part.

4.5 Previous valuation studies in Austria

4.5.1 Valuation of the side-effects of agriculture and forestry

At the beginning of the nineties, PRUCKNER and HOFREITHER (1991) carried out extensive calculations relating to the services provided by agriculture and forestry beyond business level, and also dealt theoretically with approaches to valuation. As a point of reference for valuing biodiversity, although a very indirect one, they used the travel cost method (TCM) in conjunction with the agricultural character of tourist centres and the estimated replacement or reconstruction costs combined with the protective function of the forest. The calculations were carried out at the aggregate national level, i.e. for the whole of Austria.

The result obtained by the travel cost method (TCM):

The travel costs - including estimated expenditure at the holiday resort - were classified according to regions or main tourist centres and related to the tourist provisions, the visitors' income level, the agricultural character (index number) of the resort, and the proportion of fallow land in a region. The most important result was that in summer tourism the agrarian character has a considerable effect on the tourists' willingness to pay (travel costs). A 1 % increase of the agrarian character in the index would increase holiday makers' willingness to pay by 1.4 % (i.e. a total of about ATS 800 million). In winter tourism there would be a negative relationship. However, this is due to the special structure of the skiing industry, which is active chiefly in specialist tourist centres in the high Alps. Only a slight agrarian character was attributed to these centres.

The result obtained from the replacement cost approach for the protective effect of forests:

The aim was to determine the functional value of forests in relation to flood control and protection against erosion, conservation of water quality as well as in relation to avalanche control. The replacement value for the given protective function of forests was taken to be the theoretical building cost of torrent and avalanche control measures for all the potentially threatened areas. The replacement costs without any discounting were over ATS 4,000 billion for permanent control measures and about ATS 1,800 billion for temporary regulation. With high discounting for 50 years, the costs would still have a current value of about ATS 1,200 billion, respectively 500 billion, which would then have been about 80 %, respectively or one third of Austria's gross national product.

These studies were also the subject of a critical scientific discourse. In 1994, WÖRGÖTTER evaluated them and concluded with a very pointed remark: "The valuation studies submitted offer a broad spectrum of figures ranging from somewhat more than nothing to almost everything. No direct, specific guidance for political action can be derived from them." In 1998, NEUNTEUFEL replied that the term "ecological services" could neither be satisfactorily defined nor could the problems of a monetary valuation method be solved. He stated that when bringing about ecologically sustainable development it was more urgent and more promising to solve other problems such as establishing ecological indicators or analysing the efficiency of political measures. However, it should also be emphasised that these studies were the first instance when the internationally developed range of methods for valuing ecosystem functions was used in Austria.

4.5.2 Analysis of the willingness to pay for the management of cultivated landscapes (PRUCKNER, 1994) – Contingent valuation method

In 1994, PRUCKNER carried out a differentiated willingness-to-pay analysis based on questioning over 4,500 holiday-makers in Austria. The empirical part of the study was designed to determine the maximum amount per day a tourist would be willing to pay to farmers to properly manage the landscape. The management work was described briefly in

the introduction to the questionnaire, and it was mentioned that the existence of mountain farming was endangered.

An average of ATS 9.2 per holiday-maker per day was obtained for the whole of Austria, which was extrapolated to give a total of ATS 720 million. The Austrians' esteem for the management of cultivated landscapes was not directly assessed, but PRUCKNER stated in 1994 that according to a Swedish valuation approach, an annual amount of approximately ATS 9 billion would be expected.

The intention of the study was also to establish a direct connection between tourism and payment for environment-related agricultural programmes in general. This met with a critical response from the tourist industry, which declined to make a specific payment without the opportunity for direct participation. This also demonstrates that, apart from wanting a generally positive image for a region, an intensive tourist industry is only interested in direct participation in maintaining and protecting natural resources if this is expected to be directly profitable.

