Brandenburgische Technische Universität Cottbus

Lecture Notes on

"LAND USE AND HABITAT MANAGEMENT BY ANIMALS"

International Study Courses „Environmental and Resource Management", Bachelor-Program, and "World Heritage Studies", Master-Program, Part of Modul ERM B21 'Ecosystem and Landscape Management' (old#BA-0504), Winter Semester 2009/10, 4th revised edition

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1 Introduction and Overview

1.1 Schedule of the lecture

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Rare domestic animal breeds 2: Case studies on ecological and economic aspects of animal breeds	Berg
Hunting 1: Definitions, socio-economic and ecological functions of hunting	Berg
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Nature conservation: Special emphasis on habitat and landscape management in cultural landscapes	Berg
Synoptic view on questions of land use related to animals: animals, land use and sustainability	Berg
Written Exam	Berg

The title of the class is more correctly characterised by:

Land use and habitat management by (wild and domestic) (vertebrate terrestrial) animals.

Conventional agriculture, forestry, and fisheries are not covered in detail (will be touched on or addressed in an excursion only), and neither are tourist facilities such as horse pensions and riding schools, zoological gardens, natural history museums and other educational facilities (may occasionally be treated in excursions).

Within the modul "Ecosystem and Landscape Management" the class "Land Use and Habitat Management by Animals" will concentrate on those aspects of environmental management which are related to the **development and sustainable management of cultural landscapes**.

1.2 Surface areas of per Medium and per Land Use worldwide

About 30% of the terrestrial surface of the planet are use by livestock. 4% are crops which is one third of the total cropland, the remaining 26% are permanent pastures predominantly in extensive use (acc. to Steinfeld et al., 2006). The low-intensity and alternative forms of land use are difficult to quantify, as they are not restricted to a distinct landscape type in the statistics.

Overview of land and land use types (see also Annex; FAO statistical databases 2006)

	Area (million km^2)	Percentage of whole earth	Percentage of land
Whole earth	510		
Oceans	377	74	
Fresh water	3.7	<1	
Land	130	25	
- Arable land	14.1		11
- Permanent crops	1.4		1
- Permanent grazing lands	33.8		26
- Forest and woodland	39.9		31
- Other (incl. ice, tundra, desert, towns etc.)	40.8		31

1.3 Problems of Conventional Land Use in Central Europe

Land use in Central Europe is expected to be facing various problems in the near future (example Brandenburg):

- The predicted development of **agriculture** in Central Europe in the coming 10-20 years equals a horror scenario for many people: large areas will be set aside (mainly areas with oflow crop yield). Estimations hint at 5-20 % of the whole country. Agriculture does no longer pay under the regulations of the EC (Agenda 2000, new members of the EC). No concepts of land use and management exist for many types of non-productive landscape.
- On the other hand, we observe a strong pressure on the **productive land,** due to urban sprawl. E.g. in the new federal states booming cities like Berlin, Dresden, and Leipzig are significantly encroaching onto their surroundings.
- There is a stagnation and even reduction in net profits of forestry in Central Europe. Only 10% of the private and 35% of the public forests of Brandenburg are still used for wood production. Woodland remains profitable only through the profits generatedwith hunting permits(Chapter 3.13).
- The land use patterns of the close-to-natural and nutrient poor areas in the post-mining landscape after restoration / reclamation of open-cast minesin Lower Lusatia (about 6.000 ha) are under discussion. Several research projects have been carried out at the BTU Cottbus (on hydrology, water quality, forest development, development of natural areas).
- There is some controversy regarding the present and future land uses of former military training areas (to a large extent belonging to the formerRed army) in the eastern part of Germany (about 250.000 ha). Safety problems and unclear ownership constitute main obstacles for research and management. Military training areas may become prototypes for landscape management in non-forested areas.

Restoration of post-mining areas in Brandenburg

Aim of reclamation	**Area (hectares)**
Agriculture	4.610
Forestry	15.165
Priority areas for conservation	5.250
Water bodies	8.092
Other (buildings, landfills etc.)	918
	34.035

1.4 Problems of Conventional Land Use Worldwide

Land use problems are not only restricted to densely populated areas like Central Europe.

- Many countries of the world experience erosion, environmental pollution and a reduction in biodiversity caused by intensive soil cultivationpractices (cultivation management, technical and chemical inputs)
- Worldwide conflict: the area available to agriculture is limited by soil conditions, climate, morphology and so on. Therefore, in order to maintain production levels, the area under intensive cultivation must be increased (see problems above) or methods and types of land use have to be found, which lead to a similar output, but saving resources.
- Biodiversity is mainly threatened by the intensification of land use, generally leading to overexploitation and habitat destruction.
- The abandonment of land in remote and unproductive areas may be one of the possible chances for biodiversity to recover in the future. However, the socio-economic problems and consequences related to this kind of development are not well studied (Young 1999).

Factors threatening biodiversity and related to land use

Agent of decline	Mechanism	Example/Comment
Overexploitation	Traditional or pseudo-traditional hunting	Hunting for whales, seals etc. in Japan, Canada, Iceland, Faroe Islands etc.
	Hunting or poaching in a context of poverty	Monkeys in Central Africa, rhinos
	Eating habits	Shark´s fins, bird´s nests, frog´s legs
	Selective logging	Many tree species in Brazil can only be found in botanical gardens, Japanese chopsticks
Habitat destruction	Growth of human population, changes in favor of industry and settlements	Main reason for the extinction of large vertebrates
- Tropical rainforests	Shifting cultivation, modern intensive agriculture, logging	Strong decline, high concern
- Temperate rainforests	Logging	Often unrecognized
- Freshwater wetlands and aquatic habitats	Amelioration, drainage, channelization, irrigation, dam building, lowering of groundwater tables	Dramatic in all continents and climatic zones
- Mangroves	Cutting of fuel wood Extensive aquaculture of tiger prawns	High importance for water purification, coastal protection, fish spawning
- Grasslands (desertification)	Intensive agriculture, excessive cattle populations	Combination of ecological and socio-economic reasons

1.5 Unconventional Types of Sustainable Land Use

The above-mentionned mechanisms and developments in land use require that individuals and economic enterprises using land adopt new concepts and strategies, at the same time as they impose new tasks for these same actors, which are listed below:

- Farmers, hunters, foresters and other individuals,
- Landscape Management Associations (= Landschaftspflegeverbände),

- Local authorities (municipal), regional and national administrations (ministries of economy, agriculture and forestry, nature protection and others)
- Companies dealing with tourism (Touristikunternehmen), companies of real estate marketing (= Bodenverwertungsgesellschaften),
- Military organizations,
- National NGOs, international associations and institutions (i.e. FAO, UNEP, WWF, GTZ, DED).

Below are some examples of **new tasks**, or rather tasks which may be regarded as new in certain areas (e.g. Germany) but which have been performed for decades elsewhere (e.g. in Great Britain):

- Sustainable use of natural resources
- Management of landscape and landscape view
- Economic subsistence of regions
- Development of ecotourism and recreation (nature experience)
- Nature conservation
- Creation of "living gene banks" (domestic and wild animals)

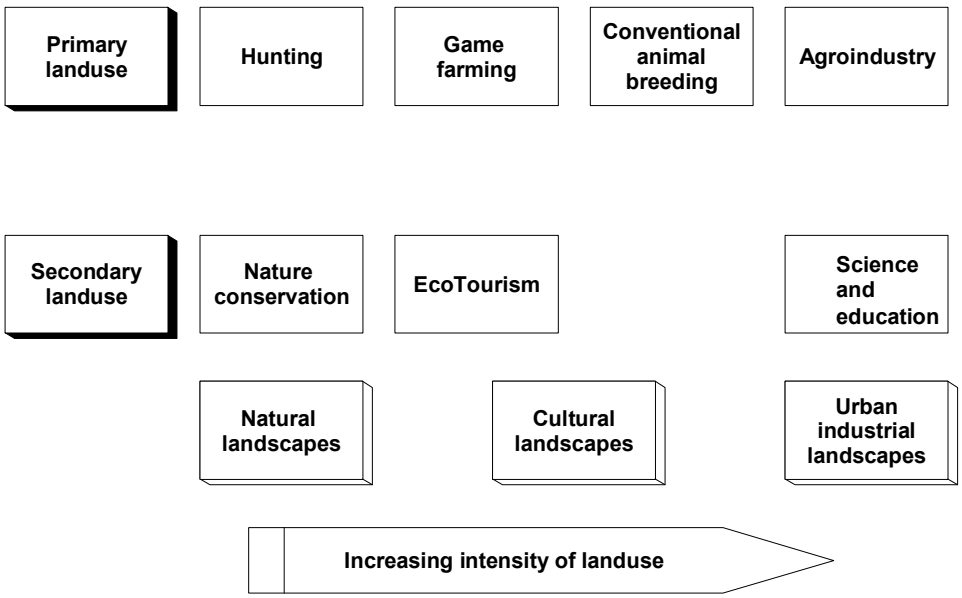
1.6 Classification of Land Use by Animals According to Intensity and Objective

Theoretical approaches to land use

Landscape classification	Natural landscape	Cultural landscapes
Conservation strategy	Segregative nature conservation	Integrated nature conservation
Concept of differentiated land uses (Odum 1973, Haber 1979)	Protective areas	Productive areas
Concept of landscape functions	Supply with water, air and soil	Supply with recreation, science, aesthetic satisfaction

Application to land use by animals

We also distinguish between **primary land use,** related to property or access rights, and **secondary land use,** a sort of by-product of primary land use and in most cases a public good.



Primary land use implies a direct use interest: nature as a private and market-oriented production factor. It usually leads to a change in the environment. Secondary land use, however, requires the preservation of nature as a collective consumptive good. Thus land use conflicts often arise from conflicts between productive and consumptive attitudes (or rather, people carrying such attitudes, e.g. rural people vs. urban people) towards nature (see also Chapter 7).

1.7 Preliminary Ideas on optimal Land Use

The question of optimal land use cannot be answered without considering landscape visions or guiding principles of regional planning (see also Chapter 6).

Scenario 1: Strict distinction between urban and rural landscapes: the rural landscape consists of high density forests and areas under intensive agriculture and the intensity of traffic between the cities is high.

- Subscenario a: free market, free trade
- Subscenario b: regional development based on cycle economy

Scenario 2: Strict partition or zonation of the landscape into protective and productive areas (concept of differentiated land uses), maximization of production on the smallest possible area (high-input-high-output agriculture)

- Subscenario a: free market, free trade
- Subscenario b: regional development based on cycle economy

Scenario 3: Integrated land use, conservation, preservation, and production on 100 % of the area, sustainable use of resources

- Subscenario a: free market, free trade
- Subscenario b: regional development based on cycle economy

These scearios have to be qualified taking into accoun also the effects of globalization.

1.8 General Remarks on Man-Animal Relationships

The modern, or more precisely post-modern human society, seems to be alienated from nature and animals in particular (see Chapter 5.2). As the everyday life gets more and more technology oriented, animals are less and less needed to achieve basic living standards. Motor vehicles, powered by fossil fuels, have completely substituted horse-drawn vehicles, and tractors now replace the animal-drawn plough. A contradictory picture arises:

- The economical function played by domestic animals is almost reduced to the production of food for humans. Animal breeding, transport and slaughtering are often carried out in violent conditions.
- Large numbers of other animals have become beloved pets given out as Birthday or Christmas presents, but always at risk of being carelessly abandoned when vacation times approach.
- There are constantly more and more books published on natural history in western countries, and this goes almost at the same rate as the nature around us is being destroyed. Many TV shows introduce us to wild animals of remote countries, since these species have been extirpated from our own regions long ago.
- Post-modern conservationists dream of reestablishing the ancient megafauna in Central Europe including not only the large herbivores (Chapter 3.10) but also the carnivorous top predators (bear, wolf, lynx) which find only a very low degree of acceptance in the general public (see Chapter 3.14 and 3.16).

1.9 Why Apply Animals in Landscape Management? (Personal remarks H. Fromm)

The application of a specific land use type by any actor or entrepreneur is based on various decision criteria:

- **Personal reasons** for a specific choice have to be expressed.
- A general method for the achievement of environmental goals **(landscape visions, guiding principles)** has to be defined.
- The **natural resources** of each place have to **inventoried and quantified** including parameters such as landscape beauty.
- The **infrastructure** (size, shape and recolonization potential of the area, structure of tourism, local markets, technical facilities, prerequisites, staff) has to be considered.
- Aspects of **business administration and economy** (investment, capital, financing, (private, public support, model plans, risk capital etc.), accounting, time demands, market prices) have to be considered.
- **Legal aspects** (tax and trading laws, acts of approval) must be observed very closely.
- **Public relations** (analysis of the market, target groups, analysis of the socio-economic background, lobbying, classic public relations in the printed press and other media) is an integral part of each planning.
- **Marketing** (incl. advertisement, direct marketing, union of co-operative societies, diversification) of potential products is necessary.
- **Historic traditions** influence land use to a great extent.

Basically we can distinguish three types of landscape management to achieve also non-economic goals (such as nature conservation, see also Chapter 2.11):

- **No management** (natural succession, natural dynamics, „Nature does it best“ approach, no costs- no profits?)
- **Mechanical management** (e.g. top soil removal, mowing, mulching, cutting, fire; such measures may be either expensive or socially unacceptable, such as fire management in Central Europe)
- **Management by means of the introduction of animals** (both wild and domestic animals)

Certain animals will be more easily accepted than others, often depending on the social values they are associated with (see also Chapters 1.5 and 2.1):

- Spiritualism and religion, history, culture, science, sociology, economy, public interest, education

On the other hand animals may cause difficulties:

- Access to specific breeds, difficulties in breeding, costs, acceptance, danger.

1.10 Approaches to ERM (Ordered According to Refinement, Barrow 1999)

All the approaches mentionned can be carried out by **experts and semi-experts** (scientists and planners) only, or the **integration** of land users, interest groups, and common sense knowledge can be pursued as early as possible in the planning process **(cooperative planning)**.

Approach	Characterization
Ad hoc approach	"Muddling through"
Problem solving approach	Obvious problems are addressed through expertise and goals for problem solving are set
Specialist's approach (resource management stricto sensu)	Environmental media (protected goods, resources) are managed according to their own logic (soil, water, air, plants, animals)
Systems approach	Management of defined systems (natural ecosystems, agroecosystems)
Regional approach	Management of physiographic regions or drainage areas
Strategic or integrated approach	Long term and side effects are incorporated into management concepts
economic, social and political approaches	Specific aspects of the socio-economic system are integrated to the decision-making process
Human ecology approach	Mankind as a whole is included into the considerations of environmental managers
Global approach, Gaia theory	The entire planet is regarded as a homeostatic system and is included as such into considerations

1.11 Framework for Management Objectives (Barrow 1999)

General relations

Management deals with the treatment of nature in an ecological, social and economic context. In all subsystems objective facts (treated by scientists) can be distinguished from values (used for decision-making by planners and managers). Note that the „ecological value" is not derived from ecology alone, but also includes socio-economic considerations (see Chapters 6 and 7).

Social system	Ecology	Economy	
Intensity of use	Ecological impact	Cost	Objective facts
Social values (derived from user´s expectations)	Ecologically oriented value	Economic values (cost-benefit analysis)	Values

Instruments of ERM

Note that all these aspects are not purely theoretical but can be found in the following considerations, regarding land use by animals.

Approaches	Instruments	Level
Advisory	Environmental education	Public
	Model farms and other examples of ecologically oriented management	Public, enterprise
	Media and public relations	Public
	Professional advice, consulting	Enterprise
Economic	Taxes	Public
	Grants	Public
	Subsidies	Public
	Quotas	Public

Regulatory	Standards	Public
	Restrictions and monitoring	Public
	Licensing	Public
	Ecolabelling, ecoauditing	Enterprise
	Zoning of landscape	Public

1.12 Summary for Chapter 1

Land use is embedded within a complex web of formal organizations, access and property rights, aims, motives and preferences of individuals as well as existing regulatory instruments and procedures. In the same way, individual decisions are influenced by:

- **The state** (legislation, administration, jurisdiction, public education).
- **The market** (investments, price fluctuations, marketing, taxation etc.).
- **The civil society** (the various activities of associations, parties, unions, interest groups, corporations, NGOs etc.).

Many decision patterns have a strong historical component and need to be adapted to the on-going development of complex modern societies.

1.13 Selected Readings

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2 Rare Animal Breeds in Landscape Management

2.1 Functions of Domestic Animals

Domestic animals are found all over the world. Certain native breeds like llamas are restricted to South America, while others are distributed over a wider geographical range, often through human interventions such as cattle breeding. The **cultural history of mankind** is closely connected with the presence of animals in general, and domestic animals in particular. The interactions between them are of a complex type and may vary widely:

- Animals as source for food and raw materials
- Animals in a special partnership in war and battle conditions
- Animals used in certain sports
- Animals used both as prey for hunting and as a helpful tool for the hunter
- Animals as caretakers and observers (dogs, geese)
- Animals as means of transportation
- Animals as symbols of social ranking and representation
- Animal as incarnation of human beings etc.

The use of animals in the completion of special tasks, such as management of landscapes and the preservation of rare domestic animal breeds is a **new aspect**. Historically landscapes have to a large extent been influenced by the activities of domestic animals (e.g. cattle and pigs in lowland forests, sheep and goats in hilly and mountainous areas). The aim of this short chapter is to give a first insight into the different aspects involved in the interactions between domestic animal breeds, with an emphasis on rare breeds and different types of landscapes and habitat patterns.

2.2 Domestication

General

Domestication is the process of subjecting a wild animal to **human control,** including the extensive associated behavioral changes. As a consequence of domestication, changes in morphology, physiology, and behavior of the animal species occur. These new patterns are inheritable, i.e. genetically stable. Back-crossing a domesticated animal with its wild counterpart is theoretically possible. The effects of domestication may stabilized in a reproductive population under selection for further breeding over generations. At the end of a domestication or breeding process a new *breed*, *race*, *line,* or *typus* is obtained. The capture and caging of wild animals for special usages (e.g. as amusement pets) is not regarded as domestication.

In recent times, a lot of different breeds of domestic animals have been created. A small number of these breeds is actually used as livestock for the production of meat, milk, and various other products. These major breeds are usually used in intensive management. Typical livestock breeds are the Friesian-Holstein breed in the case of cattle, different hybrid-lines in the case of pigs, etc. Certain breeds are used only locally or as a genetic resource; others are not used presently, but are already in a reproductive status.

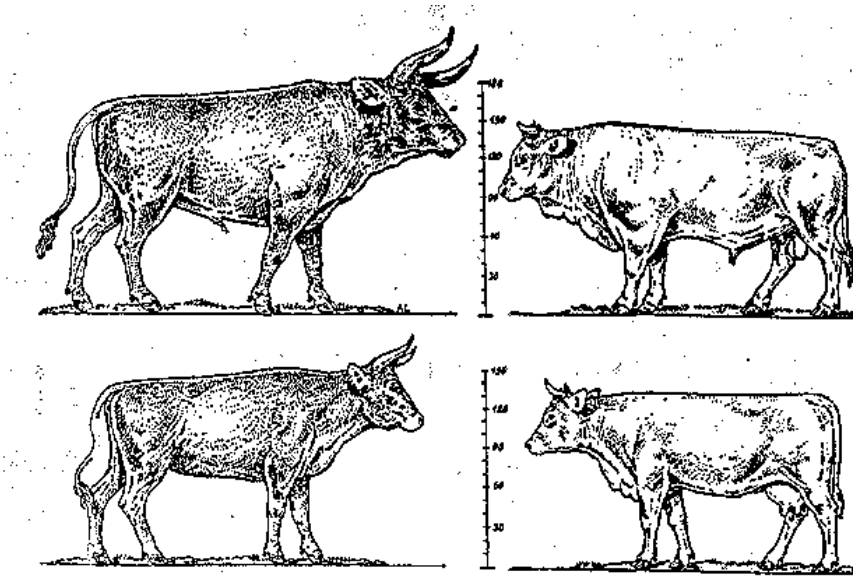
Classification Scheme

- Mainstream domestic animals like cattle are often composed of a lot of different breeds, some of which are very common while others are relatively rare (primary typus of rare domestic animal breed).
- Minor domestic animals like the ass, i.e. with only a few different breeds, are rare domestic animal species (secondary typus of rare domestic animal breed).
- Rare does not necessarily mean "endangered" but it could: A rare breed in a stable reproductive situation is not endangered. A rare breed in uncontrolled conditions is strongly endangered.

2.3 History of Domestication (Cattle, Horse, Sheep)

Cattle

All cattle breeds, even the Zebu, but not the Water buffalo, are descendants from the Ur (Bos primigenius). This wild cattle became extinct in the beginning of the 17th century in Central Europe. The Ur had come into competition with the domestic cattle and was therefore hunted intensively. In the 1920s, attempts were made to go back to the original form by cross-breeding different primitive domestic cattle forms. The result was the "Heck cattle" (bred in the zoos of Berlin and Munich) which bears a slight resemblance to the original game species. The total stock of that breed reaches 200 individuals worldwide.



