ALTERNATIVE UTILISATION OF AGRICULTURAL LAND

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Alternative Utilisation of Agricultural Land
Scientific Monograph

editet by Rembrandt s.r.o. © 2007

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ISBN 978-80-902617-6-1

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KEY WORDS

Game management, alternative agriculture, abandoned land

ABBREVIATIONS

CAP	Common Agricultural Policy
CAU	Czech Agricultural University
CEEC	Central and Eastern European Countries
CR	Czech Republic
CGMA	Czech Game Management Association
COSMC	Czech Office for Surveying, Mapping and Cadastre
CSO	Czech Statistical Office
CZK	Czech Crown
EAGGF	European Agricultural Guidance and Guarantee Fund
EC	European Community
EEC	European Economic Community
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FGMRI	Forest and Game Management Research Institute
FIFG	Financial Instrument for Fisheries Guidance
GDP	Gross Domestic Product
GJ	Giga joule
GMO	Genetically Modified Organism
Ha	Hectare
HRDP	Horizontal Rural Development Plan
LFA	Less Favored Area
MUAF	Mendel University of Agriculture and Forestry
MoA	Ministry of Agriculture of the Czech Republic
MoE	Ministry of the Environment of the Czech Republic
MRD	Ministry for Regional Development of the Czech Republic
PG	Permanent grassland
SAIF	State Agricultural Intervention Fund
SAPARD	Special Pre-Accession Program for Agriculture and Rural Development
SEA	Strategic Environmental Assessment
SF	Structural Funds
SRF	Short Rotation Forestry
SGFFF	Support and Guarantee Fund for Farmers and Forestry
SMRF	State Market Regulation Fund
TCP	Technical Cooperation Program of FAO
TSES	Territorial System of Ecological Stability
ÚZPI	Institute of Agriculture and Food Information
WTO	World Trade Organization

ACKNOWLEDGEMENT

The impetus which triggered the present book has been the successful realization of FAO's TCP project dedicated to the search of management alternatives at abandoned Czech agricultural land, where the three authors had the role of national experts. The original energy and spirit behind it originated however at Rome, in FAO Headquarters itself. It was really an honor for us to be guided by very professional and kind FAO specialists: especially by charming Mrs. Caterina Batello from the Grassland and Pasture Crops Group in the Plant Production and Protection Division, who was the project's heart and head. Meaningful contributions to the final content of this book came from Mr. Douglas Williamson from the FAO Forest Management Division, with his philosopher's sharp eye for important issues, and practical advice from Mr. Rene Czudek from the FAO Forest Economics and Policy Division. Valuable inputs and advice were also provided by Prof. Josef Nösberger – international consultant on grassland management, by Prof. Zdeněk Mudřík – expert in livestock ranching, and by Eng. Hadji Mihajlo Pavlovic – international expert in wildlife breeding. We express our appreciation to the Czech Government for its overall support during project implementation as well as for consideration of the project's results during adjustments to the subsidy regulations. We express our gratitude also to Dr. Hana Habrová for assistance in the technical editing. And last but not least, our thanks belong to all the Czech farmers and game managers in the field who had the patience to implement the authors' ideas about the development of alternative uses for temporarily-abandoned agricultural land.

PREFACE

The European cultural-landscape has been evolving and changing since Neolithic times. Its appearance has been shaped by a range of factors with different degrees of impact over time. However, truly important epochs of the cultural-landscape were not very numerous. The first important one was: the beginning of "man-made" landscape itself, when targeted-agriculture first evolved as the natural-resource management practice. From those early times the face of the landscape has been shaped through continuous efforts by the peasantry to influence surrounding wild-nature, by altering or maintaining meadows and forests in such a way that they provided required benefits. Nowadays, our ideas about the Central European cultural-landscape mostly reflect its stage at the end-18th and early-19th centuries, when the main driving force was a gradual intensification in agriculture- and forestry-management. There was however a very different picture in the medieval or Bronze-age landscapes, when transhumance (seasonal pastoral migrations) prevailed. However all cultural-landscape types can be regarded as the subsequent development stages following initial Neolithic efforts in land-management.