4.5.3 Valuation of national parks (according to KLETZAN/KRATENA, 1999)

The Upper Austria Limestone Alps National Park (Nationalpark Oberösterreichische Kalkalpen, 164 km^2)

In 1998, BAASKE et al. carried out an analysis of effects on the regional economy and a cost-benefit analysis relating to the national park region in connection with the setting up of the national park. The zero variant formed the basis for comparison. They calculated that there would be an annual regional value added of about ATS 17 million during phase 1 (the first ten years) and about ATS 26 million during phase 2 (the following 40 years). The cost-benefit analysis showed a net benefit relating to 50 years of ATS 604 million at a discount rate of 2 %, or ATS 1,068 million at a discount rate of 0 %. The benefit components were predominantly supported by a scenario of positive development of tourism in the region, while essential items on the cost side were extension of the infrastructure and compensation for restrictions of benefit by agriculture, forestry and hunting.

In 1995, HACKL and PRUCKNER estimated the potential benefit of the same national park by carrying out a willingness-to-pay analysis among the entire population of Upper Austria and the tourists in the national park region. The amount people were willing to pay was highly dependent on regional and personal features such as age, education or membership of a mountaineering club or conservation society. The average potential willingness to pay varied between ATS 34 per person per year among non-visitors and ATS 56 among inhabitants of some municipalities in the national park. According to the assumed visitor numbers, there was found to be a range of possible total benefit between ATS 55 and 184 million, and the existence value for the Upper Austrian population was estimated to be ATS 20 million.

Danube Meadowlands National Park (Nationalpark Donauauen, 93 km^2)

This national park is situated outside the Alpine region and comprises the meadowland areas along a permanently free flowing length of the Danube east of Vienna.

In 1994, SCHÖNBÄCK et al. carried out an extensive cost-benefit analysis for the Danube Meadowlands National Park. The "national park consisting of public areas" variant (national park maximum variant) was compared with two other variants with use of a power station and the adjacent national park. The possible direct cost-benefit difference was compared with a willingness-to-pay analysis based on a representative survey in Austria. In the subsequent combination of the two processes it was found that, from an annual willingness to pay of ATS 64 – about 15 % of the value revealed in the survey –, there was a higher benefit surplus for the national park variant than for the best power station variant. In view of a shortage of funds and alternative use of the capital invested to build the power station, the national park variant was acknowledged to be the most profitable one even without requiring the Austrians' willingness to pay. Political decisions were thus rationalised, retrospectively in this case, as there had been considerable political conflicts with the environmental protection

movement at the beginning of the eighties. The relatively high esteem of this national park is also due to its comparative proximity to the city of Vienna.

The planned Gesäuse Mountains National Park (Nationalpark Gesäuse, 150 km^2)

The Gesäuse Mountains National Park in the Alps is at the planning stage, and its value added effects have been assessed in a feasibility study (JUNGMEIER et al., 1999). Primary and secondary effects of about ATS 97 million are expected from the initial investments in the national park and in tourism, and annual profits of about ATS 85 million, including a positive yield of about ATS 20 million from agriculture. The authors of the study conclude that: "With all due caution ..... the possible creation of a Gesäuse Mountains National Park can be regarded as an opportunity for the regional economy equivalent to the arrival of a medium-size business."

Economic valuation of all Austrian national parks (KLETZAN/KRATENA, 1999)

In 1999, the Austrian Economic Research Institute discussed the approaches so far made to the valuation of national parks, then assessed the gross production value and the effects on employment on the basis of the input-output tables for 1990 and a differentiated record of the expenditure of all national parks. With direct expenditure of ATS 168 million and 61 million for subsidies to agriculture, forestry and the hunting industry, a gross value added of ATS 326 million, or, taking subsidies into account, a value added of ATS 329 million is produced. Without taking subsidies into account, a multiplier of 1.94 is obtained, which has a top position among the input-output multipliers for 1990. The total effect on employment is said to be the creation of 322 jobs.

Altogether this analysis provided very realistic values for the economic benefits which can be attributed directly to national parks. However, the fact that national parks positively influence the image value of entire tourist regions, and that the image value is used over vast areas to increase the experience value of the tourist provision in general, shows that the actual economic value of national parks may be considerably higher.