The figure shows the Ur (left hand side, male above, female below) and the Heck cattle (right hand side, male above female below).

Horse

All domestic horses are descendants of the Przewalski horse (Equus ferus przewalskii), which until recently could be found at the margin of the south-western Mongolian steppes, but is nowadays probably extinct in nature. The few captured individuals have increased to above 1,000 in zoological gardens all over the world. Breeding and reintroduction programs are carried out through the participation of several institutions, particularly in France. As a genuine wild horse the Przewalski horse has a standing mane. The Tarpan horse (a wild horse living in central and eastern European woodlands) was sometimes regarded as the western subspecies

of the original wild horse, adapted to life in woodlands instead of steppes. It was also regarded as the wild form of certain horse breeds. However, it may already have been a domesticated form. Back-crossing from old Polish Tarpan-like horses led to the Konik Polskie, a strain which is kept as the European wild horse in various locations.

Friedrich the Great of Brandenburg and sheep breeding

Mainly because of the poor soils of Lower Lusatia and Mark Brandenburg, an increasing `set aside` of agricultural land has taken place since the middle ages. These areas were converted ito sheep meadows (= Schaf-Triften). In Prussia, sheep breeding was strongly favoured (`golden fleece`). Until the 1870s this economical branch was a "flagship" of German agriculture. Later, cheaper imports from overseas became available.

2.4 Classified List of Domestic Animals (according to Zeuner 1967)

Mammals domesticated before the development of agricultural societies
- Dog (Wolf)
- Goat (Wild goat)
- Sheep (Mouflon)
- Reindeer

Mammals domesticated during the development of agricultural societies
- Pig (Wild boar)
- Cattle (Ur)
- Water buffalo
- Yak
- Banteng
- Llama, alpaka (Guanaco)

Mammals domesticated as animals used for specific procedures
- Camel and dromedary
- Horse (Wild horse)
- Ass (Wild ass)
- Mule
- Asian wild ass

Mammals used as predators against pests
- Cat
- Ferret
- Mungo

Other mammals
- Rabbit
- Guinea pig
- Fat dormouse

Mammals in experimental status
- Indian elephant
- Cheetah
- Hyena
- Fox
- African elephant
- Elk (wapeetee)
- Fallow deer
- Various antelopes (e.g. eland)
- Ibex etc.

Gallinaceous birds
- Chicken, fowl (Bankiva)
- Peacock
- Guinea fowl (Perlhuhn)
- Quail (Japanese quail)
- Pheasant
- Turkey

Other birds
- Pigeons, doves
- Various birds of prey, raptors
- Ducks (mallard, musk duck)
- Geese (grey goose)
- Pelican
- Cormorant
- Ostrich
- Parrots (e.g. grass parakeet)
- Canary bird
- Other passerine birds (e.g. zebra finch)

Fishes
- Carp
- Goldfish

Insects

Silk worm moth (Seidenspinner)
Honey bee

2.5 Animal Production in the World

Some statistics are provided here to elucidate the amount and nutritional value of animal products, in particular milk.

General (after FAO Production Year Book 2007-2008)

Product	**[1,000 t/year]**
Meat (cattle, pork, sheep, poultry a.o.)	254.000
Milk	664.000
Eggs	67.400
Honey	1.400
Wool (sheep)	1.800
Pure silk	110

World production of milk (after Schindler, 1983 & FAO, 2009)

	1970		**1980**		**2007**	
Animal species	**[1,000 t]**	**[%]**	**[1,000 t]**	**[%]**	**[1,000 t]**	**[%]**
Cattle	366,405	90.6	427,162	91.0	567,000	83.5
Buffaloes	24,209	6.0	27,199	5.8	86,600	12.8
Sheep	6,794	1.7	7,671	1.6	9,04	1.3
Goats	7,082	1.7	7,386	1.6	15,1	2.2
Total	**404,490**	**100**	**469,418**	**100**	**679,000**	**100**

Composition of milk from different cattle and buffalo breeds in % (after Legel, 1989)

Breed	Dry substance	Fat	Protein	Lactose (milk sugar)
Holstein Friesian	12.07	3.53	3.08	4.78
Jersey	14.91	5.37	3.92	4.93
Brown Swiss	13.40	4.00	3.60	5.00
Yellow Cattle	12.90	3.70	3.50	4.90
Red Sindhi	13.44	4.92	2.85	4.58
Indian Land breed	14.30	5.61	3.01	4.79
Philippines Buffalo	20.40	9.70	5.30	5.30
Italian Buffalo	18.9	8.50	4.50	4.60

2.6 Rare Cattle Breeds

The best experience with habitat management using animals is found with respect to different cattle breeds.

Animal breed	Occurrence, range	Suitability for habitat management
Red Highland Cattle (Rotes Höhenvieh)	Vogelsberg / Hessia, Central Germany	Dry grassland areas
Yellow and Glan cattle	Rhineland-Palatinate, Saarland	Dry grassland areas (see picture)
Hinterwälder cattle	Southern Black Forest	Dry grassland areas
Highland	Scotland, nowadays also Central Europe	Many grassland areas, high robustness and climatic tolerance (see picture)
Galloway	South-Western Scotland, meanwhile Central Europe	Many grassland areas, good for landscape management (see picture)
Aberdeen Angus	Scotland	Many grassland areas (see picture)
Hungarian steppe cattle	Hungary	Dry grassland areas (see picture)
Maremmana	Middle-Italy (Tuscany)	Macchie-areas, also swamps (see picture)
Water buffalo (Bubalus bubalis)	Asia, South-eastern Europe, Italy, nowadays also South America	Wetland areas (see picture)
Heck cattle	Some zoos (about 200 individuals)	Back-bred wild cattle, but does not share the high climatic resistance and stable health of the original

2.7 Rare Sheep Breeds

Animal breed	Occurrence, range	Suitability for habitat management
Grey horned heathland sheep (= Graue gehörnte Heidschnucke)	Northern Germany	Heathland areas with strong regeneration of heathland shrubs, stifling on copses and woods
Mire sheep	Northwest Germany	Bogs and mires, only breed which is stifling on bitter birches

Skudden	Originally Baltic area, nearly extinct in the 40s, sheep of the Vikings?	Dry and poor nutrient soils, post-mining landscapes
Rough woollen Pomeranian sheep	Pommeria	Wetlands and mires, robust and strong resistance to infections of the claws and climatic conditions
Rhön sheep	Central Germany	Different habitats of medium mountains
Mountain sheep (several breeds)	Alps	Montainous and alpine habitats, great assurance on rocks and tolerance of high rainfall
Racka (= Zackelschaf)	Hungary	Puszta
Karakul	Southern parts of former GUS, Afghanistan	Steppe and plains, Persian wool

2.8 Rare Breeds of Other Species

Donkeys and horses

Animal breed	**Occurrence, range**	**Suitability for habitat management**
Mule	Southern Europe	Good, but not kept of this reason
Konik Polskie	Poland, post-mining landscape East Germany	Good
Several "primitive" horse breeds (pony-like small horses)	World-wide	Medium, but not kept of this reason

Pasture pigs

Animal breed	**Occurrence, range**	**Suitability for habitat management**
Mangalitza	Hungary, Ukraine, Bulgaria	Cultural asset, robust, undemanding
Several pig breeds	World-wide	Not always suitable

2.9 Organization of Breeding

The organization of breeding requires a long-term forecast of demand for animal products and/or services. Feeding physiology and economic conditions must also be taken into consideration. Some necessary steps are:

- Development of an effective breeding management
- Organization of artificial insemination and computing techniques
- Organization and realization of tests (=Leistungsprüfung) (not only for milk production but also for the ability to use and cultivate nutrient poor pastures, resistance to climatic conditions and diseases, easy calving, etc.) and estimation of breeding qualities
- Education and training of the staff
- Working out breeding programs
- Planning, organization and turnover of animal stocks (bulls, stallions etc.)
- Rapid application of scientific results
- Legislation

2.10 Population Genetics of Domestic Animal Breeds

Factors used to evaluate the endangerment status of a breed (see http://www.tiho-hannover.de/einricht/zucht/eaap/factors.htm#methods) are as follows:

1) Main factor: Effective population size N_e

N_e is an indicator of the increase in % inbreeding Delta-F per generation (and decrease of heterozygocity) of loss of genes due to the random drift of allele frequencies from generation to generation. Five classes of endangerment are defined according to the expected total increase of inbreeding Delta-F-50 during 50 years of reproduction, based on the value N_e:

Class of endangerment	Delta-F - 50%
Not endangered	< 5
Potentially endangered	5 – 15
Minimally endangered	16 - 25
Endangered	26 - 40
Critically endangered	> 40

Species with a short generation time (i.e. with more reproduction cycles in 50 years) are more vulnerable than others.

$N_e = 4 * m * f / (m + f)$

with m and f = respectively numbers of male and female breeding animals registered in the herdbook, which are available for pure-bred reproduction of breed. m and f must be known or estimated. N_e is mainly affected by m, the number of males.

Main assumptions for the use of N_e as indicator of Delta-F: Random mating, equal number of offspring per male and female, respectively, for use as parents in the next generation. Deviation from assumptions means lower N_e and higher level of endangerment!

2) Additional factors:

- In-crossing, i.e. the use of animals from different breeds for reproduction: Shifts breed down one class of endangerment if more than 20% of matings are performed by animals from different breeds, respectively.
- Decreasing number of females: Shifts breed down one class of endangerment if the trend is decreasing and the number of females f is less than 1000.
- Number of breeding herds: Shifts breed down one class of endangerment if the number of herds is less than 10 and the number of females f is less than 500.

3) Restriction of breeds:

In this update the status of endangerment was defined only for autochtonous, local or native breeds without any imports (© Copyright Department of Animal Breeding and Genetics, School of Veterinary Medicine Hannover)

Genetics of Domestic Animal Breeds / Tools and Data bases

The EAAP-Animal Genetic Data Bank of the European Association for Animal Reproduction www.tiho_hannover.de/Forschung/Zucht/eaap/Welcome.html

List of national coordinators and other providers of information www.tiho_hannover.de/Forschung/Zucht/eaap/coord.html

GENRES

Animal Genetic Resources (TGR) www.dainet.de/genres/genreadk/tgr/tgr-title-e.htm, www.dainet.de/genres/infos/projekte-e.htm, www.dainet.de/genres/infos/literatur-e.htm

Bundesinformationssystem Genetische Ressourcen (BIG)

The European Initiative for Agricultural Research for Development (EIARD) www.dainet.de/eiard/homepage

2.11 Interactions Between Domestic Breeds and their Environment

General Aspects

It is often considered that animal production on arable land, which involves two trophic levels is inevitably more complex than plant production. The animal (or products obtained from it such as milk, wool etc.) is the ultimate objective of production, but the manager must also be concerned about the productivity and nutritional value of the plants. In `rough grazing systems` the unfavourable environment practices, such as ploughing, sowing or fertilizing are regarded as uneconomic. Management techniques that can be used affect the animals by altering the stock intensity or moving them from one area to another.

Alternatives of use:

- Re-intensification of land use, application of high-tech equipment, ecologically oriented agriculture (= ökologischer Landbau)
- Non-food production: afforestation, growing of renewable raw materials and energy sources
- Conservation of cultural and natural landscapes for the sake of landscape aesthetics
- Preservation and production of natural resources (abiotic: water, soil; biotic: wild plants & animals)
- Combination with leisure time and recreation activities (ecotourism)

The last three aspects can be enhanced by rare domestic animal breeds!

Mowing vs. Grazing

For the management of landscapes and natural areas the following methods with different effects on vegetation cover and plant species composition are available.

Assessment of techniques for dry grassland and heathland restoration and management (after DVL & LUA, 1998)

Restoration technique	Regenerating potential of heathland	Removal of copses	Nutrient content	Diversity of habitat structures
Mechanical management techniques				
Top soil removal (= plaggen)	Good, but slow	Good	Strong decrease	Decreasing

Fire management	Good	Good	Strong decrease	Probable increase
Mulching	Good	Mostly good	Litter increase	Decreasing
Mowing	Good, but slow	Poor	Slight decrease	Decreasing
Management by animal breeds				
Grazing by sheep breeds	Good	Middle	Slight decrease	Increasing

Domestic animal breeds, especially those descending from old and indigenous breeds, can hold in the management of rare and endangered habitats. These habitats (e.g. heathland as a substitute for forests) evolved from the land use form(s) that took place over the centuries and can only be protected in the future if the former use is continued at the same intensity. The third possible strategy (no management = natural succession) will fail on the long run in non-climax ecosystems.

2.12 Site Characteristics of Central European Habitat Types Suitable for Habitat Management

Some typical habitat types of Central Europe have become rare in the intensively used cultural landscape. As an economically oriented agriculture is no longer practicable in these areas, habitat management with animals could be one possibility to preserve them. This means that preserving open unproductive areas is regarded as a useful strategy of environmental management.

Habitat types to be conserved	**Site characteristics**
Bare sand	Sparse or absent vegetation, relatively steep slopes, dynamic movement of sand and gravel
Arid, nutrient poor grasslands	Different soil types and geology (sand, lime, slate, granite, gravel a.o.), sparse vegetation but high diversity of plants and animals
Silvergrass meadows	Sandy soils, mostly covered by *Corynephorus canescens* with a low biodiversity, post-mining landscape and military training areas
Dry heathlands	Poor soils, post-mining landscape, military training areas and open pine forests
Ruderal herb vegetation	Closed vegetation, very patchy, varying height, with short grasses, herbs, and mosses
Tall grass prairies	Closed and dense vegetation mostly of *Calamagrostis epigejos*
Raised bogs	Without connection to the groundwater (rainwater mires), mostly Sphagnum bogs, very wet
Fens	Mires with connection to the groundwater (several hydrological types)
Reed swamps and large sedge communities	Closed and dense vegetation with Phragmites and Typha, low vegetation diversity
Moist grasslands	High biodiversity
Salt marshes	Closed vegetation
Alpine pastures	Patchy vegetation, high species diversity

2.13 Domestic Animal Breeds versus High Technologies in Agriculture and Landscape Management

There are a lot of reasons for the application of domestic animal breeds instead of machines in the management of habitats:

- A high flexibility of grazing leads to a structural diversity during cultivation or management.
- The mobility of animals can be used for changing locations.
- The small ruminants (= Wiederkäuer) show good abilities for cross-country movements and can generally be placed in steep and inaccessible areas, where machines can hardly be used.
- Multiple uses make economic sense: besides grazing and thereby cultivating the land, the animals produce meat, milk, wool and other products.
- Grazing animals in a landscape represent an enrichment for tourists.
- Old and indigenous breeds represent not only cultural and historical values, but also constitute a reservoir of genes.
- The protection of wild plants and animals can be combined, with lower costs per hectare.

2.14 Case Study: Feeding Behavior

Cattle

Cattle grasp plants with their rough tongue, bring them into their mouth, press them with the lower incisors against the upper dental plate and tear them off in a tweak. Nearly every reachable plant will be eaten consistently. This feeding technique allows for a grazing as low as to 2 cm above ground. This leaves enough vegetation to recover.

Sheep and goats

The small ruminants use their very flexible lips for holding the plants instead of the tongue. That's an explanation for their very selective feeding behavior and their deep grazing effect. Sheep tear off the plants with a stronger jerk than cattle, although by grasping the grass with the lower incisors and upper dental plate in a similar manner. The resulting manure is beneficial to certain insects and rare preying birds. The selective grazing of sheep affects the plant communities, for example by favoring an increase in populations of Gentiana spec. or Carlina acaulis.

2.15 Case Study: Methods of Production of Animal Breeding on Grassland

Cattle farming

Methods	Assessment
Dairy cattle breeding	Bad feeding conditions because of poor nutrient contents in the plants. The herding areas are mostly unfavourable and usually far from the stables, causing higher efforts in the milking process. High output of manure leads to an increase of nutrients in these habitats
Fattening bulls and young stock	Food source too small, counterproductive because of high nutritional input and therefore high output of manure, in case of an external feeding
Pension cattle breeding	Only small influence on the composition of breeds
Young stock breeding	Good, but nearly independent of breeds
Mother cattle breeding	Good, but some requirements for fertility of breeds are easy calving, vitality of calves and climatic resistance

Sheep farming

Methods	Assessment
Standing pastures	The whole year is spent at the same site (1 – 3 sheepfolds) leading to selective undergrazing in spring, followed by heavy overgrazing of the area
Paddock pastures	4 – 8 sheepfolds (fixed fences), feeding time 1 – 2 weeks
Driving pastures	> 8 sheepfolds (electric fences), short feeding times (3 – 4 days), good for cultivation areas
Portion pastures	Mobile electric fences, very short feeding times (0,5 – 1 day), good for cultivation of small areas
Sheep tending	No fences, short feeding time, large flocks and areas needed, good for cultivation of different areas
Transhumance	Cultural heritage (Schwäbische Alb, Southern France, Spain), summer and winter pastures, transport over large distances

2.16 Case Study: Grazing Management – Influencing Factors

For an economic benefit (beneficial to the farmer) and an ecological gain (conservation of a species rich landscape and soil protection) – optimal results of grazing management – certain mutually influential aspects have to be considered:

- **Site conditions**, differing according to topography (plain – steep), soil conditions (dry – wet), or fodder yields (poor – rich)
- **Domestic animal species present** (cattle, sheep etc.), with respective trampling patterns and feeding behavior, including a spectrum of potential food items and corresponding biting effects
- **Density of stock.** Soil conditions and vegetation composition have to be taken into account to avoid under- and overgrazing

Calculation of the density of stock

	GVE / *lu*	RGV
Calves, young stock < 6 months	0.3	0.1
Cattle > 6 months < 2 years	0.6	0.6
Cattle > 2 years	1.0	1.0
Mother sheep (incl. Lambs < 6 months)	0.15	0.12
Other sheep > 1 year	0.1	0.1
Horses < 6 months	0.5	0.25
Horses > 6 months	1.0	1.0
Fallow deer	0.17	0.17

GVE: Großvieheinheit (cattle and horses unit / *livestock unit*)
RGV: Rauhfutter verzehrende Großvieheinheit (rough fodder feeding cattle and horses unit)

2.17 Further Management Factors

Strategies for a higher income from grazing management regimes:

- Achieve a higher turnover, higher quality and better prices (see marketing strategies below)
- Optimize stock density
- Lower input of time, staff, fertilizers, feeding and veterinary costs, etc. because of well adapted animal breeds

Effects of the stock density on the potential growth of living biomass of cattle (200-250 kg) on a 100 ha natural pasture over 100 days (after UN-report 1963)

Numbers of cattle on 100 ha	Grazing type	Part TDN used for growth of living biomass	Total development [kg]	Development of living biomass per animal and day [g]
17	Slightly understocked	32	+630	+370
25	Optimal density	45	+900	+360
32	Slightly overstocked	30	+600	+190
42	Middle overstocked	7	+150	+35
50	High density	0	-180	-35

Minimum required pasture size per cattle in different parts of Africa (with palaeotropic vegetation) according to rainfall and altitude (according to Rattray, 1960)

Amount of rainfall	Necessary area size of pastures	
	Lowlands below 1000 m [ha]	Highlands above 1000 m [ha]
100 – 250 (mm)	26 - 56	18 – 28
250 – 500 (mm)	10 - 21	5 – 18
500 – 750 (mm)	5 - 8	4 – 13
750 – 1,000 (mm)	4 - 7	1 – 5
1,000 - 1,500 (mm)	3 - 6	0.4 - 4
Europe for comparison	0.25 - 1	

2.18 Case Study: Changes in the Use and Function of Goats in Kenya

Traditional use:

Besides the other domestic animal breeds used in Kenya (cattle, sheep, and pig) goats are of special importance:

- The number of goats is a symbol of social status.
- Goats are used as an equivalent for money.
- Goats were also used as gift or present etc.

Milk was used for medical and cosmetic products, as well as various other applications. A half litre only per female was too small for protein production. There was no special feeding, grass was at any place. During social events the animals were slaughtered, the meat was used directly, the skin, bones etc. were applied to different uses.

Modern capitalistic usage:

- The number of animals is not the only measure of wealth anymore, as it now also depends on their price on the marketplace. An interest in new breeds arises.

Social pressure

- There is a need for stabilization or even increase in protein production. Poverty is growing.

Land use situation

- Reduced areas per family from generation to generation according to the traditional pattern of divorce.
- It is impossible to keep cattle on an area smaller than 1 ha, so the goat with its large tradition in Kenya was the aim of a project.

Project (more details see GTZ information)

New breeds with European genes for milk production and African genes for disease resistance were introduced. The situation for 1200 families today is the following:

- Joint co-operation in the feeding of the goats
- Milk production of 2 l per animal, production of dairy products for eating, especially for children
- They are supplying a market (beyond subsistence economy)
- Women get money.