Under present-day impacts the shaping of the landscape is certainly a more dynamic process, with extremes seen in urban and industrial areas. As emphasized by the Czech environmentalist J. Sadlo, the face of the present-day agricultural-landscape is very far from its climax stage (sensu seral stages concept - Clements 1916), being altered by the major technological agents: mechanization and chemicalisation. In such a landscape, modern phenomena, technologies and land husbandry operate, including: the large-scale cultivation of biomass-plants; new plant varieties; new staple-crops; new approaches to animal-breeding. One interesting facet is the declining accent on high production of food or wood, which allows for the development of new or renewed land-management approaches. Such approaches can restore the functionality and harmony of the landscape. But in order to fill the newly-opened niches, people in the rural landscape need to restore their capacity and knowledge of alternative management-approaches and the particulars of the earlier traditional (and already frequently forgotten) approaches.

Mostly in the countries of Central and Eastern Europe, after the collapse of former communist bloc, large acreages of land became freed-up and available for other uses. Such abandoned areas had often been invaded by wild plant-species, which sometimes reduced the original level of biodiversity and contributed minimally, or rather negatively, to habitat-quality or the quality of human life. And so, in order to support country-side development, the Czech Government, requested the Food and Agriculture Organization of the United Nations (FAO), to support a pilot project under FAO's Technical Cooperation Programme, to stimulate a search for viable alternative approaches to land-use in this sub-continent, especially taking advantage from, and building upon, the excellent standards of Czech game-management, which are based on both tradition and progressive technology in wildlife-breeding. FAO's pilot project was focused in the Czech Republic for three reasons: firstly, that the most intensive nationalization of agricultural land after 1948 had occurred in this part of Europe; secondly, a relatively large part of the agriculture had remained traditional in the Bohemian lands since the times of the Habsburg monarchy, until the technology moved towards high-intensity farming (fields merged into blocks, chemicalisation, etc), and thirdly to stimulate a search for viable alternative approaches to land-use in the whole sub-region.

The present book has arisen out of the theoretical knowledge and practical experience gained during the implementation of this FAO project in the Czech Republic: TCP/CEH/2902 "Sustainable Utilization of Agricultural 'Abandoned' Land". The outputs from this project have brought not only improved models for management of the natural resources, but also tested new practical methods of alternative agriculture, combining game-keeping, food-marketing, eco-tourism, etc. The wish of the authors is that the distinguished readers of this volume may benefit from the data presented, and the authors try to answer some particular problems which may burden both the inhabitants and the architects of today's cultural-landscapes. One of these basic issues is "how to make the best use of abandoned arable land?" This book thus hopes to become your practical guide through the main processes which are still taking place in the present Central European landscape: i.e. the succession of vegetation from wilderness to town and eventually back again, including intervening animal and human interactions. Believe it or not: within mankind's living-space (from the poles to the equator), all the types of landscape-evolution are very similar in their basic pattern. The authors therefore modestly hope that this book can provide above all, factual information on how to handle or combine farm-, game- and land-management alternatives, in other similar European latitudes, and possibly provide some inspiration for other regions as well.

J. Pavliš & F. Havránek 2006

I. INTRODUCTION – BROADER EUROPEAN LANDSCAPE MANAGEMENT CONTEXT

I.I Towards sustainable agriculture in a cultural landscape of Europe

Ecosystems controlled and created by man fulfill historically changeable objectives of the society repeatedly reformulated and concretized. The natural world was always a friend as well as an enemy to Berbers, Masais, Dayaks, Incans, Toltecs, Yanomans or perhaps Slavs & Anglo-Saxons (Jeník, 1973). They lived and carried out their needs in it according to the "development of their technical and cultural level" with more or less destructive impacts on the surrounding environment. A cultural landscape is always a mosaic of ecosystems that have been modified to differing extents by human influence with varying structure and species composition. Each has their demand for additional external energy needed for them to be able to function (Míchal, 1994). In other words, landscape can be regarded as a system comprised of a specific geology, land use, natural and artificial features, flora and fauna, watercourses and climate, together with mankind's habitation patterns and related socio-economic factors. The aim of ecological optimization of the countryside is to reach a state of harmonious cultural landscape, where the ecosystems destabilized by man are balanced by suitable areas of stable natural and semi-natural ecosystems.

Environmentalists emphatically draw attention to a conflict between the trend of natural processes towards the maximum stability of ecosystems and human objectives of their maximum exploitation. Odum (1977) concludes that the first inevitable step for the rational use of natural resources is to take into account the conflict. In the modern concept of sustainability (accepted in the UN conference in Rio de Janeiro in 1992), major departure from the anthropocentrically emphasized necessity of economic growth, based above all on the consumption of non-renewable supplies of resources, can bring a substantial change in the direction of mankind to improve life quality and sustain development with the preferential use of renewable resources.