4.5.4 An example of possible indirect valuation of biological resources through the use of drinking water resources in the Alpine region

A supra-regional market for drinking water is now forming in Europe (and also globally) through the privatisation of water supply companies in predominantly urban central areas. This inevitably leads to a discussion of market exploitation of Alpine water resources.

In this connection it has already been mentioned in the media that Austria could enjoy an income of about ATS 80 billion per annum in the medium term by using 3 to 5% of its existing water resources. Even if considerable costs are incurred, especially consequential ecological costs which have to be borne also by future generations, considerable profits would be expected, particularly because the water would be high-quality drinking water from the Alpine region.

Assuming that general biodiversity protection and sustainable management of biological resources, i.e. sustainable and extensive management of Alpine agriculture and forestry, contribute an appreciable amount to maintaining the quality of these drinking water resources, considerable indirect economic values of biodiversity can be derived *in toto* from this quality assurance function.

Without going further into the subject - very different arguments are being put forward -, sustainable and extensive management of all agricultural and forestry areas in the Alpine region and restriction of intensive tourist use of the high Alps are obviously of great importance, particularly considering that if drinking water becomes scarcer in future (world-wide), the high-quality water resources of the Alpine region will have a very high option value, which may even exceed the present income from use by tourists. Strategies regarding conservation areas, sustainable and extensive agriculture and forestry, other environmental protection measures, and above all "soft" tourism may prove to be highly profitable in future.

4.6 The role of information

4.6.1 Information concerning agriculture and biodiversity

During the 1980s, public discussion focused on the ecological re-orientation of agricultural funding and the first environmental measures were conceived. At this time, a process of re-thinking was initiated especially among farming groups and the agricultural authorities. Accordingly, environmental issues were recognised as an essential factor in any effective discussion on agricultural policy ("eco-social agricultural policy"). This discussion was broadened at the start of the 1990s when special funding for organic farming was introduced, and in consequence, organic farming experienced a powerful up-turn.

Large numbers of consumers and also the public media began to pose questions regarding sustainable development in agriculture and to consider organic farming as an alternative. In particular, the entry of the large retail chains into the marketing of organic products meant that organic farming became a central element in the advertising and communication strategies of leading retail organisations. As a result, organic foodstuffs are now no longer a rarity in TV advertising.

This interplay between funding, economic success and positive communication in the media led to the emergence of a positive underlying attitude to the environmental dimensions of agriculture, especially among farmers and agricultural organisations (including training institutions and extension services). New material was included in training courses, new courses (such as courses in organic farming) were launched, and new requirements were made on agricultural consultants.

Although the problems associated with the threat to biodiversity have only entered the arena of public discussion in the last few years, isolated discussions have been held on the loss of species diversity or the loss of indigenous domestic animal breeds. The problems of the clearance of cultivated landscapes and the loss of characteristic landscape features, the disappearance of valuable habitats and ecosystems have also, in some cases, been the subject of major public discussions, which were also rooted in the direct experience of the public. Changes to the cultivated landscape have also touched on the spheres of interest of tourism and the leisure industry.

Based on these general, positively effective levels of discussion, it was possible to present the essential information about agri-environmental programmes to farmers without much difficulty (naturally with considerable support from the agricultural authorities and farming organisations). This helped to motivate farmers to accept the offer. Although considerable stages of the decision-making process were guided by commercial calculations (i.e. the level of subsidies versus the loss of profit), the relatively high level of acceptance of organic farming does show that the initial scepticism has been overcome.

Especially those farms which chose organic management methods gained new experience using environmentally compatible production techniques. Because of their abandonment of chemical fertilisers, they were forced to consider natural site conditions, the rotation of crops, appropriate selection of varieties, synergistic effects of individual measures, and the natural context of their farms in much greater detail. Many farm managers found that they enjoyed experimenting and began to develop locally relevant know-how and to draw on the experience and original knowledge of the older generations. One farming association even developed an independent programme of consultation "by farmers for farmers". This group subsequently became an outstanding example for other areas of agriculture.