2.19 Summary of Chapter 2

Land use patterns based on alternatives to conventional agriculture and involving rare animal breeds are not only oriented to the production of goods (meat, milk, wool etc.) but also to the **preservation of the breeds** themselves, as well as to the **beneficial side-effects** of a low-intensity land use of the landscape (serving certain functions such as aesthetics). There is basic knowledge provided to successfully operate in this area. Model projects exist. However, both public relations and professional consulting are still inefficient. The economic framework within the European Community remains unfavorable. The present system of grants, subsidies and quotas favors large-scale agriculture, which may be effective at food production but certainly less at securing healthy ecosystems and varied landscapes (including the life of their inhabitants). Economic incentives to directly prevent unsustainable land use practices are strongly required. In the same manner, there is a necessary implementation of improved regulatory instruments such as monitoring, ecolabelling, and landscape zonation.

2.20 Selected Readings

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Search for „+domestic +animal +breeds“ on the internet yields interesting results.

3 Hunting

3.1 Functions of Hunting

The function of hunting heavily relies on the level of socio-cultural development.

Hunting in **hunter-gatherer cultures**

- Hunting as a prerequisite for subsistence
- Hunting as a lifestyle, including spiritual aspects

Hunting in **agricultural cultures**

- Hunting as a source of additional food
- Hunting as a defense against damage to crops

Hunting in **post-modern cultures**

- Hunting as a contribution to the nutrition of urban populations (negligible)
- Hunting as a pleasure, passion, or important component of social life in rural areas
- Hunting as an ecological, economic, social or legal necessity

People have many, often contradictory opinions on this issue. In France, a political party was even founded in order to defend the apparently threatened rights of hunters. „Threats" mainly come from nature conservation and tourism interests (attitudes typical of the urban class). In Italy we can find an ongoing discussion over the hunting of passerine birds. Hunting has retained a certain importance for the public in Germany as well. For example, influential people (politicians, industry leaders) often meet for hunting.

3.2 Attitudes of Different Social Groups towards Hunting

Social group	General attitude	Attitude towards the game	Attitude towards hunting management
Hunter	Enthusiastic: hunting is seen both as a natural, ecological and legal necessity, as well as a sustainable form of land use, justification is unnecessary	Passionate: centre of interest, likewise object of preservation, venison and trophy making, special hunting language	Favorable: Long hunting tradition is related to elaborated management techniques, oriented to high density of desired game
Forester	Divided: priority is given to forest and tree growth, mostly for economic and safety reasons (intact mountain forests minimise avalanches and landslides)	Divided: Ranging from hunting object, preserved wildlife to nuisant pest	Favorable: Because of close connections between hunting and forestry, but contradictory approaches to certain aspects (lower density desired)
Animal rights Activist	Strongly opposed: no killing of animals is justified, except in case of self-defense	Passionate: „rights" of animals important, often romantic „Bambi" mentality	Opposed: Any impact on natural population dynamics is viewed as negative
Left-wing social critic	Sceptical: hunting as a legacy of feudalism	Neutral	Psychological: hunting viewed as macho-behavior of rich and armed „old-fashioned" men
Game biologist	Realistic: hunting on a true „ecological" basis, taking into account new results of investigation	Neutral: object of research in ecology and biology, and conservation activities	Neutral: depends on the context

3.3 A Short History of Hunting in Central Europe

Until the 8th century hunting, grazing and logging activities were mostly conducted by rural village communities, also known as the commons („Allmende“). Documents indicate that in the 9th century the right for hunting was progressivley transferred to rulers such as kings, dukes, bishops, etc., as a privilege. Hunting by other social categories was regarded as „poaching“ and severely punished. For the free farmers this lead to unacceptable circumstances.

During the 14th century, and following heavy riots in the rural population the right for hunting was finally handed back. Overhunting reduced game numbers to a minimum. This period of perpetual colonization over centuries also lead to the clearing of wide tracts of forest, replaced by cultivations, and again to the centralization of the hunting rights into the hands of the feudal houses of the various dynasties. Most villages and towns of the Brandenburg / Prussia region were founded about 700 years ago.

The passion for hunting of the former sovereigns presupposes high game stocks and thus a strong pressure on the remaining forests. The woodlands of whole landscapes were devastated because rights for grazing and logging were passed on to farmers, charcoal producers, ash-burners, glass- and iron-works, mines and quarries. The first shortages of wood already occurred in the 16th century. To end the ongoing devastation of forests through fire, clear-cutting, grazing, and logging the feudal houses introduced forestry rules and warranted protection status to the woodland areas with good hunting options. But hunting excesses attained their climax only in the 17th century, when the capturing of whole herds into corrals and their subsequent killing in front of fascinated crowds occurred. The poor people were not permitted to hunt, even when locally elevated game stocks were devastating their lands and crops. The punishment for poaching was high.

The lack of wood at the beginning of industrialization required an organized forestry. Therefore, during the second half of the 18th century the plantation of forests began on a large scale. This is the beginning of regulated and systematic forestry practices. The land reform brought about by the 1848 industrial revolution connected the right for hunting with property and ist result was thus to free farmers. But the first decades of free hunting resulted in strong losses, not only of game, but also of other species (predators and raptors). As a consequence, “feudal structures” in hunting were actually re-established in the 1930s in Germany (under the Nazi regime).

3.4 Hunting in Germany Today

General legal basis

There is an elaborate legislation for hunting in Germany. The legal framework for hunting activities is defined in the „Federal Hunting Act“ (Bundesjagdgesetz) and more specific rules are to be found in the hunting laws enacted by the federal states. Additional regulations regarding the relationships between forest and wildlife are embedded within the forestry laws of the federal states and the respective programs of state forestry.

Objective of the law

The hunting law, taking into account other public interests, has the following objectives:

- The preservation of healthy populations of game, high species diversity, and a proper balance with natural living conditions.
- The limitation of damages to the forest and surrounding agriculture caused by game.
- The balancing of hunting with other public interests, especially those pertaining to nature conservation, landscape management, and recreation.
- The prevention of cruelties inflicted to animals.

Certification for hunting

The federal law requires the hunter to possess a license. You can get this license for hunting (shooting license) only after succeeding at an exam, which proves a certain amount of knowledge and the ability to behave as an educated hunter and gamekeeper. Several types of examination take place (written, practical/oral, shooting with a shot gun and with a rifle), which demonstrate an understanding and acceptance of numerous aspects of hunting (biology of game species, hunting regulations, rights and duties, concepts of nature conservation, use of firearms and ammunition, security and first aid, hunting management and practices, utilization and marketing, training of hunting dogs, diseases, feeding, forestry and agriculture, hunting customs, ethical aspects, etc.).

However, this hunting certificate does not in itself give its owner the right to hunt. It is further related to the possession of land. A land owner can be a private person or a hunting co-operative, and can use the hunting right for himself in case he succeeded at the examination and obtained the certificate. As there is a kind of obligation related to land management and land use in Germany, a non hunting land owner may pass on his hunting right to others – in most cases this will be leased for money.

Hunting grounds and hunting seasons

The hunting area has to be of a minimal size (for an individual permit holder: minimum of 150 ha, for a hunting co-operative: minimum 250 ha) according to specific wildlife requirements. The duration of a lease is also restricted by law and lasts for a period of nine years at minimum.

Hunting activities must observe well defined seasons – open or closed – which may differ between states (see Chapter 3.16). All game species are under protection from hunting during their breeding season. Hunting is prohibited during the night. Other prohibitions apply to the use of spotlights, shooting from the inside of a car and the use of dog packs. In order to spare pain or to prevent the spreading of an epidemy, there usually is no temporal restriction to the hunting of ill game.

Shooting plan

There is a requirement for certain game species (red deer, fallow deer, roe deer) to submit a so-called shooting plan for approval by the lower hunting authority. Once licensed, the shooting plan must be respected and fulfilled so that levels of game do not get too high, in other words in order to avoid damage by game, such as listed below:

- Agriculture: foraging in fields of corn/maize, cereals, potatoes, clover, and grassland.
- Forestry: 1. biting young trees, mainly leafy trees; 2. pealing of tree bark during both winter and summer, often leading to infections by fungi and a consequent reduction in economic value, and; 3. sweeping the antlers against trees, thereby damaging the young ones.

Otherwise the hunting lessee may be required to pay for damages, which can be very expensive. A hunter might be caught between two waters: a high game density may bring in a lot of

trophies, but also high damages and related costs. The population sizes of cloven-hoof game species (roe deer etc.) must correspond to their natural living conditions. The relevant basis for the shooting plan are the status of vegetation cover (biting of vegetation, barking and pealing of trees) and the physical condition of the animals. For the elaboration and approval of a shooting plan, a yearly monitoring of game density has to be performed.

Losses of game from traffic accidents fully count towards the shooting plan, as well as losses from agricultural practices (mowing, harvesting) and deaths during winter. Traffic accidents with game occur very often (>100,000 accidents per year) in the highly cultivated area of Central Europe, leading to insurance damages in the hundreds of million DM and nearly 100 human death injuries each year! In certain shooting grounds, nearly one half of the shooting plan is "fulfilled" by cars! The judgment relative to the state of vegetation should be based on a comparison between fenced and unfenced areas.

Obligations for game preservation

Today's hunting in Germany is devoted to conservation of wildlife. Practically speaking, this means:

- Protection of game from dangers caused by predators that have no natural enemies: for example so-called "poaching" (stray) dogs or cats (if found more than 200 m away from a house). Here we find a controversial situation: In Germany more cats are shot by hunters than killed by car traffic (see 3.14 and 3.16).
- Active habitat management: e.g. planting hedge rows.
- Reduction of losses of young game caused by agricultural vehicles and by traffic accidents.
- Preventing pesticide application by farmers, along with the protection of hedges, and a control over the burning of harvested or fallow lands.
- Requesting foresters to produce more natural forests.
- Reduction of excess tourism and recreation pressures on forests. However, every citizen´s right to enter a forest remains untouched by this obligation.

We easily recognize common aspects, but also potential conflicts between different human interests, such as animal protection, nature conservation, tourism etc.

3.5 Organization of Hunting in different Countries

Property rights and hunting in Germany

The table shows which rights and obligations are related to hunting.

Property right	Rights, obligations	Hunting right	Rights, obligations
Landowner	Social obligation to use property for common welfare	Landowner	Unlimited use as long as no law is violated
Landowner	Obligation to manage the forest with respect to productivity	Hunter	Obligation for wildlife management
Landowner	As above	Open access	Agreements or not
Common property	Distribution of licenses	Open access	Restriction to some rules
Nobodies property	No rights	Open access	No rules

In Germany the first two possibilities occur. The second one may lead to severe conflicts, as the interests of the landowner (forest management) may diverge from the interests of the hunter (wildlife management). If the owner is either unable or unwilling to pursue his hunting right he has to pass it over to another person. German hunting regulations obviously violate certain basic theorems of environmental economics (see Chapter 7).

Hunting in Switzerland

Hunting is often organized and regulated by communes. There is a very short hunting season (2 to 4 weeks in autumn) on red deer and roe deer. The consequence is that game is not disturbed by a long hunting period, which reduces damages to agricultural land (since hunting pressure in the forest usually causes game to evade to open areas).

Hunting in South Tyrol (Northern Italy)

The system of hunting in South Tyrol (in Northern Italy) combines the advantages of a so-called free hunting with those linked to the existence of hunting grounds, avoiding their disadvantages. Hunting is mainly carried out by the local populations, i.e. those who are interested not only in the preservation of game but also in a well organized regulative system. The major prerequisite for getting access to hunting is not money but proof of residence in the relevant village.

Hunting in Canada and USA

The system of hunting in Canada and the USA is a so called "free hunting system", where you can hunt up to certain "bag limit" (for example one White-tailed Deer, either sex) on so called "wildlife management zones" (for example zones 70 to 76, including Greenwater river and Lac La Ronge provincial park, Sasketchewan), after paying a small fee at special dates (http://www.environment.gov.sk.ca/).

3.6 Problems related to high Numbers of Game and "Forest Damages"

It can not be denied that hunting in Germany bears some intrinsic problems:

- The excessive control of predators (wolves, bears, lynxes, incl. raptors like eagles, vultures, and hawks) leads to a decrease in biodiversity and ecosystem function.
- The excessive density of roe deer and red deer in many areas because of high additional feeding during winter times occasionally lead to damages to forests.

A high density of game can be considered from two points of view.

- The reduction of the deciduous forest by a combination of forestry mismanagement (up until recently, economical aims were dominating decisions, leading to the quasi-systematic reliance on fast-growing spruce and pines plantations) and a high density of game feeding in the remaining valuable sites.

Preservation means also the relief from so called „times of necessity" (= „Notzeiten"). This requires the preservation of healthy wildlife populations resistant to diseases and climate extremes. A common method is to selectively shoot the and old and sick animals. The notion of „times of necessity" appeared in the german hunting right as early as 1935, but with an ambiguous definition. At that time, the notion referred to all wildlife species, while later concentrating more precisely on certain cloven-hoof game species. Since 1976, the term in the hunting laws of various federal states is defined as the obligation of feeding red deer and roe deer, while excluding chamois and ibex, despite the difficult winter conditions these populations experience.

A short history of hunting laws and the definition of the „times of necessity“ concept:

- 1935: long-lasting periods of frost with significant snow cover, leading to reduction in food availability. This should naturally incite the conservationist to care for his game populations, therefore a penalty for lack of intervention is not planned.
- Before 1976: times of high snow cover and the first weeks followings prolonged periods of frost.
- Since 1976: the notion has no real legal definition, apart from a very general one: “times of necessity” are times when game have problems to feed. Despite this vagueness in the definition, there is a penalty up to 10.000 DM, for who does not fulfill his obligations of feeding game in „times of necessity“.

As long as the average healthy roe deer is able to survive, an additional feeding during winter times is not deemed necessary by law, although several biologists have expressed that by this time of year assistance to feeding might already be too late. Despite this obligation to feed during „times of necessity“ (according to § 43 BJagdG (3) and (4)) there remains the legal question, whether a high level of game – with the associated damages on agriculture and landscapes, endangering the very purpose of preservation – shall be provided with adequate food supplies.

Definition of „times of necessity“ from the point of view of a game biologist:

During winter times, the quality of natural grass is at its lowest level for grazing. Species like red deer tend to show a good adaptation to such circumstances, but the traditional definition of „times of necessity“ still reflects the approach taken several decades ago. It aims exclusively at the domestication of game and is not justified by specific research results. The most important times for game to accumulate reserves of fat are during late summer and early autumn.

Problem: Natural feeding grounds during winter times (alpine meadows with lower snow cover, nutrient rich areas, specialized plant species) often cannot be reached any more because they are cut off by traffic lines, streets, buildings etc. Thus the game has to stay in suboptimal winter habitats and start to feed on tree bark, leaves and twigs. Additional feeding may compensate for the loss up to a certain extent. In case of the so-called “stone-deer” (a population of red deer in the Niedertauern Mountains, Austria) it was proven that these animals can survive even under the hardest winter conditions as long as they are allowed to migrate were they like and as long as they are not disturbed by hunters in winter. They even neglect additional feeding.

3.7 Basics of Population Biology of Game

Population dynamics

What is a population? A number of potentially inbreeding individuals of the same species, which increases through birth and immigration processes and decreases through death and emigration. A population is described by the following criteria:

- Number of individuals within a defined area
- Number per area unit (density)
- Sex ratio
- Distribution of age and size classes

Regulation of game populations

Factors	**Comments**
Bottom up	
Habitat suitability	Main requirement under normal conditions
Area	Same as above
Nutrition	Same as above
Possibilities of migration	Important in case of hard conditions and for recolonization
Competition	Mediated by space and resource availability
Exceptional bottlenecks	Severe regulation effect
Internal	
Fecundity	Derived from logistic population growth, in some species influenced by density
Carrying capacity	Derived from logistic population growth, density-dependent due to intraspecific competition for resources and space
Disease and parasites	Density-dependent
Top down	
Feeding (in winter)	„Positive“
Hunting	„Negative“
Predation	Normal regulation

3.8 What is Forest Damage?

Hypothesis: Too large population densities of game species cause damage to the forest! The answer is to be given only in the light of a thorough analysis of forest functions.

Welfare functions of forests (applicable to other habitat types, too)

Type of function	**Effect of game density on respective function**
Wildlife habitat function	**Obviously positive**
- Game itself	++
- Predators	++
- Spatial diversity	++
- Diversity of plant species	+
Landscape ecological functions	**Dependent on differences between light and dense forests**
- Evapotranspiration, mesoclimate regulation	?
- Discharge regulation	?
- Soil protection	?
Economic functions	**Reduced, but not necessarily negative**
- Timber production	--
- Production of wild fruits, berries, mushroom	+
- Production of resin	-
- Production of seed material	+
Recreation function	**Increased**
- Amenity and beauty	++
- Ecotourism	++
- Hunting tourism	+?

3.9 Influence of Grazing, Reaction of Plants

Due to the preference of animals for the higher quality parts, the overall quality of the remaining vegetation is diminished. Therefore, the energetic value of the nutritional content of vegetation in a forest tends to decrease with an increasing density of roe deer population.

Defense strategies of plants

The evolutive answer of plants to renewed biting has been to develop defense strategies against grazing. Due to selection pressure, plants developed a lot of different defense strategies:

- At the surface: thorns, prickles and hairs
- Inside: secondary products of metabolism (ranging from allergens, poisons, appetite reducer to chemical signals such as alarm pheromones), increasing silicon and lignin contents.
- Facultative repellents: production of protease-inhibitors after injuries. The digestion by herbivores is reduced after uptake of these enzyme-blockers. For example the snow-shoe hares show density–dependent stress when feeding on birch leaves after the trees were cut-off.

Compensation strategies of plants

A stabilizing effect comes from a compensatory growth of plants. Moderate grazing has the effect of doubling productivity compared to fenced control plots (McNaugthon 1985, in a Serengeti study). But there was no total compensation for biting / feeding, and one should thus be cautious with conluding that grazing is in fact promoting plant growth. Compensation by plants may result from following processes:

- Reduced competition from other plants
- Higher photosynthetic rate in the remaining plant biomass
- Mobilization of stored carbohydrates or proteins
- Regeneration of plants by grazing of old, „excess“ plant material
- Recycling of the nutrients contained in dung and urine (quick mineralization of nutrients in old plant material)
- Promotion of plant growth by substances (thiamines). Experiments showed an increase in the growth rate of plants of up to 50% after application of thiamines, which are also found in the spittle of hoofed-animals (ungulates)

Research in the Swiss National Park

In the Swiss National Park several plots were permanently put aside from grazing pressure, or at regular intervals over decades. Some date as far back as 1917. Right after the establishment of the park, the first few plots were set up to observe the process of natural reforestation which was expected to happen since the alpine pasture meadows were no longer grazed by cattle. Various plant biologists pursued the observations over the years, regularly adding new plots, so that the permanent plots in the National Park nowadays provide an excellent opportunity to analyse succession from an open grassland to a closed canopy forest.

In 1918 the first deer reappeared in the park and the deer population subsequently grew to reach a peak of 2,000 individuals in the 1980s; since that time increased hunting outside of the park has kept their number at a steady level of about 1,500. On the permanent plots, the impact of the grazing deer, replacing the cattle of earlier days, can now be observed. Ground vegetation has changed considerably but not in an undesirable fashion. Further information can be found at http://www.wsl.ch/land/deer/B1Artikel/berlin/berlin1.html.

3.10 Cost-Benefit Analysis of Hunting

Economic factor	Who pays?	Who receives?	Who else is involved?
Costs			
Equipment (weapons, cloths)	Hunter ⇒	Industry	Trade
Leases	Hunter ⇒	Land owner	State (tax)
Licenses and education	Hunter ⇒	State	Hunter organizations
Management costs (fences, food etc.)	Hunter ⇒	Industry, farmers	Foresters pay too
Introduction of game	Hunter ⇒	Other hunters, game parks etc.	State (trade license), CITES
Travel costs	Hunter ⇒	Industry, tourism industry, state	-
Prevention of poaching	State	-	Foresters
Income			
Venison	Consumer ⇒	Hunter	Butchers, state (hygiene control, parasite check)
Fur	Consumer ⇒	Hunter	Trade, CITES
Chemicals and other raw materials	Industry ⇒	Hunter	State (tax)
Trophies	Other hunters and enthusiastic people ⇒	Hunter	Legal and illegal trade
Opportunity costs			
Liability for forest damage	Hunter ⇒	Forester, landowner	Public, insurances
Liability for agricultural damage	Hunter ⇒	Farmers	Insurances
Liability for damage to urban areas and roads	Public ⇒	-	Insurances

3.11 Utilization and Marketing, Economics

Examples of economic importance in Germany

- Hunting ground in the Alps („superior game“: chamois, red deer) with a rental of 20 € / ha. Revenues from intensive forestry: not profitable
- Hunting ground in Brandenburg („superior game“: red deer, wild boar) with a rental of 5 to 10 € / ha. Revenues from intensive forestry: not profitable

If you take into account that more than half of the area of Germany is rented out by private hunters (200,000 km² = $2*10^7$ ha), that there is an average rental fee of 8 € / ha, it sums up to a profit of 160 million € for the owners without doing anything.