It is well-known that one thousand species of a tropical forest are endangered annually and an area of the rain forest the size of New York City disappears every 4 days. This confirms the fact that the largest destruction of the environment in the history of mankind has occurred during the last 100 years. Unfortunately, it is in connection with the so-called development of new technologies and mechanization in agriculture (Goodland, 1990). Considering this situation, the increasing number of people opens a question concerning the usefulness of the rapid technological progress which is not controlled by mankind capable to use creatively powerful tools which it produced.

But in view of that, one should also bear in mind that human coexistence with surrounding nature by everyday media and ultra ecological* organizations is stereotypical and "black without white". One can be certainly proud of the beauty of landscapes and diverse habitats, which are in Europe as a result of a 1,000-year long coexistence of "cultivator" with surrounding nature.

Abandoned field overgrown by monocoenosis of thistle (Cirsium arvense)

Accordingly, the relationship between agriculture and the environment in Europe is not static. Agriculture has intensified and intensification has in turn increased pressure on the environment. The desired relationship between agriculture and the environment can be captured by the term „sustainable agriculture". Sustainable agriculture would call for a management of natural resources in a way which ensures that the benefits are also available in the future. It has to ensure that environmental integration is adequately considered in the decisions to be made on agricultural policies within the context of Agenda 2000 (vide chapter I.II.).

Over three-quarters of the territory of the EU is agricultural (44%) or wooded land (33%). Farming may not be featured in every landscape, but covering almost half of EU territory, agriculture remains the main land use. Thus farmers have historically, and to a large extent unwittingly, been responsible for the development and stewardship of the landscape. They have provided environmental, social and amenity benefits for free, while pursuing the production of food, fiber and fuel for subsistence and for profit. While there is great diversity in environmental values and land uses from Mediterranean to sub-Arctic regions, a significant level of interdependence between agriculture and conservation of the environment is evident throughout the EU.

At the abandoned agricultural land the forest succession of broadleaved species is usually triggered

The above mentioned definition of sustainable agriculture reflects the self-interest of farmers. A broader understanding of sustainability extends, however, to a broader set of features linked to land and land use, such as the protection of landscapes, habitats, and biodiversity, and to overall objectives such as the quality of drin-

** Ecology is a relatively young discipline developed mainly in the 50s of the 20th century. On the other hand e.g. Forestry (sensu sricto - the multidisciplinary art) respects a principle of sustainability already for several centuries due to the long-time understanding of economic consequences of the simple depletion of resources.*

king water and air. Therefore, in a more comprehensive perspective, the beneficial use of land and natural resources for agricultural production also has to be balanced with society's values relating to the protection of the environment and cultural heritage.
As commercial activities, agriculture and forestry are aimed principally at production, which both relies on the availability of natural resources and, in exploiting these resources, places environmental pressure on them. Technological developments, and commercial considerations to maximize returns and minimize costs, have given rise to a marked intensification of agriculture in the last 40 years. The role of the common agricultural policy (CAP) in contributing to intensification also has to be mentioned.

Five main objectives cover the CAP reform proposals of the Commission:

- increase competitiveness;
- assure food safety and food quality;
- maintain a fair standard of living for the agricultural community and to stabilize farm incomes;
- integrate better environmental goals into the CAP
- and develop alternative job and income opportunities for farmers and their families.

The various roles performed by farmers, in particular in maintaining and conserving the countryside, are increasingly under close scrutiny by society. On the one hand, farmers must reach the minimum standard of environmental care demanded by society including observance of compulsory legislation. On the other hand, if society wants farmers to provide environmental services beyond the basic level of good agricultural practice, they should be paid for their costs and income losses in delivering these public benefits.
A high level of price support favored intensive agriculture and an increasing use of fertilizers and pesticides. This resulted in pollution of water and soils and damage done to certain eco-systems, resulting in high treatment costs which had to be borne by consumers or taxpayers.
Among the environmental developments, which the CAP helped to speed up, changes of landscapes due to the intensification of agriculture are often mentioned. The destruction of hedge rows, stonewalls, and ditches and the drainage of wet lands have contributed to the loss of valuable habitats for many birds, plants and other species. Intensification in certain areas led to an excessive use of water resources and to increased soil erosion.
Therefore, in certain perspective, agricultural land is under severe "threat" in many parts of the EU from alternative land uses, but also by the real threat of inadequate land use practices. In particular, sites for housing, industry, and the expanding transportation network remove, sometimes entirely, the environmental value of land.