It must also be pointed out that organic farms exhibit a high degree of self-organisation. 57 % of organic farms are organised into 10 independent organic associations - the largest of these has more than 7000 members. There are also two umbrella organisations operating at the Federal level. The basic agenda of these associations relates to marketing (brand rights), training, consultation, collaboration with control organisations and independent public relations work (association and technical journals). The problems of preserving biodiversity,

and in particular the preservation of genetic diversity in cultivated plants, often form a major component of training courses, advisory and informative publications.

In matters relating to in-situ or on-farm preservation of plant genetic resources, close collaboration is encouraged with groups and individuals who have worked in this area. Specific positions are developed for designing legal framework conditions. There is a lively interchange of information and know-how between different organisations, and also between the organisations and their members. Over recent years, interest in rare cultivated plants, rare varieties or ancient cultivars has grown enormously.

4.6.2 Information concerning "soft" tourism and nature protection in the Alps

Tourism, and not least mountain tourism, often goes beyond the psychological and natural stress limits of a region and has therefore become the subject of critical observation and wide-ranging discussion (MÜLLER, 1998). The large mountaineering clubs in particular were very concerned to keep a critical eye both on industrial activities such as major hydraulic engineering projects and on the social and ecological problems of mass tourism in the Alps (see STREMLOW, 1998). As early as in 1952, these clubs formed an international network under the International Commission for the Protection of the Alps - CIPRA (Commission Internationale pour la Protection des Alpes). At present, 9 Austrian NGOs and all 9 Austrian Federal Provinces are members of CIPRA.

In addition, the mountaineering clubs maintain a wide infrastructure of mountain huts and refuges. These not only make hiking and mountaineering tourism possible in the high Alps but also convey the clubs' concern for environmental protection and conservation in the Alps and its importance very clearly to tourists. As their services and concerns are so broadly based and well established, the clubs can not only call for the preservation of natural landscapes and traditional cultivated landscapes; in certain situations they can also take part in forming policies for economic development in the Alpine region. Thus CIPRA was and is always present as an official observer and, together with its regional representatives and clubs, provides the driving force behind the enforcement and implementation of the Alpine Convention.

An itemisation just of the protocols to be fulfilled under the Alpine Convention shows that protection of the Alpine habitat is not merely a matter of protecting nature and the landscape. Sustainable development in agriculture and forestry, tourism, traffic planning and in areas such as regional planning and the power industry are also among the main concerns.

There are wide-ranging public discussions and great political sensitivity regarding all these subjects. In addition, there is a great variety of scientific publications and plenty of other information in the media about the prospects of sustainable development in the Alps. This may also have resulted in the relatively high environmental awareness of the Austrian population.

Limits to the effectiveness of information in economically relevant decisions:

However, there are also limits to the effectiveness of information. If political decisions are pending which might give rise to immediate obstruction or restriction of current economic developments, most of the local population and thus most politicians will decide in favour of an immediate prospect of economic profit rather than a possible future option value.

This may also be the reason why conservation areas in the Austrian Alps have so far been set up at the periphery of the high Alps and were the subject of public discussion and controversy. The local population does not accept them fully until it becomes clear that tourist development, compensation payments and investments will also bring positive economic effects.

Information does have (limited) political effects:

Information may, however, have some impact, as evidenced by the example of “soft” tourism. “Soft tourism” was basically just a catch phrase until the mid-eighties, but it developed surprisingly quickly into a central theme of the discussion about tourism (PEVETZ 1999).

The fact that at least some of these ideas are taken seriously even by politicians in the Alpine Provinces, and that they eventually have political effects, is illustrated by the report by Mr. WEINGARTNER, head of the Tyrolean government, in the “First Report on the Alps” (1998). According to his report, the Tyrol is setting limits to opening land up to tourists. After a pause for thought, principles governing cableways have been formulated, not allowing any new ones to be opened. Moreover, expansion will now be allowed only to a limited extent, and for the first time final limits will be set to the enlargement of skiing areas.

Even if these concessions are not effective enough for conservation and environmental organisations, and even if further expansion “to a limited extent” may be taken in a very relative sense, the fact that politicians pause for thought about the limits to opening land up to tourists is definitely a breakthrough.