Venison

The main product from hunting is the venison (meat of game). The meat is sold for a high price partly directly, partly to restaurants and to commission agents. The self-sufficiency rate in Germany with venison is about 50%. Hunting bags were counted in Germany in 1990:

Hunting bags of some popular game species in Germany per year, profits by selling venison (after Bogner, 1990 & Krebs, 1990)

Game species	Hunting bag	kg venison / game	Price € / kg
Roe deer	700,000	6 – 12	> 5.-
Red deer	30,000	30 – 110	> 4.-
Wild boar	60,000	10 – 100	> 5.-
Hares	300,000 – 1200,000	2 – 4	variable
Ducks	600,000	0,5 – 2	variable

Trophies

The rank of a trophy (antlers, horns, teeth, skin, feathers a.o.) can be estimated by a point system, but it is difficult to fix a price (personal interests and preferences, pride, etc.). During the past decades, the obtention of trophy was queasily the only objective of hunting, with consequences for game, landscape, forests, agriculture and tourists alike. Parts of trophies were often used in the embellishment industry (buttons and knife grips made of horn, „Gamsbart“ - made of the back hairs from the mountain goat - for Bavarian and Austrian hats – costing up to 5,000 €).

Sometimes the trophy is used in scientific research: determination of radioactive content, heavy metal and toxic substances concentration, determination of age and weight for the investigation of population structure of game etc.

Total economic value

The commercial turnover (selling of venison, hunting equipment, etc.) sums up to several billions € per year. 500,000 people are active hunters in Germany (out of 80 million residents; for comparison: in France, Spain, Italy with 40 to 55 million residents there are 1 to 3 million hunters), another 500,000 passed the examinations.

3.12 Is Hunting Good or Bad?

Controversial and clear cases

Hunting objects	Justification	Comment
Crows, rooks, magpies, and jackdaws	Damage to agriculture and gardening	Unnecessary because of density dependent population regulation mechanisms
Cormorant	Damage to fisheries	Doubtful case, damage much lower than assumed
Reinvading lynxes and wolves	Damage to game and sheep	Nonsense
Introduced small carnivores such as racoons, racoon dogs, and minks	Damage to small game and birds	Unjustified
Domestic cats	Damage to small game and birds, inbreeding with wild cat	Unjustified
Fox and badger	Dispersal of rabies, damage to rare birds	Counterproductive, other methods available (vaccination)
Introduced semiaquatic mammals (nutria, bisam)	Conflict with water management	Partly justified
Beaver	Damage in water management and forestry	Justified but conservation priority
Partridge and quail	Once ordinary wildfowl	Nature conservation
Otter and wild cat	Damage to fishery and birds	Nature conservation
Seal	None at present	Nature conservation
Red deer, roe deer, fallow deer, wild boar, hare, rabbit, pheasant	Ordinary game or wildfowl	Justified for venison and wildfowl
Black grouse and capercallie	Once ordinary wildfowl	Target species for conservation of heathlands or berry shrub-rich spruce forest respectively, reintroduction may serve both interests of hunting and nature conservation

3.13 Tourism Hunting

Tourism hunting generates some controversy. The main argument of conflict is that international tourism hunting has the effect of reducing populations of endangered species. Most countries signed the „Convention of International Trading of Endangered Species (CITES)“, which successfully regulates the trade of animal parts and products since the 1970s. The probability of extinction of endangered animal species has been reduced since. However, severe problems occur with those countries which have lax controls.

Tourism hunting is sometimes the only potential source of income in remote areas using the skills (hunting, stalking, trapping a.o.) of indigenous people. It may be regarded as one of the opportunities for the **„valuation“ of wildlife** by local people.

3.14 Examples of the Legal Treatment of Non-Domestic Mammals in Germany

In organized societies, animals thus tend to be at the same time the subjects of hunting, nature conservation, and animal protection legislation (see also the distinctions made by Civil Law, under Chapter 4.18).

Species	**Status in Germany**	**Huntable species**	**Special conservation**	**Animal protection law**
Mammals				
Brown Hare	+	Yes**	Yes, declining	Yes
Rabbit	+	Yes	Yes	Yes
Squirrel	+	No	Yes	Yes
Beaver	+	No	Yes, reexpanding	Yes
Coypu (nutria)	Introduced	No*	No	Yes
Muskrat (bisam)	Introduced	No	No	Yes, hunted down as a pest
Norway rat	+?	No (vermin)	No	Yes, hunted down as a pest
Domestic dogs	Run wild	Yes (vermin)	No	Yes
Wolf	Reinvading	No	Yes	Yes
Red fox	+	Yes	Yes	Yes, victim of extermination campaigns
Racoon dog	Introduced	No* (vermin)	No	Yes
Racoon	Introduced	No* (vermin)	No	Yes
Brown bear	-	No	Yes	Yes
Weasels, martens and polecats	+	Yes**	Yes	Yes
American mink	Introduced	No*	No	Yes
Otter	+	Yes, year round closed season	Yes	Yes
Badger	+	Yes**	Yes	Yes, but victim of anti-fox campaigns
Domestic cat	Turned wild	No (vermin)	No	Yes
Wild cat	+	Yes, year round closed season	Yes	Yes
Lynx	-	Yes, year round closed season	Yes	Yes
Seal	+	Yes**	Yes	Yes
Wild boar	+	Yes**	Yes	Yes
Red dear		Yes**	Yes	Yes
Fallow deer	(Introduced)	Yes**	Yes	Yes
Sika deer	Introduced	Yes**	Yes	Yes
Roe deer	+	Yes**	Yes	Yes
Moose	Reinvading	Yes, year round closed season	Yes	Yes
Chamois	+	Yes**	Yes	Yes
Ibex	+	Yes, year round closed season	Yes	Yes
European bison	-	Yes, year round closed season	Yes	Yes
Mouflon	(Introduced)	Yes**	Yes	Yes

3.15 Examples of the Legal Treatment of other Non-Domestic Animals in Germany

Species	Status in Germany	Huntable species	Special conservation	Animal protection law
Birds				
Crested grebe	+	Yes, year round closed season	Yes	Yes
Other divers and grebes	+/-	No	Yes	Yes
Mute swan	+?	Yes	Yes	Yes
Other swans	Migrating	No	Yes	Yes
Wild geese	+ and migrating	Yes**, special restrictions	Yes	
Mallard	++	Yes**	Yes	Yes
Other ducks	+	Yes (** or year round closed season)	Yes	Yes
Cormorant	+	No	Yes, exceptions possible	Yes
Grey heron	+	Yes, year round closes season, with exceptions	Yes	Yes
Other herons	+	No	Yes	Yes
Storks	+ and migrating	No	Yes	Yes
Buzzards, harriers, hawks, eagles etc.	+/-	Yes (formerly vermin)	Yes	Yes
Osprey	+	Yes	Yes	Yes
Falcons	+/-	Yes	Yes	Yes
Capercallie	+	Yes (year round closed season*)	Yes	Yes
Black grouse	+	Yes (year round closed season*)	Yes	Yes
Hazel hen	+	Yes, year round closed season	Yes	Yes
Partridge	+	Yes**	Yes	Yes
Quail	+	Yes, year round closed season	Yes	Yes
Pheasant	Introduced	Yes**	Yes	Yes
Wild turkey	Introduced	Yes**	Yes	Yes
Domestic dove	Turned wild	No (pest)	No	Yes
Wild doves	+	Yes**	Yes	Yes
Crane		No	Yes	Yes
Coot		Yes**	Yes	Yes
Other rails		No	Yes	Yes
Great bustard		Yes, year round closed season	Yes	Yes
Woodcock		Yes (only springtime)	Yes	Yes

Other snipes and plovers		No	Yes	Yes
Gulls		Yes**	Yes	Yes
Terns		No	Yes	Yes
Owls, barn owl		No	Yes	Yes
Raven		Yes	Yes	Yes
Other corvids		No	Yes (3 species only recently)	Yes
Other breeding birds		No	Yes (3 species only recently)	Yes
Exotic birds (run wild or released)		No	No	Yes
Other migrating birds		No	Yes	Yes
Other animal groups				
Reptiles	+/-	No	Yes	Yes
Amphibia		No	Yes	Yes
Molluscs		No	Yes, partly	No
Dragonflies		No	Yes	No
Locusts		No	Yes, partly	No
Bees and bumble bees		No	Yes	No
Red wood ant		No	Yes	No
Beetles		No	Yes, partly	No
Ant lions		No	Yes	No
Butterflies and moths		No	Yes, except pest species	No
Other insects		No	No	No
Other animals		No	No	No

\+ Indigenous species
* Permitted hunting in certain federal states
** Longer closed seasons, mainly in summer.

3.16 Summary of Chapter 3

Hunting is a very traditional land use form with all its organizations, aims, attitudes, and regulatory instruments, developed over long time periods. Even though a legal obligation to ecologically oriented management exists, discussions about „modern“ or “adequate“ hunting still prevail. Because of the decentralized organization of hunting, easy solutions cannot be found. In general, environmental education will have a strong influence on the behavior of individuals. Economy is not really important as a regulatory instrument. Sovereign acts of regulation should be restricted to the necessary minimum (animal protection and biodiversity preservation law). The specific circumstances at play in Central Europe cannot be generalized to other continents, with their different history, cultural background, and regulations (ranging from an open access to hunting rights to total prohibition).

3.19 Selected Readings

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4 Game Farming

4.1 Definition of Game Farming

Game farming is also sometimes known as „game ranching". However, the definitions of game farming and/or ranching vary widely. This is because there is no clear-cut boundary between "wildlife" in total, "game" (as the huntable part) and various steps of accomodation of "wild" animals or animals under domestication to human stewardship. An Ontario Ministry of Natural Resources publication defines **game farming** as "...the husbandry of animals for the production of meat and other products in an intensive operation on small, fenced, closely managed farms or paddocks," and **game ranching** as "...the husbandry of animals for the production of meat, other animal products and hunting privileges in an extensive operation where stock roam over large areas in a more natural fashion." Research is conducted at different levels, such as veterinary science, animal production, game biology, and ecology. Both, game farming and game ranching, is understood as the husbandry of wildlife species.

The per capita consumption of meat from game totals only 0.6 kg/a (1991). The self-sufficiency rate is about 50% in Germany and only 20% in the EC. The marketing potential of game meat can be precisely assessed. The profitability of game farming in temperate areas is able to compete with other alternative land use forms, e.g. sheep breeding. In 1991, there were about 3,500 game farms in Germany, covering a total area of about 10,000 ha.

The following sections provide two examples of game farming in the (temperate) region of Saskatchewan, Canada (white-tailed deer; after http://www.canvena.com/farming) and in Central Europe (fallow deer; Bogner et al., 1991).

4.2 Origin and Domestication of Game

At all times, human beings have tried to domesticate, breed and hybridize wild animals to compensate for bad fortune in hunting. They used the animals either as a living „reserve of meat" or as a source of milk. Historians presume that in the Middle East gazellas and antelopes were domesticated around 10,000-7,000 B.C. by capturing young animals and breeding them. Drawings of the ancient Egyptians and West Asians (3,000-2,000 B.C.) support these assumptions:

- Asian stone carvings display tamed gazelles with a collar resp. on the arms of a attendant/guard, others feature so called holy herds of Oryx antelopes and gazellas.
- Reliefs on Egyptian graves show domesticated gazelles and antelopes resting beneath their master's throne, carvings and paintings display the feeding, sacrifice or slaughtering of herds of antelopes.

These successful attempts (e.g. in case of the gazellas) and the acquired knowledge on the domestication of animals were subsequently forgotten, because other breeds – the ancestors of today's domestic animals – were preferred in domestication.

It is a long way from a wild type to the domesticated animal. Animals suited for domestic domestication have the following characteristics:

- Sociability (form herds or flocks), low aggression potential
- Inclination to contact with man
- No territorial defense

- No specialized feeding habits
- Attachment of offspring to their mothers

4.3 Desirable and Undesirable Behaviors and Extent of Realization in Several Game Species (after Rammelsberg, 1985)

Below is a detailed account comparing 5 European species of game.

Desirable	Species ranking	Undesirable
Weak social behavior	Fallow deer – red deer – reindeer – moose – roe deer	Strong social behavior
Low aggression (frequency)	Fallow deer – reindeer – red deer – moose – roe deer	High aggression
High tolerance levels	Fallow deer – reindeer – moose – red deer – roe deer	Low tolerance levels
Low influence of variability in conditions of captivity	Fallow deer – red deer – reindeer – roe deer – moose	Strong influence of variability in conditions of captivity
Low influence of seasons	Reindeer – fallow deer – moose – red deer - roe deer	Strong influence of seasons
Low behavior intensity	Fallow deer – reindeer – red deer– moose - roe deer	High behavior intensity

4.4 Economic Concerns and Necessity of Game Farming

Humans Population Growth

With the high population growth experienced by the African and Asian continents, a system has to be found which balances the needs of the people with those of a healthy flora, fauna and functioning ecosystems, which provide a great contribution to the economy. Sustainable development and wildlife management are viewed as the relevant approaches for the maintenance of both humans and wildlife.

People are confronted with significant problems: in order to preserve the genetic integrity of animals (which are the cornerstone of tourism in certain countries, e.g. South Africa, Kenya, and Botswana) the struggle to save ecosystems as well as to reverse, or at least minimize damage to land as a result of cattle over-grazing must be sustained. Erosion of topsoil and decimation of flora remain a problem, even after the cattle have been removed.

One reason for concern on the African continent is the growing scarcity of food. While the land available for cattle is diminishing due to overgrazing, erosion and the loss of land to national parks, the demand for food is increasing. Since the land cannot support more cattle, a logical conclusion may be game farming, which is becoming a realistic alternative.

Balancing the needs of both the people and wildlife renders the management of game a very difficult activity. There is apparently no simple, quick-fix solution that would benefit all stakeholders. Efforts to preserve wildlife and feed the human population may sometimes come at odds with each other. For example, Pilanesberg National Park (SA) was created solely to create jobs in order to benefit the surrounding community. The recent introduction of

lions as predators into the park, transferred from surrounding areas, demonstrates how park management can sustain local economics. The presence of large predators attracts more tourists, which increases revenues to the park and creates further jobs, like foot patrols who monitor the perimeter fence or gas station employees to supply the growing number of tourist vehicles. It also increases the market for game products (meat, horn etc.).

4.5 Potentials of Game Farming

A structured and planned game farming is developed especially in those areas where the farming of domestic animals is **limited** because of food resources, overgrazing, water supply and occurrence of the Tsetse-fly. The per hectare meat production potential of wild game is normally higher as that of domestic animals.

This is mainly due to a wide utilization of different horizons and vegetational stages in natural pastures, high resistance to diseases and epidemies, and extraordinary adaptations to changes in the environment. However, cattle, sheep and goats do overuse vegetation if kept too long on the same area, with impacts on the vegetation cover. At a larger scale, the stability of the ecosystem could be lost and primary productivity significantly reduced.

There are other aspects to consider when dealing with conventional farming in tropical countries:

- High organizational costs of intensive management
- Seasonal variations in food availability
- Insufficient water supply
- Strong risk of dehydration during droughts
- High sensitivity to epidemics and parasites

These problems occur only at a very small rate with the breeding of wild animals. The range of uses includes several varieties of game under different shooting plans **(game cropping)**, the farming of certain gazella species in restricted territories along with or without domestic animal breeds **(game management)**, as well as concrete attempts at using suitable wildlife animals as livestock / cattle (game ranching, game farming). There exist 3 options for a better efficiency:

1. Increase efficiency within a constant stock.
2. Increase number of stock within a constant grazing area.
3. Increase area.

4.6 Ecological requirements of Game

The reasons for the broad range of game species are:

- Game is able to migrate over long distances
- Game may tolerate periods of starvation, extreme heat, and water deficiency
- Game animals can utilize plants with low nutrient content and display a better ability at food selection than domestic animals
- Game animals can consume plants and grasses which could in theory also be foraged by domestic animals, but which are growing in areas inaccessible to these, for various reasons (climate, slope, water deficiency, diseases (e.g. presence of Tsetse flies))

- Game animals feed on plants and grasses often rejected by domestic animals, for various reasons (taste, toxicity, presence of thorns, inaccessible tree leaves).

There is a need for further research on the plants used for feeding, including species composition, feeding value, size, biomass, and accessibility. The grazing preferences of wild animals can generally be grouped into three categories:

1. Grass or rough fodder feeders (mainly grain rich in carbohydrates): Topi, White-tailed Wildebeest, African Buffalo, Zebra, in Europe: Ibex
2. Intermediate, or mixed feeders (grasses and leaves in different amounts): Eland, Impala, Grant, Warthog, in Europe: Red deer
3. Leaf or „concentrate selective" feeders (mainly nutrient rich plants and/or plant parts): Giraffe, Rhino, Dik-dik, in Europe: Roe deer, Elk

4.7 Suitability, Utilization and Potential of Different Vegetation Zones Used by Wild Game and Domestic Animals (after Legel, 1993)

Suitability / utilization / potential	**Game**	**Domestic animals**
Deserts and Semi-Deserts		
Suitability	Certain Antelope species (Oryx, Addax, Grant)	Regionally restricted (Camel, Goats)
Utilization	Throughout the year (Game cropping)	Only during and after rainfall
Potential	Population enlargement	No enlargement
Thorn bush Savannah		
Suitability	Superior to domestic animals	Only sheep / goats but inferior to game
Utilization	From game cropping to game ranching	Limited
Potential	Increased use in arid areas	Restriction in arid areas
Dry Savannah		
Suitability	Inferior to domestic animals	Domain of cattle and sheep
Utilization	Limited by domestic animals	5-6 humid months
Potential	Only specialized game ranches	Typical vegetation zone for intensive farming
Humid Savannah		
Suitability	Only big game	Good for cattle
Utilization	Competition with domestic animals	7-9 humid months, but Tsetse-flies
Potential	Restricted to Tsetse-fly endemic areas	Increasing by reduction of Tsetse-fly contaminates areas
Tropical Rain Forest		
Suitability	Unlimited possibilities for game	Unfavourable for cattle and sheep
Utilization	Limited because of infrastructure	Strongly limited
Potential	Slow increase	Increased through deforestation

4.8 Additional Aspects

Diseases

Through the process of natural selection, indigenous game species are relatively well adapted to local germs and diseases. Conversely, imported domestic animals often suffer from the diseases found in warmer climates, since the selection process has been too short for adaptation.

Wild game even often represents a transmitter and even a reservoir of germs for domestic animals!

General capacities, management and methods of utilization

Some socio-economic prerequisites and arrangements seem to be necessary (after Knemeyer, 1985):

- Launching pilot projects for demonstration and the determination of the economically relevant factors
- Promoting larger animal populations
- Modifying the fencing schemes and traditional breeding methods
- Ensuring on-site slaughtering and meat processing to avoid long transports.

Further Problems

However, organizations and individuals concerned about wildlife have criticized game farming for a number of reasons, including:

- The threat to native wildlife through the spread of diseases between and among game animals, livestock, and humans. Bovine tuberculosis (TB) is only one of those potential diseases (that has already caused extensive problems in Alberta and Ontario).
- The contamination of pure gene pools (of wildlife species)
- The losses of wildlife due to competition with farmed animals (see below, farming systems)
- Potential destruction of rare plant communities in the case of high animal densities

4.9 Prerequisites, Benefits and Problems Related to the 3 Major Game Farming Methods used for Meat Production in Natural Tropical Pasture Land

Game farming in areas with no possibility for cattle raising	**Game farming in fenced areas (ranch)**	**Utilization of domesticated game in fenced areas**
Prerequisites		
Big game populations and large areas (20,000 ha)	Fencing and controlling	Game suited for domestication (Eland, Saiga a.o.)
Control of game population and their migration routes	Grazing management	Ranching conditions and grazing management
Benefits		
Use of areas unsuited for grazing by domestic livestock	Maximization of biomass production (game feeding on plants refused by livestock)	Controlled and planned production of game

Use of various vegetation horizons, resistance against diseases and parasites	Game farming can be integrated in the organization and marketing of livestock production	Control of animal health
High fertility and high growth rates	Connection with a veterinary control	Like game farming
High meat quality and high yield of slaughter		
Problems		
Problems during capture, transport and with infrastructure, difficulties during marketing	Game can act as transmitters and reservoirs of germs	Slow progress in domestication, only small numbers of possible game species
Regulations		

4.10 Case Study: The Kenya Wildlife Service

Well over 70 percent of Kenya's Wildlife is found outside protected areas. KWS (Kenya's Wildlife Service) which is charged with the conservation of wildlife throughout the country, believes that conservation of wildlife outside protected areas cannot be achieved without addressing the needs and rights of communities coexisting with wildlife. Hence, a sustainable strategy of wildlife conservation in places where wildlife coexist with human beings is a major objective of KWS.