Agriculture, in contrast, in many cases preserves land, although negative pressure may be exerted on the soil quality. The damaging effects fall into three categories:

- physical degradation, such as erosion, desertification, waterlogging and compaction,
- chemical degradation, such as changes in acidity, salinisation, contamination by pesticides, heavy metals, etc.,
- biological degradation, including changes to micro-organisms and to the humus content of soil.

The main agricultural driving forces for soil erosion are: unsustainable agricultural practices on sloping lands, such as lack of effective erosion control measures in production systems such as certain types of intensive fruit production and olive trees; soil compaction through the use of heavy machinery; cropping systems that leave soil bare during the rainy season; improper irrigation systems; burning of crop residues; removal of river bank trees and scrub; and non-soil protecting monoculture. Despite positive results achieved in areas covered by agri-environmental or afforestation measures, soil erosion is increasing. About 115 mil hectares in Europe are suffering from water erosion and 42 mil hectares suffer from wind erosion.
Therefore, certain farming systems, such as managed grazing, the presence of hedges and trees, and traditional rotation patterns, may be essential to maintain soil quality. Several agri-environment programs have the conservation of soil resources as an aim. The programs assure certain crop rotations and in particular promote organic farming. Programs also exist to guard against erosion and fire risk, particularly in relation to abandoned land. Afforestation programs under Regulation (EEC) No 2080/92 can also make an important contribution by reducing soil erosion.
As a matter of fact, awareness has grown during the last 15 years that the differentiated landscape and related biodiversity shaped by agriculture over several centuries has given rise to a unique semi-natural environment. Rich varieties of species depend on the continuation of farming and can be harmed by both – the intensification or abandonment of agriculture. Intensification can raise problems, not just in relation to landscape and biodiversity, but also for soil, water and air.
Many programs exist in EU member states to meet the costs of preserving the landscape and its cultural heritage under the agri-environment regulation. In the less-favored areas, compensatory allowances are designed to encourage farmers to maintain, and not to abandon the countryside.
The agri-environment measures cover ways of using agricultural land, which are compatible with the protection and improvement of the environment, the landscape and its features, natural resources, the soil and genetic resources. This includes organic farming, low-input farming techniques or alternatives described not only in this book. Such land management practices support the nature protection values coded by eg EU Natura 2000 program, and deal with land set-aside for environmental purposes, and the environmental maintenance of abandoned farmland.

I.II Abandoned agricultural land in Europe and its conversion on other uses

Land use in Europe has been particularly influenced by socio-economic changes following the 2nd World War, which resulted in intensified agriculture in suitable areas and abandonment of low productivity sites. In the arable sector growth in yields has been accompanied by an increase in inputs. Fertilizer consumption has increased from approximately 5 million tonnes in 1950 (nutrients), peaking at over 20 million tonnes in the 1970s and 1980s and decreasing to the current 16 million tonnes (EFMA 1998). Pesticide use shows a similar development with a level in 1996 of approximately 300,000 tonnes per year. However, pesticide usage has increased in Portugal, Ireland and Greece, countries with traditionally low usage. In last few years, distinctive changes have occurred not only in agriculture but in EU as such. After accession of Eastern European countries, the agriculturally used areas extended by one half. New ways of using abandoned land, including conservation and/or restoration of the most valuable parts of the landscape, are becoming an aim of research activities in western and northern Europe (Bakker 1989; Bogenrieder & Wilmanns 1991).

The abandonment of land use for agricultural purposes which is taking place mainly for economic reasons also creates pressure on landscape and biodiversity. Sound utilization of agricultural land can naturally contribute towards the solution of social issues, such as unemployment and movement of the young "village" generation into towns. In Europe in particular, the abandonment of farming activities can reduce biodiversity, and in any case would not normally lead to the recreation of the aboriginal natural status. The challenges proposed by both the intensification and aban-

donment of farming therefore raise questions concerning the relationship between agriculture and the environment and the future basis for the European model of sustainable agriculture.

As a consequence, the network of alternative agri-environment programs offers payments to European farmers who, on a voluntary and contractual basis, provide environmental services to protect the environment and maintain the countryside. These services improve the quality of life in the countryside and can contribute to the diversification of economic activities, particularly through tourism. Such payments are also open for bio-mass and bio-fuels, provided that environmental protection is ensured. The payments are based on the costs incurred and income foregone by the farmer who carries out the environmental activity. The policy proposals also expressly cover the environmentally favorable management of low-intensity pasture systems, and a new measure for the conservation of high nature farmed environments which are under threat. For example, erosion, abandonment or fire, is introduced. Concerning the upkeep of landscape features, the maintenance of historical farmland features is included as well.