If the population does not get the necessary information, and if no alternatives are offered, such self-limitation ideas will never be discussed or will have no chance of being accepted. Basic scientific studies, education programmes and critical media coverage also emphasise positive features, and (from an optimistic viewpoint) these features may in the longer term be reflected in political measures.

In this way the idea of protecting and preserving natural resources has changed from a passive, defensive attitude to an active, constructive one in the Alpine and mountain regions. Conflicts between the interests of conservation organisations and the economic interests of further expansion of the “hard” tourist infrastructure have indeed not been settled, but the prospects of environmental protection not being abandoned have at least improved.

5 CHAPTER 5 IS PARTLY COVERED BY A PRECEDING CASE STUDY (SEE OECD DOCUMENT ENV/EPOC/GEEI/BIO (98)12)

“CASE STUDY OF THE AUSTRIAN PROGRAMME FOR ENVIRONMENTALLY SOUND AND SUSTAINABLE AGRICULTURE, BASED ON EU REGULATION 2078/92 - EXPERIENCES AND CONSEQUENCES OF SUSTAINABLE USE OF BIODIVERSITY IN AUSTRIAN AGRICULTURE”

For the cultivated landscape in the mountain area of Austria with special reference to the mountain area policy see OECD (1998) – Document C/RUR(98)4, Advisory Group on Rural Development:

“RURAL AMENITY IN AUSTRIA – A CASE STUDY OF THE CULTIVATED LANDSCAPE”

6 POLICY-RELEVANT CONCLUSIONS

6.1 Lessons learned

This study describes the biological resources of Austria's Alpine and mountain regions and the main forces of change contributing to the loss of biodiversity. These forces emanate chiefly from intensive residential development, globalisation of agricultural and forestry markets, increased economic activity in the Alpine valleys, and growing traffic density. An additional influence is the intensive tourist use of many Alpine regions. Previous indirect approaches to the valuation of biodiversity in Austria have been discussed on the basis of the present analysis.

Valuation of large-scale areas such as the Alpine and mountain regions

If monetary approaches to valuation are applied to the entire Federal territory or to large parts of it such as the Alpine and mountain regions, a very broad spectrum of parameters is obtained. Depending on the applied approach, method and data frame very different monetary values can be calculated; they may vary from a few billion ATS (e.g. from the ecological accounts and people's willingness to pay for properly managed cultivated landscapes) to over ATS 1,000 billion (technical costs for replacing the function of forests to provide protection against natural disasters). Direct political measures cannot or only hardly be derived therefrom.

However, these approaches serve to underline the special importance of biodiversity conservation and maintenance and to relate the ecosystem functions to other economic activities, so as to provide a basis for public responsibilities and intervention in general and also for strategic discussions.

Another factor is that monetary valuation can be carried out only via specific markets or modelled versions thereof. To Austria's Alpine and mountain regions, which are among the most intensively used tourist regions of Europe, this means that the tourist industry is the main point of reference for valuation. However, no clear parameters describing the value of natural and cultivated landscapes can be derived from the tourist industry's turnover; only rough estimates can be made, as there is rarely a direct relationship between the tourist industry and biodiversity in the form of landscapes and experience values. In fact, the relationship is in most cases conveyed in a very indirect way: Biodiversity, interesting cultivated landscapes and traditional cultural activities of the local inhabitants are only one component of the industry's comprehensive strategy to provide experience values.

The function of biodiversity to provide protection against natural disasters is of great general and economic importance to tourist centres and their facilities located in the high Alps as well as to the provision of tourist infrastructure by traditional agriculture and forestry.

The valuation approaches also generally indicate that failure to protect biodiversity in the Alpine region, failure to maintain traditional cultivated landscapes, failure to ensure sustainable development in traditional mountain farming and forestry, and even failure to restrict intensive tourism may in the long run undermine the foundations of the tourist industry and consequently lead to considerable economic losses.