Whereas the hunting ban is limiting consumptive use of wildlife in Kenya, KWS has authorized land owners to carry out experimental cropping and game farming. The rationale for allowing such cropping and game farming is to enable landowners who let wildlife flourish on their land, to reduce wildlife related costs and reap economic benefits. There is also the long-term consideration that for landowners to have maximum economic incentives to conserve wildlife, they should have a reasonably free hand in the choice of the most profitable form of land use. Some of the species involved in the experimental game farming include snakes and other reptiles, frogs, crocodiles, ostriches, butterflies, elands and bees.

Under the Wildlife Development Fund Program introduced by KWS in 1990, community and enterprise development projects totalling US$ 982,000 have been approved and disbursements totalling US$ 672,000 were made.

4.11 Game Farming in Other Countries

Ukraine

Game farming in Askania Nova: Saiga antelope, Eland (breeding and milking since 1896), Camel, Dromedary a.o.

Kazakhstan (1998)

Traditional land use and grazing economy: The Federation of Farmers of Akmola is a non-governmental organization founded in 1992 (after the privatization of Kazak agriculture).

Particularly in the region encompassing the southern steppes – in former times extremely subventioned – the cultivation of wheat was no longer lucrative because of increasing energy costs and frequent crop failures due to droughts.

In place of intensive modern agriculture, a revival of the traditional grazing economy should be promoted. This would give people new hopes and reduce emigration. In the development zone of the new „Lakes of Tengis“national park, a model region should be created using ranching concepts (cattle, sheep, game?), since an important limiting factor is the supply with winter hay.

USA

Since the 1930s, the 3.900 ha of the Sanhill Game farm in Wisconsin have served research purposes by keeping stable, semi-natural conditions for Buffaloes and Pronghorns. In the seventies, 26 species of large game were introduced to Texas in order to test the suitability of natural pastures (see table after Ramsey, 1970). This undisputably demonstrated the economic potential of game farming.

Species	**Origin**	**Number of individuals**	**Number of farms**
Axis deer	India	6,500	69
Schwarzbuck Antelope		400	56
Audad-Sheep		1,300	40
Wildsheep	Europe	10,000	121
Eland	Africa	4,000	7

Miscellaneous

Semi-domesticated or domesticated species: Reindeer, Dromedary, Camel, Lama, Alpaka, Chinchilla, Buffaloes of Asia (Yak)

- Experiences with introduced animal species (New Zealand)
- Bison (USA, Europe)
- Elk (engl.) / Moose (U.S.) (breeding station in the former USSR, near Moscow)
- Kangaroo (Australia)
- Fallow-deer (Europe, New Zealand)
- Ostrich (SA)

Some institutions in South Africa (SA) dealing with game conservation, game farming and game ranching:

- African Gamebird Research, Education and Development Trust (AGRED)
- Game Capture Assoc. of SA and Zimbabwe, Pietermaritzburg
- Game Farming, Mammal Research Institute, Pretoria
- Game Marketing Assoc. of Natal, Pietermaritzburg
- Guinea Fowl, Research Technician, Dept. of Environment Affairs, Pretoria
- National Game Organization Transvaal, Vrystaa
- National Parks Board, Pretoria
- Wildlife Management Assoc. of SA, Bellville.

4.12 Case Study White-tailed Deer (1)

Reasons for farming

Why farmers should seriously consider raising White-tailed Deer.

- Excellent prospects for industry growth in the short and medium term resulting in high demand and prices for breeding stock.
- Increasing world-wide demand for venison, a meat that is perceived as „very healthy“, e.g., low fat, low cholesterol, high in protein and organic (chemical free).
- Venison, unlike some of the more exotic species such as emu and ostrich, is a known and accepted meat in North America & Europe.
- White-tailed Deer have a high reproduction rate; twins and triplets are common. They are the most productive of all deer species and thus provide a significant competitive advantage to farmers.
- White-tailed Deer are native, very adaptable, hardy and intelligent. They are a low-maintenance animals with few disease problems.
- White-tailed Deer farming is environmentally friendly and unlikely to raise the same concerns and political opposition as other intensive livestock operations such as hog barns and cattle feed lots.
- White-tailed Deer farming is relatively new and thus there are opportunities to take a leadership role to develop a healthy, profitable long-term industry and avoid the mistakes make by other alternative livestock groups.
- White-tailed Deer farming is a much more profitable use of the available land than other applications. Smart producers farm deer on low-cost, marginal land where the deer thrive.
- White-tailed deer farming has minimum labour requirements. With the use of automatic feeders and waterers, only occasional inspection is required.
- Barriers to entry for new producers are relatively high due to costs of breeding stock, and a high investment in fencing and facilities. This should keep prices and demand high.
- The return on investment over the next 10 years, and possibly much longer, is expected to be quite attractive. Analysis suggests that the returns on White-tailed Deer farming are 4 times that of cattle, and twice as much as for bison or elk (= Wapiti).

4.13 Case Study White-tailed Deer (2)

Legal requirements

- A license is required to operate a game farm, slaughter, process or sell farm animals and their products. The license fee is C$100/yr.
- It is illegal to trap Crown wildlife for stocking game farms.
- All game farm animals must be uniquely and permanently identified (with proper ear tags) as prescribed by SAF (Saskatchewan Agriculture & Food) within the year of birth and prior to transport.
- All game farm meat must be identified and labelled as prescribed.
- Every game farm operator shall maintain, and update on an annual basis, a permanent written record for all inventories and changes in inventory. The records shall include births, deaths, purchases and transfers to and from the game farm.
- The perimeter fence for the enclosure must be 2.1 meters high and securely locked to prevent public access to the enclosure and escape of game farm animals.

Land and facilities

A deer farm requires land both for grazing and producing a supply of winter feed. Although up to 8-10 individuals can be set per acre, this may result in increased stress for the animals. Alberta agriculture recommends that 3 to 4 per acre may be more appropriate.

Effects of grazing by animals on the plants were shown in investigations comparing different grazing regimes. Each of the four most abundant grasses responded differently to grazing. The two dominant species in the ungrazed prairie, *Andropogon scoparius* and *Bouteloua curtipendula*, were fairly tall and there was much ground between them that was bare or covered by dead plant material. These two were almost completely replaced in the heavily grazed area by smaller invasive grasses, and the percentage of the ground covered by vegetation increased substantially under grazing.

Safety and handling

Good fencing is required to prevent domestic deer from escaping and wild deer from entering a game farm. Predators such as dogs can be a problem, therefore fences must be predator proof. In Alberta perimeter fences must be 9 feet high while in Saskatchewan the minimum requirement is set at 7 feet. It is highly recommended that stucco or chicken wire be attached to the outside bottom of the perimeter fence and extending 2 feet along the ground to prevent coyotes from digging under the fence. The chicken wire will also aid in preventing the escape of fawns. A single electric wire on the outside of the perimeter fence at a height of 5 inches can also be used to stop predators from digging under the fence.

The most important component of a White-tailed Deer farm is the handling facility. Farmers should take the time and money to build a good one. Handling facilities must have a squeeze and alley way designed to hold animals securely and safely. Since White-tailed Deer are nervous animals, producers must learn to handle them in a manner that prevents injury to the animal.

4.14 Case Study White-tailed Deer (3)

Feeding

Deer will do very well in marginal land as long as there is feed, brush cover and water. Rotational grazing systems will help utilize pasture to its fullest potential and reduce parasite levels. Deer will access water particularly in winter. If natural shelter is not available, it will be necessary to build sheds or other facilities to protect them from bad weather. Regulations specify fencing requirements.

The following factors are important to consider when planning a sound feeding program for White-tailed Deer.

- Good nutrition is required to maximize reproduction rates and improve fawning percentages. White-tailed deer that do not enter the winter in good condition will generally not survive it.
- White-tailed Deer are browsers or selective grazers who prefer high quality forages, particularly the freshly grown part of plants.

- Breeding stock requires 2.5% of their body weight (dry matter) per day in order to maintain their weight.
- The quality and quantity of available pasture will determine the level of supplemental feeding while on pasture. Supplemental winter feeding is required. Rotational grazing is used to fully utilize available pasture and to reduce parasite levels.
- Several feed companies are now producing feed specifically designed to differing deer requirements, e.g., Champion Feeds.
- Hay, grain, vitamins and minerals must be provided during the winter season to ensure that nutritional requirements are met. Supplemental feeding is also necessary during hot weather, when grass is growing slowly and during late summer in preparation for the rut.
- Clean, fresh water must be available year round.

There are three types of food:

1. Rough food: hay, grasscobs, twigs, branches, straw
2. Sap food: silage of maize, grass, carrots; trester of fruit, treber of beer, roots and knolls of potatoes, turnips, mangel-wurzel
3. Energy or mixed food:
   - from own production: cereals, peas, beans
   - residues from industry production
   - special mixtures for sheep and cattle
   - special mixtures for wild ruminants

White-tailed deer are generally resistant to disease. However farming large numbers of animals on a limited acreage requires an ongoing parasite control.

4.15 Case Study: White-tailed Deer (4)

Breeding

Key breeding management issues for deer producers include:

- Does can be bred at one and half years of age and up. The average productive life of does is 10 years. The current production practice is to replace bucks after 5 years of breeding. Bottle feeding of fawns can increase the productive life of does.
- The breeding season (rut) takes place in the period from November to January in Alberta and Saskatchewan. The recommended practice is to run 1 buck with every 10 does.
- Dr. James Kroll from the Institute for White-tailed Deer Management and Research has had very good success with artificial insemination. This is an option that deer producers should seriously consider.
- The gestation period for White-tailed Deer is in the range of 187 to 222 days. Undernourished does will have longer gestation periods. In Alberta and Saskatchewan, most fawns are born in May and June.
- A high level of breeding performance is a fawning rate of 1.8 live fawns per doe and a weaning rate of 1.6 fawns per doe (bottle feeding can increase the weaning rate to about 2.0).
- Assisting in the delivery of fawns is not practiced, due to the nervous nature of the animal. Does that have been bottle-raised can be assisted.
- Producers who leave the antlers on their bucks for sale as hunt bucks will need to ensure the bucks have adequate space and separation. Most producers remove buck antles in the fall to prevent injury.

- If deer are being breed for antler size, aggressive culling must be practiced to remove inferior animals.
- Mature bucks will weigh 250 to 270 pounds (110-120 kg) and have a carcass weight of 125 pounds (57 kg). Mature does will weigh 150 to 175 pounds (68-80 kg) and have a carcass weight of 88 pounds (40 kg).

4.16 Case Study: White-tailed Deer (5)

Economic efficiency

Besides living animals, meat, skins and shooting by paying clients, there is a big velvet market. In early summer all bulls are herded into processing facilities to have their still-soft and acutely sensitive antlers sawed off nearly flush with their heads. The horns are sold for $60 per pound as part of the US$3 billion Asian market of aphrodisiacs.

In the early days of farming elk for aphrodisiacs, ranchers used anaesthesia to ease what was thought to be an excruciatingly painful process for the bull elk, but the radical amount of blood flow into the growing antler transported detectable amounts of the anaesthetic. Chinese customers, demanding purity in their aphrodisiac courses, protested.

Here are some cost estimates (in Canadian dollars):

Asset Investment Requirements

Item	Cost per Unit
Fawn does (8 months old)	$4,500
Fawn bucks (breeding 8 months)	$850
Bred yearling does (20 months)	$8,000
Two year old bucks (28 months)	$4,000
Mature does	$8,000
Mature bucks	$5,000
Fencing (per mile)	$11,400
Shed & handling systems	$8,000
Squeeze and scale	$6,000
Miscellaneous	$5,000

The above costs do not include land or pasture improvements. Pasture improvements, depending on the quality of existing forage, can run an additional $30 to $50 per acre.

Annual Operating Costs

Item	Cost per Deer
Prepared feed	$75
Alfalfa hay	$22
Veterinary fees, supplies	$20
Insurance	$65
Marketing & transportation	$10

The above operating costs are averages and will vary by age and sex of the deer. If a financing (debt or equity) is required to establish your White-tailed Deer farm, it will be necessary to prepare a business plan for your bank and investors.

4.17 Case Study: White-tailed Deer (6)

Risks

Like any livestock venture, White-tailed Deer farming does have a number of risks and challenges. These include:

- *Price stability*. Because current demand exceeds supply, prices for breeding stock are high and may go higher. However, how stable are prices likely to remain? Prices that go too high will discourage potential buyers from entering the business. Lower prices will reduce the profitability and attractiveness of White-tailed Deer farming.
- *Availability.* White-tailed breeding stock is in short supply with waiting times almost a year long. Major restrictions, due to disease concerns, on importing and exporting animals are likely to remain and thus contribute to the shortages.
- *Infrastructure.* Currently no federally or European approved slaughter facilities exist in Alberta or Saskatchewan that are willing to accept deer. As well, no grading standards have been established for venison. No marketing or distribution systems for venison have yet been set up.
- *Regulatory environment.* The game farm industry in Alberta and Canada is heavily regulated. Unexpected changes in regulations could have an impact on profitability. Accurate and detailed records have to be kept and submitted to provincial agriculture departments.
- *Natural disasters.* Deer losses can occur due to poaching, predators, disease and escape.
- *Financing.* Banks and lending institutions consider White-tailed Deer farming to be non-traditional and of high risk. Therefore financing is often difficult to obtain.

4.18 Game Farming in Germany

General remarks

Since the enactment of the Federal Nature Conservation Act, a permission is necessary to set up and run a game farm, granted by relevant state authorities (§ 24 of BNatSchG). In Brandenburg, these are the UNBs (Untere Naturschutzbehörde = lower county authority for nature conservation).

Grants can only be awarded, if

- neither the household of nature nor the landscape are impaired
- the free access to fields, forests, and wetlands is not severely restricted as a result of the farming activity
- site size, shape and equipment used for fencing, feeding, and caring for the animals satisfy the demands of animal protection laws
- there are no consequences for species conservation

Enclosures are diffentiated into animal and game enclosures:

- Animal enclosure: zoological gardens, „Tierparks“, mobile animal exhibitions and circuses
- Game enclosure:
  1. Hunting enclosures: mostly of the size of a „Eigenjagdbezirk“
  2. Game parks: special type of enclosure
  3. Enclosures for exhibition (<10 ha)
  4. Trapping of individuals in a small case for research, breeding, meat production, species conservation, or wintering purposes.

Civil law differentiates between:

- Free-ranging wild animals: free to roam in their natural environment, under no ownership
- Captured wild animals: mostly game farming
- Tamed animals of a wild species: e.g. raptors for falconry
- Tamed animals: domestic animal breeds

4.19 Comparison of Different Land use Options on Grasslands (after Bogner, 1991)

Production form	Cover (margin of loss) €/unit[1]	Feeding area ha/unit[2]	Operating time hours/unit	Costs of new building €/unit	Utilization of factors €/ha[3]	Utilization of factors €/hour[3]
Fallow deer, 2 ha-farm[4]	34.-	0.11	5	-	305.-	7.-
Fallow deer, 10 ha farm[4]	48.-	0.11	5	-	437.-	10.-
Red deer, 2 ha-farm[4]	56.-	0.19	7	-	295.-	8.-
Red deer, 10 ha-farm[4]	85.-	0.19	7	-	448.-	12.-
Paddock pastures with sheep, fattening of lambs[5]	52.- to 85.-	0.09	9	308.-	545.- to 917.-	6.- to 9.-
Mother cattle breeding, baby-beef production[6]	428.-	0.10	9	393.-	470.- to 805.-	5.- to 9.-
Cattle breeding[7]	335.-	0.60	62	1,800.-	585.-	7.-
Young stock breeding	585.-	0.76	78	3,750.-	763.-	7.-
Diary sheep farming	371.-	0.11	48-68	360.-	3,550.-	6.- to 8.-
Diary goats farming	411.-	0.09	43-68	360.-	4,365.-	7.- to 10.-
Horse pensions	1,890.-	0.31	92	5,000.-	5,015	16.-

[1] With basic feeding costs, accountable fertilizing factor, interest rate of property for cattle and transport, without yearly costs of buildings, EC-funds and running premiums
[2] 4,500 kStE/ha gross amount, fallow deer 3,880 kStE/ha net amount
[3] only maintenance costs in the height of 1% of building costs
[4] 10 production units of fallow deer / ha, 5 productions units of red deer / ha
[5] Marketing by production communities or direct marketing
[6] German-Angus, direct marketing of baby-beef
[7] Scottish highland cattle or Galloway, mother cattle breeding

4.20 Biomass of Game and Domestic Animals in Natural pastures of Warm Countries (condensed after Legel)

Game species usually reach higher population densities and therefore biomass values per squre kilometre than domestic animals in the same habitat.

Type of pasture	Biomass (kg/km^2)	Animals
Thornbush savanna (EastAfrica)	18,800	5,000 game (grazers), 450 small mammals, 850 carnivores, 2,500 small herbiviores, 10,000 invertebrates
Savannah (East Africa)	200 – 20,000	Mixed game
- same	3,300	Domestic animals
Serengetti region (Kenya)		
- grassland/scrubland	4,000 – 5,300	12 game, 4 domestic species
- open grassland	8,200	6 game, 4 domesti species
- mixed pasture ground	12,000 – 17,000	12 game species
- scrubland	5,300	12 game species
Natural pastures (Africa)		
- savannah	2,400	cattle, sheep, goat
- same	15,700	game species
- scrubland	860	cattle, sheep, goat
- same	5,250	game species
- degraded pasture	1,550	cattle, shep, goat
- same	3,100	game species
- good pasture	35,000	mixed game and domestic animals

4.21 Milk yield of game and domestic animals

Lactation time and effectivity

Game species may yield the same yearly amount of milk (or lactation period) even though the daily yield may be lower.

Species	Duration of lactation period (days)	Milk production (kg/lactation), normal range and maximum	Daily milk amount (kg), average and maximum
Eland	250	320 – 450 (1750)	1.2 (6.2)
African cattle	233	370 – 1,080 (2,120)	3.1 (9.1)
Sheep	125	35 – 80 (360)	1.4 (3.6)
Goat	215	200 – 240 (500)	1.6 (2.0)
Camel	270 (180-540)	800 – 1,200 (3,150)	3.7 (9.0)

Composition of milk

The composition of milk of game species is comparable to that of domestic species.

Species	Dry mass (%)	Contents in dry mass (g/kg)		
		Protein	Fat	Carbohydrate
Springbok	22.8	351	390	210
Eland	22.9	338	435	190
Impala	19.3	306	409	243
Cattle (Cebu)	13.9	218	346	386
Buffalo	17.3	285	439	232
Sheep	18.0	327	415	211
Goat	12.7	288	339	307
Camel	13.0	300	223	418

4.22 Summary of Chapter 4

Game farming is a relavively recent practice. In Europe and North America, game farming is legally equivalent to conventional farming (using game species instead of domestic animal species). The idea is being propagated by model farms and public relations. Even textbooks already exist. The economic prospects are good, although some competition and resistance by conventional farmers has to be overcome. In tropical areas, game farming is favored by natural circumstances (such as the distribution of diseases, or obvious ecological damages caused by domestic animals). The actual beneficial influence on the landscape is poorly known. A comprehensive ecological balancing under different physiographic and climatic conditions must be carried out.

4.23 Selected Readings

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Further literature: www.admin.ch/bvet/tierschutz/d/berichte_...wildtier7d.html
Search also for „+game +farming +(any species name) or +(any country name)“ on the Internet.

5 Ecotourism

5.1 What Do People Need during Vacations?

- Sun and fun?
- Adventure and challenge?
- Rest and relaxation?
- Sporting and fitness?
- Culture and traditions?
- Nature and landscapes?
- All of the above?
- What else?

What types of tourists are there?

An empirical study in Germany revealed the following motives (Saupe 1997) (in response to the question: how would you like to experience nature)?

- 30% mainly seek recreational activities (leisure parks etc.), nightlife (pubs etc.) and comfort (high quality infrastructure); for these nature experience is of secondary importance.
- For 30% of the respondents, leisure and the experience of nature are of equal importance; besides the search for „intact" nature (e.g. by hiking, etc.) the general conditions (infrastructure with restaurants a.o.) are also important.
- 30% consider place the experience of nature in the foreground (activity and mobility oriented experiences, out-door activities, meeting with landscape and nature, experiencing wilderness etc.)
- 10% are indifferent with respect to this classification

5.2 Nature Views in Germany 1997

The following table is based on a representative study in Germany.