The main objectives of compensatory allowances in less-favored areas remain broadly unchanged. Namely they are to assure continued farming in the less-favored areas, to contribute to the maintenance of a viable rural community, to preserve the landscape and to promote the continuation of sustainable farming in areas where it is necessary for the protection of the countryside. Mountain areas, areas north of the 62nd parallel and other less-favored areas are defined with reference to the handicaps of farming imposed by altitude, slope, climate or poverty of the soil. These lead to pressures for abandonment. Such areas are often of high nature and landscape value, where the cessation or diminution of farming care would threaten the landscape and lead to a loss of biodiversity value. In these areas, the continuation of environmentally beneficial agriculture may require a substantial effort on the part of the farmer, and costs exceed the level of compensatory allowances. In addition to the mountain and other less-favored areas, EU states are enabled to continue to designate areas subject to specific handicaps where farming should be continued, particularly to protect the environment, preserve the tourist potential of a region and to protect the coastline.

An increase in application of the agri-environment measures is foreseen. An amount of EUR 2,8 billion per year was mentioned in the budget evaluation for Agenda 2000 for the accompanying measures.

Only 20% of the agricultural land in the EU is currently covered by agri-environmental undertakings. That exceeds the initial 15% target set out in the Fifth Environmental Action Program to be achieved by the year 2000, however, only five member states account for 86% of the expenditure. Uptake of programs is generally low in highly productive and intensive agricultural areas.

In historical hindsight, the EEC members approved a program of compensations in 1987 for voluntary abandoning of agricultural areas for either 1 or 5 years, as a result of the increasing agricultural surplus production and obvious negative effects accompanying the intensive forms of agricultural activities. The abandoned land was requested to be covered with vegetation or left for spontaneous grassing, and farming was forbidden. However, this program had not been effective enough in reducing the surplus agricultural production. Therefore, in 1993-1994, the obligatory abandonment of 15 percent of managed field areas was established. Later, based on further development of agricultural production demands, this percentage was modified several times. At present, the obligatory part is 10 percent. Small agricultural firms with annual production up to 92 t of corn are exempt from this obligation.

Compensation for abandonment is calculated according to average regional yields and amounts to EUR 63 per 1 ton of crops.

As mentioned above, the main idea was to decrease food production. But it doesn't mean that those areas are restrained from all agricultural activities. In compliance with the current EU regulations, it is allowed to grow so called "growing commodities" (biofuel etc.) and other cultural plants (non-food plants). For instance, in Germany these plants are grown on approximately 1/3 of abandoned land.

According to EU regulations, acreage of the abandoned land must be of at least 0.3 hectare, the plot width 20 m minimally. Exceptions are possible along water streams and on areas with fixed, constant borders. In order to protect the areas from nitrate loss, they must be covered with vegetation or left for spontaneous grassing. The cultural plants used (crops, rape, soya, sunflower, flax, and some varieties of pulse) do not have to be sowed as sole crop. During the fallow period, no fertilizers and herbicides are to be applied. The farmer has to manage the area so that it is permanently suitable for field plant cultures.

In order to protect the area from weeding and subsequent necessary chemical treatment, it is allowable to seed up mixtures suitable both as a protection from weed and, especially in the second half of a year, as a graze and hide for free living animals.

In EU states, 75% of the abandoned areas are managed as a fallow for 1 year, and 25% for more years. An intensive agricultural activity has not only led to surplus crop production, but also to deterioration of living conditions for the majority of free living animals. Therefore, within the reform of the European agrarian policy (CAP), so called "accompanying measures" have been adopted in 1992 in order to harmonize the agriculture and the environment. These measures have been incorporated into Regulation EEC No 2078/92.

With regard to Regulation No. 1257/1999, which is a part of "Agenda 2000", these measures will be maintained. In principle, farmers are encouraged to preserve the nature and environment during their land management practices. In return, they are entitled to corresponding compensations. Those farmers, who agree to participate in ecological programs for 5 years, will obtain a financial premium. The respective areas must be managed in an environmental-friendly manner exceeding standards. The premium amount corresponds with income loss caused by environmental measures. In 2000-2006, the expenditures on agricultural ecological programs will total about EUR 2.3 milliards.