The potential development of vast markets for high-quality drinking water resources opens up interesting perspectives for the valuation of biodiversity in the Alpine and mountain regions. These markets might eventually develop the same or even substantially greater economic importance than Alpine tourism (option value). If biodiversity and the sustainable management of these resources play a significant part in maintaining the high-quality drinking water resources, this will raise questions related to alternatives: Should areas or regions or the entire Alpine area be used intensively for tourism at all, at the risk of endangering valuable drinking water resources, or should intensive tourism be abandoned and restricted in order to minimise the danger of threatening future option values?

With the declining economic importance of agriculture and forestry in highly developed industrialised countries, also the direct market value of biodiversity products drops in relative terms compared to other economic activities. The diminishing importance of the primary sector is becoming very obvious in the Alpine and mountain regions, which could originally only be populated by the direct and close-to-nature utilisation of natural resources through agriculture and forestry. In some areas the share of agriculture and forestry in the value added amounts to no more than 1 %, while that of the services sector has already reached 60 %. The maintenance of traditional mountain farming and forestry nevertheless has, however, functions which are essential to the economy of the Alpine region and which go far beyond the provision of high-quality food and natural products. Among these additional functions figure (see HOVORKA, 1998):

- design, maintenance and tending of cultivated and recreational landscapes (main resources for tourism);
- safeguarding the natural essentials of life - soil, water, species diversity (also for people living outside the Alps);
- maintaining continued settlement of peripheral rural areas and their social and other economic activities;
- development of ecologically compatible forms of management;
- provision of regional economic impetus;
- protection against from natural hazards – continuation of traditional cultivation methods providing protection against floods and avalanches.

In addition, mountain farming and forestry have a basic option value (or guaranteed value) ensuring a basic supply of food and natural products to rather densely populated Alpine regions in the event of crises.

Valuation of projects such as national parks

If monetary valuation methods such as cost-benefit analyses, analyses of value added or of people's willingness to pay are applied to a separate specific project such as one or more national parks, these methods and their results may be helpful in political decision-making or objectivise the political debate.

The primary point of reference for valuation is almost exclusively the tourist industry or the modelling of potential developments in tourism. (Willingness-to-pay analyses may also provide a survey of people's general attitude towards specific projects.) However, in the context of conservation areas this also means that the latter can only be justified economically in the case of positive developments in tourism (or other economic sectors) benefiting the local population.

Where areas are already intensively used by tourists, or conservation projects restrict existing tourism, there will not be sufficient economic arguments in favour of conservation goals. In densely populated Alpine areas, conservation and maintenance strategies will thus only be successful when combined with an overall positive economic development in the respective regions or, in areas already used excessively by tourists, when offering other economic perspectives.

Social benefits (costs) – Individual benefits (costs) – "Copyright on nature"?

Reflection on potential market values of biodiversity and particularly on property rights and missing markets has encouraged us to consider whether the economic theories directed towards exclusive individualisation of all costs and benefits of public goods (with possible allocation of costs) actually make sense in relation to biodiversity conservation, or whether it would be better for the conservation of public goods, providing general social benefits (globally, regionally and locally), and loss of which would incur high social costs particularly to future generations, to be to a greater extent regarded public (and political) responsibilities again.

When shortages are imminent, public goods need not, and are not to be, freely available. It is thus certainly possible to have not only a copyright on pictures but also a “copyright on nature” *per se* in connection with the commercial use of pictures and films. The resultant income might be paid into an international fund for global biodiversity conservation, or allocated to specific regions and locations. In any case the idea is worth being considered with a view to the overall development of “fair systems” of property rights.

6.2 Transferability of results

Although the results of the described valuations focus on the specific Austrian situation in the Alpine and mountain regions, some of them can certainly be applied to the situation in densely populated tourist mountain areas of other European countries or other industrialised countries; problems are probably similar there. Generally, the comparability of the results is however limited to mountain areas which do not have a large population, increased economic activity and a flourishing tourist industry. It may be interesting to note that the present analysis and valuation discussion leads to information and strategies similar to those considered and described in Chapter 13 of Agenda 21 (Managing fragile ecosystems: sustainable mountain development) although that document is not referred to in this study.

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