Category	**Explanation**	**%**
Romantic approach (to nature)	Beauty, meadows, woodland, love for nature, scenic places; always positive valuation	38
Evaluative approach	Nature is good, optimal, very important; always positive valuation	5
Ontological approach	Creation, apotheosis of nature, nature is God or god-like	4
Reproductive approach	Health, recreation, leisure, trekking, sports, holidays, good nutrition	27
Idea of a threatened Or endangered nature	Threatened life-support systems, impaired nature, air pollution, waste, noise, traffic, ozone; negative valuation	23
Environmental (protection) approach	Ecology, environmental protection, nature conservation	22
Countercultural approach	Nature as an opposite to culture, frontier life, naturalness, originality, avoidance of human impact on nature	9
Nature as a reproductive Resource	Energy, raw materials, agriculture	3
Systems approach	Interactions between living organisms, plants, air, soil, cycling, autopoesis	3
Scientific approach	Natural sciences, natural laws, nature as source of knowledge, basis for our understanding	1
„Nature as life" approach	Nature is life, or necessary for life	8
Nostalgic approach	Nature as it was, positive valuation	1

Visionary approach	Nature as it will be, following generations (normative statements)	2
Nature as a threat	Natural catastrophes, selection, cruelty of nature	3
Geographical approach	Being outside, landscape, power, energy, environment	12
Functional approach	Come into being, growth, power, energy, death	5
Universal approach	Heaven and earth, cosmos, universe, stars	5
Syntagmatic approach	Non-valuating list of elements	29
Others		1

5.3 Sustainable Tourism Development

What are the principles and philosophy?

Criticism about the social, ecological and cultural impacts of modern tourism began to emerge in the 1970s, indicating a need for alternative forms of tourism. The issues related to a holistic approach to tourism are under discussion since the early 1980s. However, it took another decade for this reflexion to really mature.

Today, the belief that tourism in one particular region or community is part of a very complex system has gained widespread acceptance. A holistic approach to tourism also needs to take into account the mentality of the indigenous population (fears, wishes and necessities) and the practices of the local tourist organizations => this last point has become an essential ingredient in planning for current-day tourism.

Holistic approach to tourism

A holistic approach to the development of tourism should also take into account the demands from other sectors and vice versa, in order to ensure a growth in coordination with – and not against – the other interests at play in the region or country. For a wise use of limited resources and in order to achieve sustainability, tourism development must be harmonized with these other needs.

Sustainable tourism

Since the Earth Summit in Rio de Janeiro in 1992, an increasing number of initiatives towards sustainable tourism have been developed. Sustainable tourism meets the needs of present tourists and host regions while protecting and enhancing opportunity for the future generations of tourists, leading to the management of all resources in a way that fulfills economic, social and aesthetic interests while maintaining cultural integrity, essential ecological processes, biological diversity and life-support systems.

The achievment of sustainability depends on a balance of private initiatives, economic instruments and regulation, translating global principles into focused local action and new public-private sector delivery mechanisms leading to a new and necessary tourism culture.

5.4 The Principles of Ecotourism

The International Conference on Biodiversity and Tourism in Berlin (March 1997) was an important step towards a more sustainable tourism. The ministers participating at the conference adopted a declaration affirming the key principles which should guide touristic activities

in the future. According to **Agenda 21**, a sustainable tourism and travel industry should respect the following principles:

- Tourism and travel should assist people in living a healthy and productive life, in harmony with nature.
- Tourism and travel should contribute to the conservation, protection and restoration of the Earth's ecosystem.
- Tourism and travel should be based upon sustainable patterns of production and consumption.
- Nations should cooperate to promote an open economic system, within which international trade in tourism and travel services can take place on a sustainable basis.
- Tourism and travel, peace, development, and environmental protection are interdependent.
- Protectionist practices in trade in travel and tourism services should be avoided and, wherever possible, abandoned.
- Environmental protection should constitute an integral part of the tourism development process.
- Tourism development issues should be handled with participation of all stakeholders and the planning decisions should be adopted at a local level.
- Nations should warn one another of natural disasters that could affect tourists or touristic areas.
- Tourism and travel should favor the creation of employment for indigenous people, to the largest extent feasible.
- Tourism development should recognize and support the identity, culture, and interests of indigenous people.
- The tourism and travel industry should respect and promote international environmental laws.

5.5 Soft, Green, and Nature Tourism or Ecotourism

Soft tourism was the expression during the 1980s. Whereas **green or nature / ecotourism** principally refers to the ecological aspects related with tourism, soft tourism also includes socio-cultural components. **Soft tourism** therefore includes:

- Nature compatibility: conservation of landscapes, water, soil, flora and fauna as well as nature in general (also **environmentally sensitive tourism);**
- Health compatibility: human and animal health alike, organic farming, personal and public recreation;
- Socio-compatibility: in agreement with local values, customs and traditions, as well as with the social structures and hierarchies in place;
- Economic compatibility: refers to the economic benefits of tourism to the region, fair distribution of incomes, financial aid for small and medium enterprises, development towards the differentiation and multiplication of touristic activities;
- Physical compatibility: refers to the ability of the infrastructure to gradually absorb the development of tourism, taking account of the local physical constraints (e.g. **minimum impact tourism**).

Nature tourism is concerned with the discovery of nature (also in the sense of consumption), ecotourism additionally involves a conservation aspect. Nature tourism refers to a special tourism segment characterised by the demand for nature-related activities in attractive, close-to-natural landscapes, preferably in protected areas. The activity spectrum ranges from scientific tourism, through wildlife watching and nature photography to consumptive activities (fishing and hunting) as well as sport and adventure tourism.

In theory, **ecotourism** is a responsible form of travel in natural areas, which aims at conserving the environment and helps sustain the livelihood of local people. Ecotourism is understood to incorporate types of nature tourism which, in a resposible way, attempt to minimise environmental impacts and socio-cultural changes, contribute to funding protected areas and create earnings potential for the local inhabitants.

5.6 Some Key Concepts of Ecotourism

- **Ecotouristic activities:** activities included in a tour designed for a certain category of customers and co-ordinated by a professional guide or interprete. There are over 80 official activities listed under the eco-tourism label, such as birdwatching, hiking, diving, kayaking, participating in cultural events, photography, safari, mountain-climbing, etc.
- **Ecotouristic products:** a combination of resources, activities, and services which are sold / managed by professional tour operators
- **Ecotouristic resources:** natural and cultural features which attract visitors, such as landscapes, endemic or rare flora and fauna, cultural festivals, and historical monuments
- **Endemism:** species which in nature only occur in a given region or at a specific site
- **Ecotouristic services:** transportation, food, lodging, guiding and interpretation services designed to cause minimal damage to the biological and cultural environments and to promote a better understanding between local people and visitors
- **Stakeholders:** individuals who have a vested interest in development, including community members; environmental / social / community NGO`s; natural resource planning + government officials; hotel owners, tour operators, guides, transport companies, and representatives from many other related services in the private sector

5.7 Ecotourism: Market and Economy

A lot of important and indispensable nature reserves in the world (World Heritage Sites as Galapagos-islands, Serengeti a.o.) could only be saved through tourism and/or land use by animals. Profits in these areas, especially in „hard foreign currencies“ is much higher than the incomes provided by conventional land use forms.

Total market for tourism: 567 million tourists were censed in 1995, generating US$ 337 billion in revenues and creating some 200 million jobs. The part devoted to nature discovey (in a wide sense) represents 40-60% of this industry. Ecotourism is one of the fastest growing segments of the market (CI-Ecotourism 1998). Unfortunately, over 90% of gross revenues land into the large urban centres in the country of visit or even remain in the tourist’s country of origin.

The value of environmentally sensitive tourism and ecotourism world-wide 1980 – 2000, in billion dollars (after Jenner & Smith, 1992) Excludes transport. e = estimate, f = forecast

Type of tourism Year	1980e	1985e	1989e	1995f	2000f
Environmentally sensitive tourism	10	20	50	150	300
Ecotourism	4	5	10	25	50
Minimum impact ecotourism	25	0.035	0.10	0.25	0.50

Example: In Kenya**,** over 50% of foreign trade (> $350 million) is related to tourism.

Target groups:

Individuals with strong interests in environmental protection and nature conservation, NGOs, ornithological societies, animal photographers, photo-clubs, local hiking associations, seminars, painting and language courses, student excursions (Biology, Geology, Geography), biker groups and a lot more.

5.8 Management of Ecotourism

International organizations

In April 1995, UNESCO hosted the World Conference on Sustainable Tourism in Lanzarote, Canary Islands. The participants signed the Charter for Sustainable Tourism, urging national and regional governments to develop action plans for a sustainable tourism.

In the same year, three other international organizations – the World Travel and Tourism Council (WTTC), the World Tourism Organization (WTO) and the Earth Council – jointly produced a report called "Agenda 21 for the Travel and Tourism Industry: Towards Environmentally Sustainable Development", which transforms Agenda 21 into an action program for travel and tourism.

WTO is an intergovernmental organization for tourism. Its mission is to develop tourism with the means of encouraging international peace and understanding, as well as promoting economic development and international trade. Among its many publications, there is a Sustainable Tourism Development Guide for Local Planners. Furthermore, it has worked with various National Tourist Associations (NTAs) to develop a course on planning for the sustainable development of tourism at the local level.

WTTC is a global coalition of more than 90 chief executive officers from all sectors of the travel and tourism industry. One of its primary goals is to promote environmentally compatible developments by establishing a policy framework for sustainability based on Agenda 21 and by encouraging environmental industry initiatives such as the Green Globe program.

5.9 Political Framework for Ecotourism

International level

The Convention on Biological Diversity and the EU´s Fifth Environmental Action Program identify tourism and transport as one of the sectors impacting the most on the environment. Full commitment to agreed measures can only be achieved by replacing the command-and-control approach with shared responsibility between the different parties (governments, industry, general public).

The tourism and travel industry has a strong interest in protecting the natural and cultural resources which constitute the core of its business. It also has the means to do so. As the world's largest industry, it has the potential to bring about sustainable development for the communities and countries in which it operates.

National level

In recent years, the distinction between national tourism authorities and representative trade organizations has become more difficult to make. In addition to more traditional activities, national tourism authorities now frequently include representatives from – and provide advice to – tourism and travel companies. Meanwhile, trade organizations are progressively taking charge of the traditional functions of national tourism authorities, such as advising governments on travel and tourism policy. As a consequence, many parties are involved in the definition of tourism and travel policies – each motivated by its own interests. A few examples might help illustrate these national policies collaborating with the tourism and travel industry.

National strategies in UK

In the early 1990s, the UK launched the „Tourism and the environment – maintaining the balance“ initiative. Subsequently, the tourism industry developed environmental codes of practice. In 1992 a number of camping and camping-car clubs adopted a Parks Industry Environmental Code, which gives proper attention to sympathetic park layout, location and design, the use of environment-friendly products and design, efficient and sensitive management, energy conservation, the use of biodegradable materials, and recycling.

National Strategies of the NGO CI-Ecotourism

The Ecotourism Program of CI works to prevent losses (due to a continued lack of coordination between stakeholders) by integrating effective ecotourism planning into development strategies. Such planning will protect the ecological integrity of the region, enhance community participation, and result in high quality experiences for tourists. This combination will provide governments with a long-term plan to help maximize economic benefits from ecotourism development.

5.10 Laws, Rules and Regulations

Potential solutions to the extensive problems generated by tourism are to be found in the form of programs, strategies, and guidelines among governmental, intergovernmental and non-governmental organizations. Nevertheless, compliance with the existing laws and regulations is often difficult to control.

Tourism in parks and protected areas

The National Park system gives individual governments the framework to potentially protect vast ecosystems. In order to support these favoured touristic destinations, special attention is here given to the concept of sustainable tourism. In the context of its Action Plan for Protected Areas in Europe, the IUCN Commission on National Parks and Protected Areas in 1994 turned to governments, requesting that zoning plans be prepared for the management of each protected area, in order to prohibit certain activities in certain zones, also known as buffers.

With clever and careful planning, it is possible to minimize damages and to maximize benefits. One of the aims of nature preservation is to allow for a combination of both recreation and protection of the natural landscape components.

Strategies to solve the conflict:

- Nature protection takes precedence over all recreational uses of natural, rare or endangered biotopes and ecosystems.
- Recreational needs must be satisified, especially in the evenings and during weekends; if possible in a spatial relationship to suburbs.
- Improvement of the aesthetic and relaxing aspects of landscapes; revalorization of bare, artificial landscapes through restoration measures or through the extensification of farming and forestry activities.
- Supply of recreational activities in relation to and in respect for the local conditions, leaving sensitive areas under full protection.

Natural protection laws

Denmark's coastal conservation laws are some of the most developed in the world. The latest version of these nature conservation laws extends the protected coastal strip from 100 m to 300 m into land. The laws and regulations dealing with city planning stipulates that all „undeveloped" coastal areas should remain protected natural resources. In order to achieve this purpose, all local and regional authorities are requested to review existing ordinance plans.

Following the enactment of a 1977 decree in France on the protection of natural resources, development projects such as marinas and camping sites are subject to environmental impact assessments. Since 1993, with the amendment of the decree, golf courses and theme parks are also subjects to such studies.

5.11 Ecolabelling

Competitions or eco-label awards appear to be an effective tool to support sustainable development of tourism. The objective is to encourage the travel agencies to increase their environmental commitment while advising the tourist for a destination, a hotel, etc.

Eco-labels can also be awarded for accommodation, sports and recreational activities or for communities. Three requirements are essential requirements for the labels to be successful:

1. Informative criteria of high environmental standards;
2. Transparent award structures;
3. High level of recognition among supplier and consumer.

Competition between environment-friendly tourist communities

Established in 1995, this competition has been organized by the German Tourist Board, together with the German Ministry of Environment and the German Ministry of Trade and Commerce. Several other important local, touristic and environmental organizations are involved. The competition aims at investigating the ecological effectiveness and economic efficiency of the initiatives and activities taking place in the almost 6,000 German domestic touristic destinations. Performance in traffic, waste, fresh water, sewage, energy and environmental management, as well as in nature and landscape conservation is evaluated. In 1997, 27 communities received an award.

5.12 The Individual Level

The individual tourists should be aware of the problems and constraints inherent to the destination locality, and should require information from tour operators in order to adapt their expectations and activities accordingly. They should conform to the following guidelines, which could be made public (park board, NGOs, agencies a.o.):

- Willingness to forego a certain degree of comfort: Meaning that only the existing recourses are being used, that indigenous cultures and economies are supported and that natural resources are protected; in some cases this may result in a certain lack of comfort.
- Willingness to use public transport: Individual traffic is one of the main sources of the negative implications that tourism has on the environment; "soft" tourists are inclined to make use of the public transport system instead.
- Inclination to relax and allow oneself time for leisure: Getting to know a foreign culture and environment may take time.
- Interest and respect for local traditions, customs and generally their way of life: It is important to respect local habits, customs and rituals; the soft tourist values the traditional way of life and is eager to learn about local particularities.
- Enthusiasm to protect the environmental actively: The negative effects of recreational activities need to be minimized; the soft tourist strives to play a part in preserving the environment; special care should be taken to avoid buying souvenirs made from animals and plants.
- Sensitivity for existing problems
- Reducing the frequency of traveling: Increasing the length of any individual vacation may reduce the strain on the environment by reducing the number of journeys, thus contributing to a reduction in traffic.
- Favouring local products that add value to the region: this refers to foods as well as souvenirs etc.; buying local products has two positive effects: it directly benefits the local economy and it reduces transport-related traffic.

5.13 The Role of Professionals

Companies

On the side of the travel companies, the most important is to develop systems and procedures that incorporate sustainable development principles as part of their core management and to identify the relevant steps needed to implement a sustainable tourism.

Tour operators

Sustainable development measures on the part of tour operators should include the decisions relative to office facilities, catalogue design, selected means of transportation, as well as accommodation type for the tourist. Activities of tour operators may include:

- Formulating an environmental policy
- Incorporating environmental competence in the corporate image
- Environmental auditing of internal and external activities
- Developing a panel of environmentally-friendly travel offers (e.g. cycling tours)
- Implementing and supporting conservation activities
- Sponsoring ecologically-minded activities
- Designing guiding tools for travelers, i.e. directions for a responsible behavior on site in the travel booklets

- Exerting influence regarding accommodation etc., by setting up minimum criteria for sustainable management and making the signature of contracts conditional on their fulfillment
- Implementing an environmentally-oriented education and training of tour guides and personnel
- Exerting influence on political decision-makers in the host country
- Selecting environmentally-friendly means of transportation
- Applying environmental standards in office facilities

5.14 Examples of Ecotourism

White stork (Weißstorch):

National Park Elbe-valley-lowlands (Elbtalaue), Biosphere Reserve Spreewald: „A vacation in pristine nature – an unforgettable experience for the whole family in the protected large area of Elbe-valley-lowlands“: managed and sponsored by the company ...

Cranes (Kraniche):

Nature parks in Brandenburg, Isle of Rügen / Baltic coast as a famous resting site of cranes (> 60,000 individuals)

Parrots (Aras):

Different protected areas in Central and South-America

Tiger

National Parks in India, Nepal

African Wildlife

National Parks and Game Reserves in Kenya, Tanzania, South-Africa, Namibia, Botswana

Brazil

Tamandua Ecotourism, Serra de Canastra, Minas Gerais.

5.15 Problems related to Ecotourism

Ecotourism is not an absolute remedy for developing countries. Furthermore, not all forms of nature tourism are compatible with one another: trekking, mountain biking and white-water rafting may for example not be compatible with birdwatching or photo-safaris. As has been shown in the past, certain forms of nature tourism may actually dramatically transform unspoiled natural areas. Consider for instance the transformation of the beaches in Goa, Bali and many places around the Mediterranean.

Even very soft ecotourism puts a burden on valuable ecosystems like high mountainous regions, rocks, gorges and watercourses, which have negative impacts on disturbance sensitive species, vegetation or soils (e.g. erosion). Socio-economic conflicts may arise because of the difference in welfare status between visitors and residents.

Research is needed on:

- The influence of different types of tourism on ecosystems / habitats / wildlife
- The socio-economical aspects of ecotrourism projects
- The profit-sharing aspects: what revenues are remaining in a region
- The comparative advantages of different types of management
- The optimization of land use forms through ecotourism

5.16 Supplementary Information

In order to preserve development opportunities for future generations, we have seen that tourism programs must ensure a reasonable management of natural resources and an overall protection of the environment. Sustainable tourism operates in harmony with the local environment, community and cultures, in order for these to become the permanent beneficiaries of tourism, and not its victims. Finally, a sustainable tourism that respects the collective natural, social and cultural assets of the host country or locality should be profitable to local populations and visitors alike.

In 1994 the International Federation of Tour Operators (IFTO) conducted a study, ECOMOST, which examined the development and corresponding environmental and economic impacts of tourism on the island of Mallorca over the past 40 years. The study is curently being applied to Rhodes, another Mediterranean island which, unlike Mallorca, is on the brink of an intensive tourism development.

The general consensus among the various international organizations is that environmental considerations should be integrated to all major policy arenas has. The organization of free time, recreation and tourism in Germany became more and more important in the last two decades. The increasing requirements for recreation and the trend of spending more time in nature also generated a larger traffic on cultural sites and in sensitive natural, especially in the mountains and at the coast. In parallel with the installation of larger facilities and infrastructure, the recreational activities themselves increased in as yet untouched areas (notably because of their extreme climatic or geographic features).

5.17 Summary of Chapter 5

A certain form of ecotourism already existed in the 19th century, but its modern version was only developed in the last 30 years. The growing tourism market naturally lead to a similar growth in ecotourim. Ecological conciousness are required both from the organizers and the individual tourist. This can be achieved by using tax reductions or subsidies, or by providing an appropriate environmental education. Advisory and purely economical approaches may not be sufficient in the long run. Standards, monitoring and licensing activities, ecolabelling, and landscape zonation must be implemented in parallel.

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A search for „+ecotourims +(any country name)" on the internet will yield interesting results.

6 Nature Conservation and Habitat Management

6.1 General Motivations in Nature Conservation, Perception of Nature and Professional Implication

Nature conservation has neither one single aim nor is it fed by one single motive.

General motivations, professional implication	Measuring parameters
Protecting ecological processes: guarantors of natural processes and phenomena (evolution, succession, soil formation, and geomorphology a.o.)	Fractal dimension of landscapes, succession and soil formation stages
Minimizing land use intensity: minimizing anthropogenic disturbance and interference	Land use intensity, number of visitors entering, shape and size of area, distance to cultivated land
Preserving wilderness: preservation of the very original elements of landscapes, mostly connected with untouched and intact nature. But also more negative association: areas which have not been not cleared yet	Stage of hemeroby, naturally eroded valleys, and wildlife: animals and plants etc.
Preventing environmental poisoning: prevention of toxic releases	Amounts of toxic substances in the environment
Achieving and maintaining sustainability: protection and reconstruction of landscape functions for the promotion of sustainable crop yields and soil protection (erosion prevention, groundwater, etc.)	Soil erosion rates, yields, quality of water, rate of groundwater renewal etc.
Preserving diversity at the species level: optimizing or maximizing species numbers, key-stone / umbrella species, soil functions	Species numbers, diversity index, population density (minimum viable population)
Preserving diversity at the landscape level): different habitats, diversified landscapes, high geomorphologic energy, mosaics	Amount of different habitats, size and shape, distribution and fluctuation rates
Preserving originality (peculiarity): geological or geomorphological formations, biological adaptations (geysers**,** rare rock formations, endemic species)	Rareness in the context of a region, country, continent, world
Preserving beauty: landscape aesthetics, views, attractive features (lakes, mountains, rocks and trees), particular animals and plants	Area, observable distance, amount and quality of features, characteristics of organisms
Aiming at symbiosis: sympathy for other living beings	Animal rights
Mystic or religious attitudes to nature: holy shrines, natural formations associated to Gods	History, tales, esoterism, etc.