As for the present support to create abandoned areas in EU, it would be wrong to consider this state definite. EU now produces more crops that it can consume. With respect to the international trade agreements, only a limited amount can be exported – by means of export subventions. At present, green fallow areas are the most important measures in the regulation of agricultural production. If the situation in the world market changes, attitudes on obligatory abandonment of a certain percentage of productive land area will change as well. Even today, trends aimed at cancellation of this duty exist. In 2002, "Agenda 2000" was reviewed – in a so-called "Mid-term review". Taking into account the present acreage of agriculturally managed land in EU and the ten percent fallow obligation, theoretically, there is an area of 6 million hectares of abandoned green land that could serve for alternative uses.

EUROPEAN AGRICULTURAL FUND FOR RURAL DEVELOPMENT IN THE PERSPECTIVE OF 2007-2013

European Agricultural Fund for Rural Development (EAFRD) consists of four Axes. Axis 1 includes improving competitiveness of the agricultural and forestry sector and supporting business dynamics in agriculture. The priority is modernization of agricultural holdings and adding value to agricultural products. This axis is financed by EU out of 75 %. Its main aims are the same as in the Agriculture Operational Program and in the Sapard program. This should markedly facilitate application of this axis measure with respect to the previous experience of potential applicants. Axis 1 is, from the viewpoint of an alternative use of agricultural land, defined as follows:

- maximum interrelationship to existing subsidies within the Agriculture Operational Program and in the Sapard program
- innovations and access to results of research and development
- integration of agricultural-food chain
- development of new markets for agricultural and forest products
- support for sustainable production
- modernization of agricultural holdings
- support for restructuring and developing agricultural production potential
- improving quality of agricultural products and ensuring they will be unharmful
- supporting goal-directed management in forests
- setting up and restoring lands
- restoring ponds and pond systems
- improving the landscape

Axis 2 covers solutions for economic problems in less favorable regions, protection of natural resources and the environment in the countryside, laying emphasis on conservation of the countryside and water resources. Axis 2 will be financed by EU out of 80 %. The main aim of this axis is continuation of existing subsidies and measures for improving the environment and countryside. So it will be closely related to programs of the Horizontal Development of the Country and Operational program that are working now. The subsidies for new measures in NATURA 2000 areas as well as for the measures concerning sustainable use of the forest land are to be increased in the period between 2007 and 2013. Axis 2, from the viewpoint of an alternative use of agricultural land, is defined as follows:

- solution for economic problems in agricultural areas with handicaps by means of protection of natural resources and the environment in the country regions laying emphasis on conservation of the countryside in agriculture and forestry
- to maintain existing payments (LFA, AEO and forestry)
- measures for sustainable use of agricultural and forestry land
- support for non-productive investments (plantation of scattered vegetation),
- afforestation
- payments within NATURA 2000 (spontaneous development in forests)
- non-productive investments in the forest
- supporting investments to modification of wood composition in the forest
- supporting investments to activities resulting in rules specified for forest visitors and their safety
- agri-environmental measures such as meadow grazing, integrated production of vegetables, new management of pastures and steppes, grassing arable land near streams.

Axes 3 and 4 priorities will be the support for diversification of rural economy and improving life quality in the country and creating new jobs and stability for rural population. Axis 3 will be co-financed by EU out of 75 % . Axis 4 comes through the three previous axes and thus European Agricultural Fund for Rural Development facilitates participation of country micro-regions thanks to the Leader method. We can expect an increased initiative of country micro-regions after the EAFRD program starts. Axis 4 will be financed by EU out of 80 %. Axes 3 and 4, from the viewpoint of an alternative use of agricultural land, are defined as follows:

- life quality
- better possibilities for women in the labor market
- development of micro-holdings
- development of traditional skills
- application of renewable energy source
- tourism
- mobilization of endogenous potential
- nature and landscape management on agricultural and forest land
- life quality in country regions
- diversification of rural economy
- multi-field strategies
- creating network of local partnerships

Specific agri-environmental programs include: grassland, eco-agriculture (ie organic farming), grassing of arable land, creation of grass belts on sloping grounds, growing interim crops (ie further catch crops) , maintenance of permanently waterlogged meadows, bird habitats on grasslands, bio-belts (food supply for widlife), and the like.

II. CZECH REPUBLIC AS A MODEL COUNTRY OF LAND USE APPROACHES IN CENTRAL & EASTERN EUROPE

About 88 % of the Czech Republic's territory is suitable for different purposes in agriculture and forestry, depending on the fertility of soils. Accordingly, agriculture is the largest user of land in the Czech Republic. The quality of cultivated lands, soil types, physical features, slope conditions and climatic conditions are all good for agricultural production in general, although there are substantial regional differences.

Overview of the agricultural land situation

The total extent of agricultural land reserves in CR decreased from 4,374,000 ha in 1980 to 4,259,480 ha in 2005 (State environmental policy 2001, COSMC 2006), of which:

- 22 % of agricultural land are protected areas with special management regimes
- c. 50,1% of the agricultural land reserves belong to category LFA (less favored areas)
- 7 %, i.e. 300,000 ha of agricultural land (according to a qualified estimate) are placed in extraordinarily unfavorable natural conditions, i.e. steep land over 11º in more than 800 m above sea level, and steep land over 8º in 600-800 m above sea level (State environmental policy 2001).

Table 1: Composition of the Agricultural Area in the Czech Republic (2001)

Type of use of agricultural area	total agricultural area [ha]	arable land [ha]	grassland [ha]	permanent cultures [ha]
used fertilized soils	3 400 000	2 800 000	300 000	300 000
unused unfertilized soils	880 000	280 000	600 000	0
total agricultural areas	4 280 000	3 080 000	900 000	300 000

Source: MoA statistics

The arable land areas have been reduced from 3,294,000 ha to 3,047,249 ha. The percentage of cultivated agricultural land has not changed, and, if compared to the EU-15 average (60.1%), it stays considerably high (71.54%) (State environmental policy 2004-2010; COSMC 2006, MoA 2005).

As a result of the very intensive farming, often without regard for agro-ecological conditions that has characterized recent decades, the physical, chemical and biological condition of soils has deteriorated. The political and economic transition of the early 90s had a strong influence on the processes of the agricultural sector. They also had a strong effect on the condition of the agri-environment. The result was a somewhat self-contradictory situation. After the implementation of the privatization, holdings became fragmented and the economic conditions of the sector deteriorated in parallel with the general state of the economy. That resulted in the general introduction of more extensive farming methods with much lower levels of pesticide and fertilizer use (and in general, a lower level of input), accompanied in many cases by the appearance of the environmental problems associated with „under-utilisation" (e.g. nutrient management problems, lack of manuring, negative nutrient balances, growth of fallow areas, the stopping of the management of valuable areas under nature protection).

In the Czech Republic, large areas were abandoned over a comparably short period of years-1946 to 1955. The situation was worst in marginal, low-productivity and less accessible, mainly mountainous, parts of the country where almost all of the farmed land was abandoned. The landscape of the Czech Republic was afterwards affected by intensive large-area agriculture of the second half of the 20th century. As a result, the CR ranks among regions with a high proportion of ploughed land and a low proportion of permanent grasslands (PG).

Nevertheless, the agrarian and ecological policy of EU is naturally nowadays affecting also this proportion. New trends in the use of "abandoned" agricultural land dealing also with the protection, conservation and restoration of valuable landscape elements are an objective of many research projects (e.g. Bogenrieder & Wilmanns 1991; Bakker 1989; Hopkins & Biber 2002). The ongoing Common Agricultural Policy reform process changes patterns of world trade forces. This induces a challenge to farmers to take up their multi-functional roles as custodians of the countryside and market oriented producers, including disadvantaged areas and remote regions. It is widely recognized that the development of rural areas can no longer be based on agriculture alone and that diversification both within and beyond the agricultural sector is indispensable in order to promote, via diversified incomes, viable and sustainable rural communities.

As mentioned above, agriculture of the Czech Republic is, after 50 years of collective organization, in a transition phase. The land is returned to its original owners or to new owners. This process is very demanding because it involves completely different economic and organizational conditions. A consequence of this change is that some agricultural enterprises are very small and are not economically viable. This situation favors, especially in marginal areas, the abandonment or neglect of the land. The population is migrating to other regions. The resulting land-use system may be no more sustainable. To avoid such negative effects, many measures at the policy and technical level are needed. The Second European Conference on Rural Development in Salzburg (12-14 November 2003) concluded that sustainable economic growth of the agricultural sector must come increasingly through the diversification, innovation and value added products that consumers demand. Marginal areas have fewer possibilities for alternative land uses. Often they are limited by natural constraints for a higher productivity (www.europa.eu). However, they often have a combination of natural resources which favor biodiversity and are a basis for an attractive landscape. These factors are potential assets for an eco-tourism. The use of the agricultural land by an extensive grassland system could contribute to such objectives and help to improve the livelihood of the rural population.