6.2 General Motivations for Nature Conservation

In a more systematic way, four independent general motivations for nature conservation can be distinguished, each justified by national law and present in international treaties. Different motivations will of course lead to different decisions and entail different management options. The general motivations ‘return to a natural state’ and ‘rich biodiversity’ will be treated in more detail in the lecture on „Conservation of global and regional biodiversity“.

Basic motive	Specification
(Close-to-)Naturalness	
- Protection of ecological processes	Allowance for natural development and processes (such as succession, soil formation, geomorphological processes, evolution)
- Intensity of use minimization	Absence of human disturbance, interference or impact
- Wilderness	Primeval landscape (comparable to post glacial times)
Biodiversity	
- Protection of total species diversity	Maximization or local optimization of species numbers of wild plants and animals
- Protection of functional diversity	Maximization of food chain and network connectivity
- Species conservation	Conservation of local populations of rare, endangered or otherwise valuable species (target species)
- Habitat conservation	Preservation of typical habitats or typical regional communities of species

6.3 General Motivations for Nature Conservation 2

The motivations relevant to land use by animals are sustainability and cultural heritage. Land use management can only be performed with moderately anthropocentric ethics. „Anthropocentric“ does not obligatorily mean „use-oriented” or „exploitation-oriented” but can actually imply the idea of nature „stewardship“ (see Chapter 6.16).

Basic motive	Specification
Sustainability (sustainable development)	
- Minimization of material loss	Optimization of landscape efficiency with respect to material losses (plant nutrients, cations)
- Protection of landscape functions	Media-oriented soil protection, protection of surface and groundwater, protection of mesoclimate
Cultural heritage	
- Habitat management	Initialization and maintenance of landscape elements, which are also important for habitat protection and recreation
- Preservation of historical landscapes	Reestablishment of the historical cultural landscape (around 1850)
- Landscape gardening	Landscape architecture (parks), recultivation, geomorphological reintegration, planting hedge rows, arranging erratic features
- Land art	Artificial landscape, including introduced elements of cultural and historical importance

In case of sustainability we have to determine whether sustainability is the real management objective (as opposed to other objectives listed this table) or a management strategy (also called “sustainable development”, as opposed to preservation or restoration strategies). Sustainability encompasses the 3 notions of economic effectiveness (welfare), social effectiveness (justice) and ecological effectiveness (Chapter 7.6 and 7.7).

6.4 Definition and Delimitation of Nature Conservation

As we have seen nature conservation includes the protection, conservation and development of a certain quality of biotic and abiotic resources (natural goods) including species, habitats, ecological processes etc. The application of ecological science to nature conservation requires certain **normative definitions**, which cannot be derived from ecology itself because of its claim to be a pure science.

Basic science	**Applied Science**
Ecology	Nature conservation
Physiology	Medicine
Physics	Electro techniques

In this sense, nature conservation is one of the possible fields of application of the knowledge acquired in ecology. Other traditional fields are for example agriculture, forestry, fisheries, epidemiology, ecotoxicology, water and soil protection, etc.

Currently it seems that **global aspects** must also be taken into account, such as human population growth and its potential consequences, large-scale deforestation and desertifica-tion, the eutrophication or acidification of aquatic systems, the destruction of corral reefs and mangrove forests. It is obvious nowadays that ecological entities are threatened at the level of entire biomes (tropical rainforests, high mountains, coastal marine ecosystems etc.).

6.5 Tasks and Fields of Nature Conservation

Protection of biotic resources

The conservation of biotic resources (nature as a living environment) will be dealt with in more detail in the „biodiversity“ lecture. It involves for example species protection and conservation by means of:

- International agreements, habitat conservation, publication of red lists, landscape planning, construction of new habitats, ecotechnologies (such as assistance to breeding or wintering equipment), reintroduction of species (e.g. Beaver, Lynx in Central Europe), controlled breeding of endangered species etc.
- New approaches include restoration of habitats and landscapes, construction of habitat networks, conservation of whole ecosystems, protection of functional properties of species (metapopulations) and communities (food webs).

Conservation of abiotic resources: nature as a vital source

The conservation of abiotic resourcea appies to features such as water, soil and air as parts of functional ecosystems, thus as prerequisites for life. It can only be achieved by taking total land use systems into consideration, according to the following principles (see Chapter 1.8):

- Segregation principle (cultivated and protected areas, principle of diversified land use).
- Totality or integration principle (nature conservation at 100% of the area).
- Compromising approaches, including gradient models (with buffer- and filter areas, simulation of former land use options) and network models (see habitat networks).

In the vicinity of urban areas, industry and traffic, the coexistence of agriculture and forestry on the one hand and nature conservation on the other have to be kept in mind.

6.6 Examples from Agriculture and Forestry

Biodiversity and Agriculture: In more than 70 projects, the German Development Co-operation (GTZ) helps to develop or restore sustainable land use systems adapted to the local socio-economic and ecological contexts. One strategy to achieve this goal relies on **agro-forestry.** One advantage of the higher biodiversity of this system is that it needs less input (money, fertilizers, etc.) and is more stable compared to agricultural cash-crop monocultures. Besides the support of gene banks and agricultural research, potential (and already implemented) agro-forestry techniques are for example:

- Alley cropping (hedgerow inter-cropping)
- Life fences
- Taungya System (combination of trees and agricultural crops)
- Home gardens

Only a few decades ago, the absolute belief in progress greatly reshaped agricultural practices in Germany, leading to monocropping systems, high fertilizer inputs, high degrees of mechanization, etc. As a result, erosion, air and water pollution often increased, while biodiversity in agricultural areas decreased. Efforts are being undertaken today to revert this trend and to restore agricultural practices more respectful of the environment. A legislative framework has been created and certain incentives are given to farmers to support those efforts. All over Germany, hedges are being reintroduced between fields, enriching the landscape as much as enhancing biodiversity.

Another possibility is the reduction of agricultural intensity based on an **agreement and compensation payment.**

- Compensation payments for a more extensive management of pastures (1992: approx. 1 mio. DM for almost 3,000 ha)
- Compensation payment for the non-utilization of herbicides and reduction of pesticides and fertilizers on the borders of fields (1992: approx. 0.4 mio. DM for 370 ha)
- Promotion of the traditional extensive land use system of fruit growing (1994: 100,000 DM)

Biodiversity and Forestry: Concerned with the destruction of tropical forests; with such a large spectrum of reasons for deforestation, the strategies have to be manifold as well. Among other things, support focuses on:

- Integrated (intersectoral and supranational) planning
- Development of sustainable forest management systems according to the specific ecological and socio-economic environment.
- Natural forest research
- Social Forestry

Forest management systems in Germany have been through a long trend of monocultural planting and harvesting driven by short-term economic reasoning. In addition to the disadvantage of a decreased diversity in animal and plant species, monocultural forests are particularly susceptible to natural hazards.

Again, great efforts are now being undertaken to return to a more environmentally-friendly silviculture. Some examples from Baden-Württemberg:

- Preference for natural regeneration (1982: approx. 8%, 1992: approx. 15%)

- Promotion of mixed and vertically structured stands (1983: 50% planted deciduous trees, 1992: 80%)
- Selected and sound logging operations
- Restoration and maintenance of natural forest edges

6.7 Management of Protected Areas in Germany

Besides Landscape Planning and Impact Assessment, the creation of protected areas is one of the main strategies of nature conservation. However, these instruments often encounter severe practical managerial problems. This can be viewed as a typical German problem.

Germany, a densely populated and highly induztrialised country, has a system of protected areas combining different objectives with different conservation levels. The categories encompass:

- **National parks (after IUCN 1985), criteria:**

- One or more ecosystems within these parks should remain untouched by humans
- Visitors should be allowed to enter the parks for education and recreation under specific rules
- Minimum area of 1,000 ha, dotted with a professional staff, under state control

The first National Park in the world was founded in 1872 („Yellowstone"); the first National Park in Europe was founded 1914 („Unterengadin" in Switzerland).

- **Nature conservation areas, criteria:**

- Valid areas (by legal decree), in which protection is applied to the entire areas or only parts of it
- Conservation of communities of distinct wild plant and animal species
- Scientific and nature-historical reasons
- Because of rarity or outstanding beauty

- **Landscape conservation areas, criteria:**

- Preservation and development of the natural efficiency
- Diversity, originality and beauty of the scenery
- Recreation

- **Nature Parks, criteria:**

Western part of Germany	**Eastern part of Germany**
Recreational activities	Recreational activities
Protected parts included, but mostly with a weak concept and lax control	Protected parts included, mostly into an integrated concept, sometimes with a good control

- **Natural monuments**

- Similar to nature conservation areas, but no larger than 5 ha (40,000 nature monuments in Germany, mostly trees = 30,000)

6.8 Biosphere Reserves

The main nature conservation instrument that involves land use by animals is the **Biosphere reserve** system**.** The UNESCO has introduced biosphere reserves in order to reconcile the divergent goal functions inherent to the protection of natural and cultural landscapes.

Biosphere Reserves (BR, after „Man and Biosphere“ Program of the UNESCO)

Criteria:

- Man made landscapes with historical and traditional uses of natural resources (e.g. small scale fishery, traditional agriculture etc).
- Designation of different zones with different levels of protection, scientific research.
- A BR is mostly made up of three (sometimes four) conservation zones. Two of the three zones are open to the public in order to serve the people's need for recreation and information. The third zone is mainly closed to the public for conservation reasons, but may allow a certain amount of traditional natural resource use.

Examples from Germany:

BR “Wadden Sea of Schleswig-Holstein and Lower Saxony“ (525,000 ha), agriculture, fisheries, soft tourism.

BR „Spreewald“ (476,000 ha), small-scale agriculture, landscape view.

BR „Rhön“ (132,000 ha), forestry.

BR „Pfälzerwald“ (180,000 ha), alpine pasturing.

6.9 Protected Areas in Germany (acc. to Bundesamt für Naturschutz, 2008)

Type	Number	Area (ha)	Percentage of total area	Remarks
Nature conservation area	7,923	1,900,000	5.3	Without waterbodies of North and Baltic Sea
Landscape conservation area	7,239	9,900,000	27.7	In some states no new data
Nature Park	97	8,647,000	24.2	11 more NP fixed in the Eastern states
National Park	14	962,000	2.7	80 % open sea
Biosphere Reserve	13	1,659,000	4.6	40 % waterbodies
Natural Forest reserve	719	31,400	0.09	-

6.10 Nature Conservation through Multiple Land uses (Agriculture, Forestry, Fisheries, Water management)

Planning procedures and fields of activity for the conservation of biodiversity: In order to satisfy competing interests in land use, local authorities use the instrument of landscape planning at two different levels.

1. The Law provides for public participation. In case of a suspected impact on the environment by a project (e.g. building, road etc.), an Environmental Impact Assessment must carried

out. To increase human capacity in biodiversity conservation, the following points have to be considered:

- **Policies:** Making biodiversity conservation an integral part of the international and national planning processes, and setting priorities and catalytic actions.
- **Legal framework:** Encompassing all aspects of biodiversity and laying the grounds for action at the international, national, community and individual levels.
- **Institutional setting:** Adapted to the specific needs of managing biodiversity by greater decentralization and diversification of actors (e.g. strengthening capacity of NGOs).
- **Research and training:** Geared towards a long-term, site-specific, multidisciplinary research, linking biodiversity conservation with sustainable economic development.
- **Information management:** Providing access to information by strengthening or establishing institutions and by undertaking biodiversity assessments.

2. Even more important is the expansion of public awareness. Nature conservation and landscape management plans will in the future will include:

- Creation of habitat networks
- Creation of land use areas relevant to the local conditions
- Protection from pollution
- Measures of direct nature protection / conservation

Besides economic factors, investment decisions (by the government and private companies) should include so-called "soft" position factors such as social and cultural surroundings, a region's image. Protection, conservation, management and development of nature and landscapes therefore appear to be important investment factors in the future.

Other legal tools that relevant to nature protection are for example legislation regarding pollution protection, water management, regional planning, zoning ordinances, etc., which can all contribute to the conservation of biological diversity and a sustainable use of its elements.

6.11 Landscape Management or Free Succession

One of the main dichotomy in nature conservation can be described as the choice between "Nature conservation by cultivation and management" or "Nature conservation through natural succession and spontaneous dynamics". A famous example is the history of management regimes in Yellowstone National Park, USA.

Time	Objective	Rationale	Action taken
1872	Keep large herds of grazers such as elk, bison and pronghorn (species oriented approach)	Conservation of grazers as typical elements of the prairie landscape for future generations	None
1900	Same	Fear of predation (presence of livestock in the vicinity)	Control or extermination of predators, in particular grey wolves
1930	Reduce the number of elk	Fear of overgrazing	Reduction of elk by transportation and hunting
1940	Let natural processes regulate the ecosystem	Influence of Also Leopold's land ethics	End of predator control because of scientific studies

1968	Increase number of elk	Preservation of the total environment, fear of regional extinction (Green Book)	No control inside the national park, hunting outside allowed
1978	Protection of natural ecosystems (integrity), and endangered species		
1988		Protection of biodiversity	Reintroduction of the grey wolf (1995)
1991	Greater Yellowstone Ecosystem		Migration allowed

Further interesting examples can be found on the Internet. Search for „+habitat (or +wildlife or +landscape) +management“.

6.12 Rehabilitation of Degraded Ecosystems

Besides conservation and sustainability, a increasingly popular strategy in natural resources management consists in the restoration or rehabilitation of degraded ecosystems and landscapes. The damage done by humans to ecosystems has taken an unprecedented rate: 1) buildings, pavement, and other stone or concrete constructions in cities seal the soil. Programs have been initiated for roadside plantings and for creating green space, planned and controlled by the zoning agency. 2) Open-cast mining destroys flora and fauna on large scales. In Germany rehabilitation programs include the restoration as well as the creation of new biotopes (e.g. small lakes, wetlands etc.).

Various concepts have been advanced:

- **Restoration**: re-creation of the ecosystem's original function and structure; seldom achieved (more active, ecotechnological).
- **Reconstruction**: rebuilding of a specific habitat using hard (as opposed to soft) ecotechnologies.
- **Renaturalization:** development geared towards a more natural state, based on a less intensive land use, combined with “allowance“ for natural succession processes and the development of a „potentially natural vegetation“.
- **Regeneration:** development towards of a more natural state, based on historical information (different time scales are possible).
- **Rehabilitation**: return of an area to a proper (biological) state. This could mean the return of an area to long-term productive use, such as the promotion of income sources or the fulfillment of (less tangible) recreational needs or aesthetic values. Similar: **Self-sustaining Rehabilitation:** management of an area towards a state where human inputs are no longer required, nutrient cycles are closed, and the components of the biota are more or less in a dynamic equilibrium, e.g. flooding of mires, free flowing of rivers (removal of dykes and dams).
- **Reclamation**: describes the process of ecosystem reconstruction after a severe perturbation, often leaving nothing more than bare land (e.g. open-cast mining).
- **Extensification**: reduction of the intensity of agricultural activities per unit of area.

6.13 Ethical and Scientific Implications of Various Guiding Principles

Guiding principle	Ethical justification	Scientific theory foundation
Biodiversity	Mostly utilitaristic, also eudaemonistic or naturalistic	Weakly developed, 25 competing theories for explanation
Sustainability	Intergenerational utilitarism (altruism), partly naturalistic	Developing, single acceptable approaches (e.g. ecological efficiency according to Ripl) are available
Cultural heritage	?	?
Ecosystem health	Purely naturalistic	Eclectic (systems ecology, thermodynamics, production ecology, diversity theory etc.)
Ecosystem integrity	Purely naturalistic, partly with moral connotation	Eclectic (as above, additionally self organization and complexity theory)
Ecological goal functions	Purely naturalistic	Eclectic (all fields of ecology)

6.14 Cascades of Land use Intensity

Habitat type **Land use type and intensity**	**Water bodies**	**Woodland**	**Open areas (grassland, heathland, vegetation open areas)**
1. Intensive primary land use	Intensive water body („aquacultural lake“)	Intensive forest (Scots pine or Red oak monoculture)	Intensive open areas (intensive meadow, pasture, arable fields)
2 Intensive (direct) recreational use	Recreational lake (swimming, fishing, diving)	Recreational forest (e.g. forest with educational trails)	Recreational open areas, city parks, lawns, meadows
3. Extensive primary use	Extensive water body (water body for water management, fisheries, protection against flooding, drinking water reservoir)	Extensive forest (close-to-natural forestry)	Extensive open areas (heath, arid grassland, for erosion protection)
4. Research use	Research lake	Research forest	Research open areas
5. Landscape use (extensive recreational use)	Landscape lake	Landscape forest (recreation forest)	Landscape open areas (arid grassland, heath)
6. No use	Natural lake (museum lake)	Natural forest (primary, virgin forest)	Natural open areas (natural succession, process conservation)

6.15 Nature Development („Natuurontwickeling“)

The idea was developed in the Netherlands and was applied there in floodplains of the rivers Meuse and Rhine.

- The concept is not exactly identical with restoration, rehabilitation or related ideas.
- The main element is to allow natural succession and other natural processes after initialization.

- Initialization is not meant to be an ecotechnological measure, but rather consists in the introduction of megamammals, which should belong to the ecosystem, but could never return there by themselves.
- Megamammals are mainly herbivores such as (European Wisent, Wild horse, Heck cattle, Mouflon etc., including also Beaver) but also carnivores such as (Bear, Wolf, Lynx)
- Does this concept correspond to a certain nostalgy of the past, or does it have no particular objective? Is it only a method?
- Is this nature conservation or rather the conservation of a cultural landscape, or both? What is Nature? Woodland? Dense forests?
- Do megamammals cause damage? What is the influence of winter feeding on the spatial distribution of the animals? Should they or must they be hunted? What is the influence of disturbance on the distribution of the animals? What densities can be tolerated? (0.2-0.5 GV/ha)
- Is it justified to introduce megamammals in post-mining landscapes, former military training areas, or other highly degraded ecosystem types? What is the social acceptance of such projects? Can it be combined with tourism („Karl-May-Land“)?

6.16 Conservation of Aesthetic Resources: Nature as a Life Form

The conservation of complex landscapes, including agricultural ones from an aesthetic point of view is integral part of the modern conservation strategies. Aesthetic principles of post-modern landscape are as follows (according to Nohl):

Basics

- Aesthetic statements are value statements. The landscape view is always a personal perspective of the observer.
- In the development of aesthetic guiding principles we distinguish between aesthetically motivated subject (the observer) and an aesthetically motivating object (the landscape).
- As aesthetic quality is not a property of the landscape itself but only stems from a judgment on the part of the observer, an aesthetic landscape can be regarded as a "Mitrealität".
- A landscape is considered to be „indeliberately beautiful“, which has its roots in non-aesthetic forces such as natural processes and land use systems.
- In the light of the general deterioration of the environment, the experience of an aesthetic landscape is often seen as a surrogate for the reconciliation with nature.

Levels of Meaning

Aesthetic perception takes place on three levels:

- The perceptive level (perception of the objects themselves, which we can name, count, classify etc.).
- The symptomatic level (the object may be a symptom for another object, e.g. a tree row in a gallery forest is a symptom or indicator for a stream or brook, even though the observer cannot observe the watercourse).
- The symbolic level (the observer makes a further association with the observed object which has no direct relation to the landscape, e.g. the wheel of an old water mill reminds the observer of his youth in the countryside).

Basic needs

In the western culture, several basic needs developed, which are also important for landscape assessment:

- the need for landscape experience,
- the need for freedom,
- the need for geographic roots

Please note the contradiction between freedom (space independent) and geographic roots (bound to a certain place).

Corresponding landscape qualities

- Diversity (landscape experience).
- Close-to-nature (freedom, see Marlboro advertisements).
- Peculiarity (home).

Landscape perception types

These individual types correspond to the basic interest types found in modern society (Chapter 5.1 and 5.2)

- People attracted by nature, wilderness, wildlife etc.
- People attracted by harmonic cultural landscapes
- People attracted by technology, modern buildings, sports etc.

6.17 Summary of Chapter 6

Nature conservation with the help of animals can be achieved using various strategies, which range from grazing management within conventional agriculture (paying compensations for less intensive land use), management systems based on rare animal breeds (Chapter 2), regulating game density by means of hunting (Chapter 3), replacing domestic animals and their detrimental effects on the landscape by game farms and ranches (Chapter 4), developing ecotourism in large protected areas (Chapter 5), or directly combining species and landscape protection in a non-profit type of management regime (this Chapter). The evaluation of animals and landscapes in a nature conservation context has to relate to basic valuation as applied within our society. Several contradicting approaches to the evaluation of biotic goods exist in the fields of natural ethics, aesthetics, environmental economics, and conservation biology. „Land use by animals“ is here regarded as being connected to the principle of „protection of cultural landscapes“. The aesthetic and intrinsic values of such landscapes have to be elucidated in each specific case, as well as related to economic valuation systems (see Chapter 7).

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7 Conclusions: Animals, Land use, and Sustainability

7.1 Economic Relations and Time-lines of Various Land use Systems

Different land use systems often have a completely different economic organization. As a consequence the time-lines applied for planning purposes may differ considerably, which usually has a strong influence on the potential for implementation of sustainable development strategies.

Land use system	Economic organization	Planning horizon
Conventional agriculture	Single enterprise Total economy	Short term benefit (10 years) Medium and long term yield security, avoidance of negative trends (over-fertilization, soil compaction)
Conventional forestry	Single enterprise (mostly governmental) and total economy	Medium and long term (100-300 years yield security)
Nature conservation	Single enterprise Total economy	Not organized that way Long term stability of biodiversity and other goals
Tourism and recreation	Single enterprise Total economy	Short term profit Long term profit via lowered health costs
Water management	Single enterprise Total economy (integrated within agriculture)	Short term profit (drinking water, and municipal control) Avoidance of problems in the long-term (floods, eutrophication)

7.2 Economic Aspects of Nature Conservation

- What is the value of nature conservation?

We may differentiate between hard and soft economic factors.

Hard economic factors	Soft economic factors
Infrastructure, (such as traffic conditions and roads)	Sporting facilities
Energy supply	Cultural events
Administration, staff personal	Natural areas and parks
Market forces	Recreation activities

Any option will include both costs and benefits.

- **Costs:** depend on the cultivation methods, management options, and the frequent absence revenues
- **Benefits:** indirect, through the creation of businesses, enhanced tourism, in connection with other events (such as the Federal Garden Exhibition 1995 in Cottbus)

There is a strong necessity for research evaluating indirect commercial benefits – in terms of individual incomes and regional economy – provided by protected natural areas.

A full economic assessment of natural assets faces two severe problems:

- the difficulty to evaluate goods having **no market price,**
- the difficulty to evaluate **common property** goods (see „tragedy of the commons“) in other word's under nobody's property.

A widely used classification distinguishes between the value components of Total Economic Value (TEV). It is dealt within the lecture notes on the "Conservation of global and regional biodiversity". For our purpose the core evaluation method is more important than the theoretical approach.

7.3 Economic Valuation Procedures

Economic valuation procedures are frequently applied to soil, water and air issues. However, since recent times biotic components have also become the objects of assessments. The principal aim of these monetary valuation procedures is to locate the good considered on an **accepted scale** of values (i.e. money), all this in spite of the fact that, as already mentioned, most biotic assets simply have no market price. This also applies, albeit with substantially more success, to another non-market good: human health. In some cases, monetarization may be deemed necessary to achieve equality in impact evaluation. So-called **indirect methods** (1-4) are based on market prices, or at least estimations (e.g. traveling costs, hedonistic prices, opportunity costs, restoration costs, protection costs, costs incurred for an avoidance of damage, etc.). **Direct methods** (5) try to find out the public's direct preferences by using methods derived from the social sciences (questionnaires etc.). Values like symbolic value, option value, existence value, and bequest value can only be estimated with the help of such direct methods. Some examples include:

1. Valuation of natural goods according to market prices

- Already in 1978, Westman assessed the monetary value of a wetland, based on its benefits to the surrounding environment (oxygen, game, wildfowl, water purification etc.). Once aggregated, these benefits sum up to high amounts, even though a realistic determination of market prices is not possible. Recently, Costanza et al. (1997) applied this concept to the total value of natures services on earth.

2. Cost-benefit-analysis (CBA)

- CBA requires a defined objective, usually in the form of a development project. Advantages and disadvantages for the users are evaluated and then compared. Cost-effectiveness-analysis is a variant of CBA, in which not only user-benefits, but also non-user benefits (originally non-monetary) are quantified.

3. Countervailing duties (compensation duties)

- The monetarization of impacts is based on reconstruction costs – which are easily computed – and correction factors (time to complete establishment, risk of non-establishment, uniqueness value).

4. Opportunity costs

- Opportunity costs are obtained from the evaluation of benefits foregone by potential (future) users of a good (e.g. in the light of a newly created protected area, which would prohibit activities which could otherwise have taken place, such as logging, hunting, fishing, etc.).

5. The Contingent valuation method (CVM)

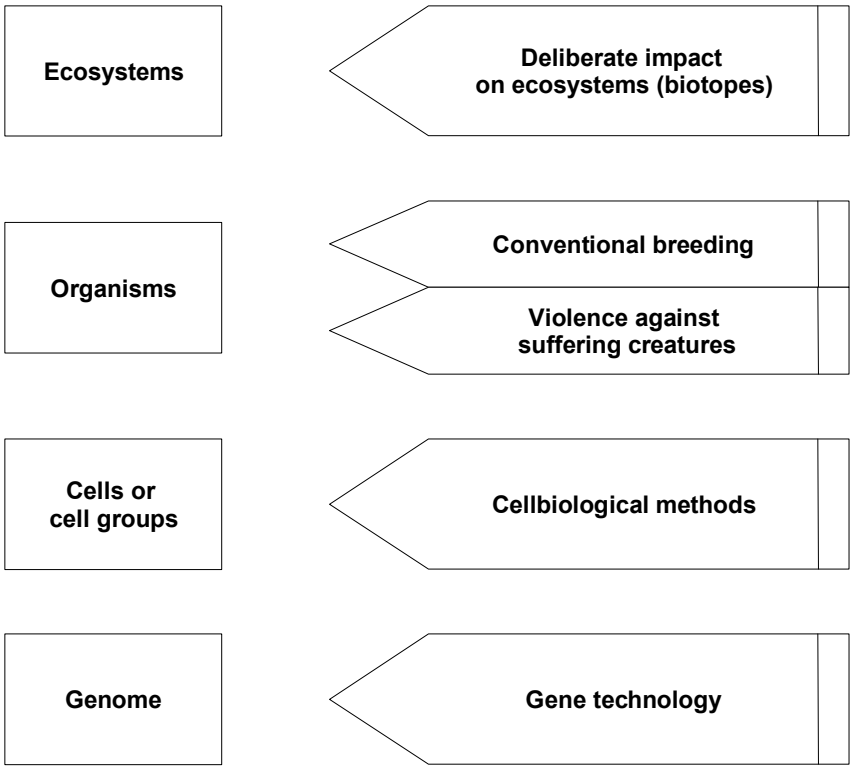
- The CVM is based on an empirical evaluation of how much a person is inclined to pay if an environmental good is protected instead of being lost to development. First, the good is comprehensively described to the questionnaire participant. Then, using fixed prices which can be accepted or rejected, a hypothetical market situation is defined that tries to assess the respondent's willingness-to-pay (WTP). This very often requires pre-tests in order to determine a realistic value for the good considered.
- The CVM has become very popular in America in the context of liability charges (e.g. the case of Exxon Valdez). There are some methodological problems, however, notably an asymmetry in preferences. The willingness-to-pay for an increase of environmental quality is often lower than the willingness-to-accept a financial burden for preventing further deterioration of the environment. People may also be dishonest in their answers.

7.4 What is an Environmental Damage?

Paradigm 1: Poisoning (by hazardous substances), approach taken by medics, chemists and large parts of the public	**Environmental policy**
Which substances are poisonous? (for men, animals, plants, ecosystems?)	Emission of toxic substances: Who? How much? What kind? By which process?
Political bargaining: threshold values, standards	Solution: limitation of concentrations or amounts released – pollution prevention Control: comparison between actual emissions and standards
Paradigm 2: Balance of Nature, approach taken by biologists, climatologists, and agricultural scientists	
How does a natural system function?	Which factors displace natural systems from their equilibrium? By whom? How?
Political bargaining: Which natural systems should be protected?	Solution: protection of natural systems (nature conservation, land use minimization, restoration) Control: survival of natural systems, are they in equilibrium or can they be nrought back to equilibrium conditions?
Paradigm 3: Entropy, approach taken by physicists and economists	
Laws of thermodynamics applied to energy and matter	Where do we use energy and/or resources faster than they are formed? (the relation to sustainability)
Political bargaining: estimating the value of human labor vs. the value of natural resources	Solution: decrease in both energy and resource use Control: do humans rely on a „natural income" or a „natural capital"?
Paradigm 4: Conviviality, approach taken by philosophers, moralists and peace-loving people	
Awareness of mutual interconnectedness, respect for life on this planet	Where do we destroy, damage or dominate other living beings (systems) more than necessary?
Political bargaining: how much damage to other goods is justified by the search for human profits?	Solution: decrease the impact on other living beings Control: is the degree of human dominance over other living beings decreasing or increasing over time?

7.5 Impact Levels of Human Action on Nature

The highest possible levels of impact are represented by the global biogeochemical cycles and the biosphere as a whole. Even though these impacts are dangerous and often cause irreversible change, they are usually no more than a sum of the indirect effects of lower level impacts.



In new breeding technologies, including the conservation and manipulation of spermatozoa and egg cells, the biochemical (genome), physiological (cells) and organismal levels are often difficult to distinguish.

7.6 Definitions of Sustainability

Many different definitions of sustainability have been proposed. These definitions are partly contradictory, or deliberately emphasize on different aspects of sustainability (ecological, economic or social). In general the term of sustainibility includes all these three aspects considering further evolution. The different definitions are only partly related to landuse.

Golley et al. (1992): „Sustainable development can mean managing human populations and the global environment so that human life on the planet can continue to evolve and change, while at the same time the health of the natural environment is maintained.“

Goodland, Daly & Serafy (1993): „Environmental sustainability means maintaining global life-support systems, or more specifically, maintaining environmental sink capacities to assimilate wastes, and maintaining environmental source capacities to regenerate raw materials, such as healthy air. Therefore, environmental sustainability means keeping both the throughput of raw materials and energy within the regenerative and assimilative capacities of environmental sources and sinks.“

Filser (1995): „Sustainable development means long-term protection of production, regulation and habitat functions of natural ecosystems. This means in detail: The produced biomass remains the same, outputs to neighbouring systems are avoided, and the present stock of plant, animal and microorganism species remains the same“

Kastenholz (1995): „A sustainable development in the long term involves the use of natural resources for human activities (including element flows) in a way that doesn't undermine the capital base nor exceed the biosphere's carrying capacity, thus allowing future generations to achieve living standards comparable to those of the present generation“.

Certain aspects of sustainability are found in almost all definitions, therefore an agreement can be reached:

1. The **consumption rate of renewable resources** must not exceed the natural regeneration rate (fundamental guideline of forestry; area and mass sustainability, since 1870, K. Gayer)
2. **Non-renewable resources** must only be used to an extent that they can be functionally replaced by renewable resources or energy carriers
3. The **output of materials** must not exceed the assimilating capacity of natural ecosystems
4. **Human-generated material flows** should be smaller than the natural variability of geogenic fluctuations
5. **Time scales** relevant to human impacts must be harmonized with the time scales related to natural processes (we generally enter the field of non-sustainability when the time scale is changed, or a process is accelerated, i.e. eutrophication)
6. The natural **variability** of species and habitats should be preserved

7.7 Comprehensive Evaluation of Land Use Options by Animals

This is an attempt at comparing different land use types. The criteria used are viewed as categories of the general notion of "sustainable development". Many question marks may be inserted.

Criterion **Land use type**	**Poison minimization**	**Wilderness***	**Entropy ****	**Conviviality**	**Ecological processes**	**Biodiversity**	**Cultural heritage**	**Aesthetics**
Landscape management by rare animal breeds	*???*	*???*	*???*	*???*	*???*	*???*	*???*	*???*
Hunting	*???*	*???*	*???*	*???*	*???*	*???*	*???*	*???*
Game farming	*???*	*???*	*???*	*???*	*???*	*???*	*???*	*???*
Ecotourism	*???*	*???*	*???*	*???*	*???*	*???*	*???*	*???*
Wildlife conservation	*???*	*???*	*???*	*???*	*???*	+++	*???*	*???*
Conventional forestry	*???*	*???*	*???*	*???*	*???*	*???*	*???*	*???*
Conventional agriculture	*???*	*???*	*???*	*???*	*???*	*???*	*???*	*???*
Industrial agriculture	*???*	*???*	*???*	*???*	*???*	*???*	*???*	*???*

* including distance from the undisturbed state and hemeroby

** including sustainability (regeneration of resources)

7.8 Summary of Chapter 7

Besides generally accepted objectives (landscape aesthetics, function, and diversity), the economic basis of landscape protection and management needs to be analyzed. The concept of „sustainable development“ usually includes, besides ecological and social sustainability, „economic sustainability“ as a third component. The quantification of economic sustainability means the introduction of yet another valuation scale. Economic evaluation is usually based on monetarization procedures, which on the one hand lead to readily interpretable figures, but on the other are difficult to apply to non-market goods. The approach used here is the decomposition of sustainability into eight principles of resource protection, which can be investigated separately regarding the economic and intrinsic benefits of each land use type. Conventional land uses such as agriculture and forestry can be investigated using the same method as for alternative land use types.

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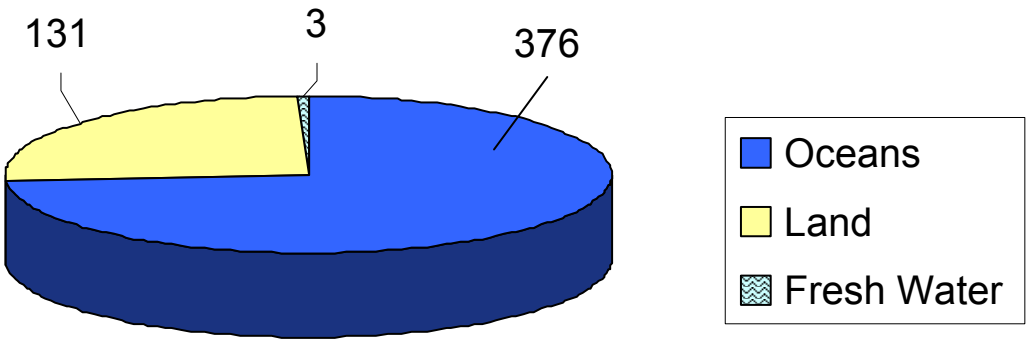
8 Annex



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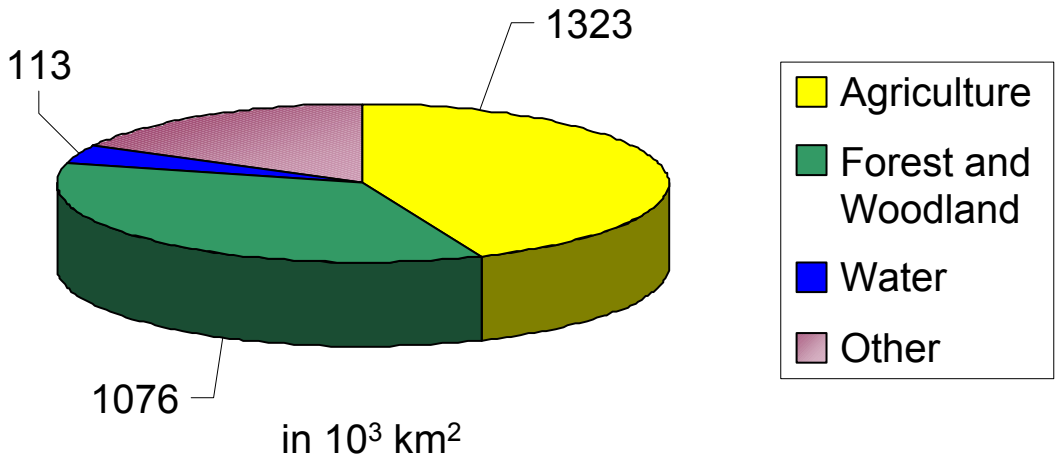
[FAO Yearbook, 2000]

Overview of Land and Land Use Types Whole Earth



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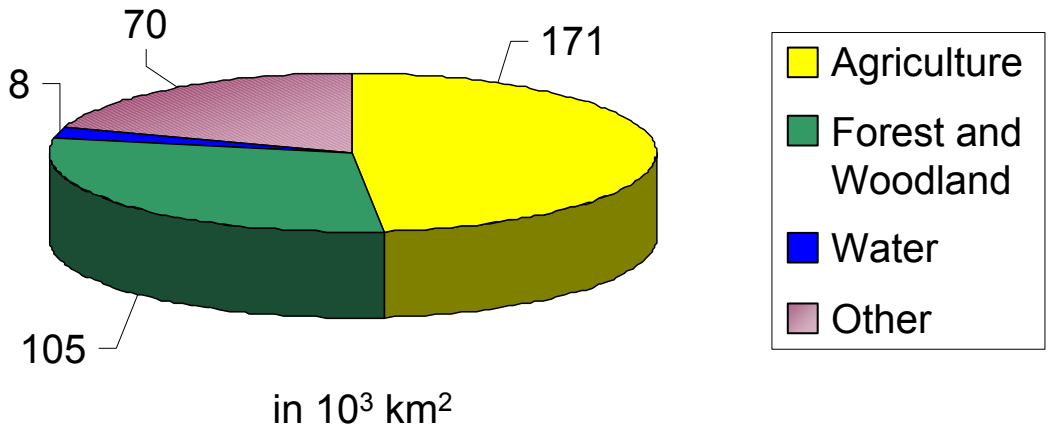
[Stat. JB Ernährg. Lw u. Forsten, 2001]

Overview of Land and Land Use Types Europe



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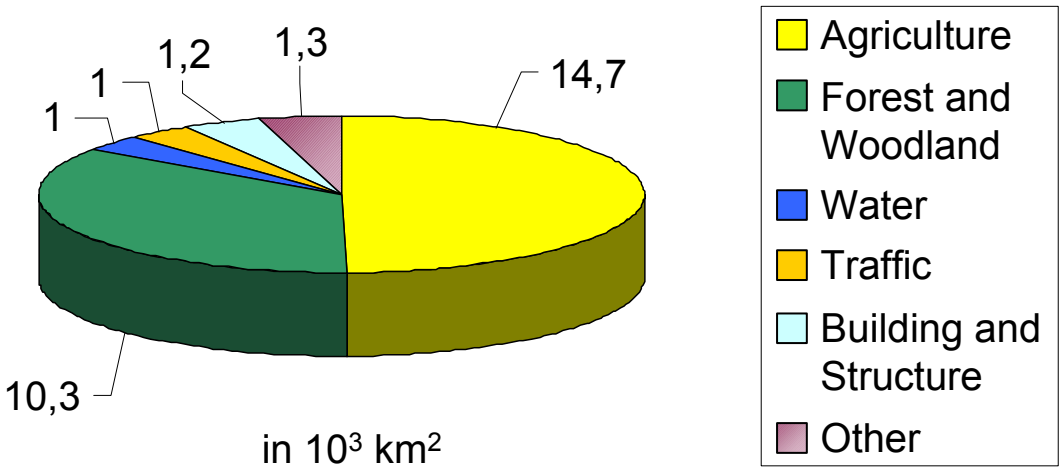
[Stat. JB Ernährg. Lw u. Forsten, 2001]

Overview of Land and Land Use Types Germany



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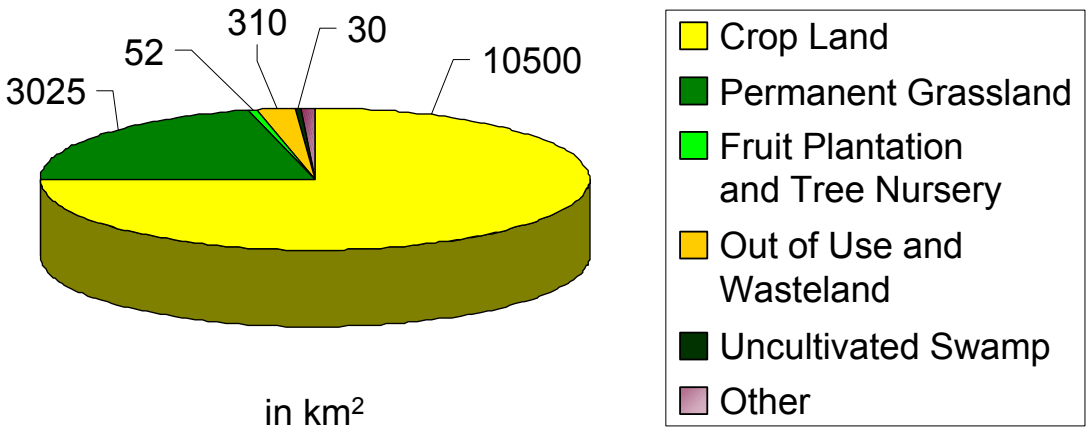
[Stat. JB Land Brandenburg, 2000]

Overview of Land and Land Use Types Brandenburg



[Stat. JB Land Brandenburg, 2000]

Overview of Land Use Types of Agricultural and Forest Farms in Brandenburg