The Czech Republic entered EU in 2004. This integration gives farmers increased competition in the market and reduced export possibilities. There is a risk that the marginal land (low soil fertility, great distance to the markets) will be abandoned, and as a consequence invasive plant species (mostly weed species) could become dominant and vegetation can start to degenerate. Such a situation has negative effects on biodiversity and diminishes the attractiveness of the landscape. In addition, there are also potential ecological risks, when farmers have to apply herbicides to control the heavy weed infestation. This situation can occur because the area cropped with cereals, rape and other crops is decreasing in regions which do not offer optimal growing conditions for arable crops. Abandoned arable land is especially prone to be infested with weeds which then become a seed bank for a larger region. It was probably the awareness of this potential ecological development and socio-economic considerations that caused the Czech Government to decide to promote the development of alternative land-use systems. In particular, in the border areas of the country (North Bohemia, North Moravia and other regions) there was a critical need for supportive measures to be identified. Their main objective is to develop land-use systems which are beneficial to the environment and promote diversification of the agricultural income. Such situations are also very common in Western Europe. Agricultural policy of the EU is stressing that there is a need to help farmers take up their multifunctional role as custodians of the countryside and market oriented producers.

Agricultural markets in the European Union (EU) and accession countries in Central and Eastern Europe are also currently facing distortions due to various support policies for agriculture production. The agriculture production of the Czech Republic faces constraints in exporting traditional agriculture commodities by limited access to EU markets. With the integration of the Czech Republic in the EU in 2004, traditional farmers were confronted with higher competition and further reduced export possibilities. Therefore, traditional agriculture production on farming land would be further limited and would result in decreased farm income and employment opportunities in rural and remote areas of the Czech Republic.

While specialized institutions are studying the problem, methods of alternative agriculture are yet to be developed to the required level. Adaptation and preservation of areas for sports and recreation purposes, particularly in relation to agro-tourism activities, production of medicinal plants for pharmaceutical purposes and cosmetics, set-up of plantations of fast growing woods and grass for energetic purposes, transfer of parts of arable land fund to so called natural reserves and transfer of arable land to meadows, only occur sporadically and unsystematically without relation to other measures of proper practical agricultural management.

The Government recognizes that this period of transition in agriculture requires the development of new techniques, tools, attitudes, and skills for interacting and supporting private, environmentally friendly, small-scale agriculture, and public participation to maintain the environment and traditional landscape character. However, public services do not dispose of the professional capacity to promote the practical utilization of different methods, models and systems for alternative agriculture that would address this problem.

II.I Agricultural land – national situation and strategies

Total land area of the Czech Republic is 78.87 km^2. The Czech population is 10.3 million inhabitants. The total agricultural area is around 4.3 million hectares, including nearly 3.1 million hectares of arable soils. Agricultural land accounts for about a half (54 %) of the total Czech Republic's area. The total area of forests is 2.6 million hectares. The areas in higher elevations (above 500 metres above sea level) can be considered as less favoured from the viewpoint of farming. In view of a relatively high population density in the CR, farming has had a tradition even in these areas. To a limited extent, farming activities are carried out up to 1250 metres above sea level.

Table 2: The basic land use structure in the CR

LAND USE STRUCTURE IN THE CR IN 2005
(state as of 31.12.2005)

Type of use	Area in ha
Arable land	3 047 249
Forests	2 647 416
Permanent grasslands	973 789
Gardens	161 811
Water areas	160 939
Orchards	46 994
Vineyards	18 670
Hop gardens	10 967
Built-up areas	130 078
Other areas	688 800
Total	**7 886 713**
• of which agricultural land	4 259 480
• of which non-agricultural land	3 627 233

Source: COSMC 2006

The agricultural land area was virtually unchanged on 31 December 2005 and remains stable at about 4.3 million ha. The area of arable land declined somewhat, and therefore there has been a slight decrease in the share of arable land (down to 71.54 %). On the other hand, the share of permanent grasslands amounting to an average of 22.8 % is relatively low considering the climatic conditions. There is 0.41 ha of agricultural land and 0.31 ha of arable land per capita in the Czech Republic.

Currently, agriculture in the Czech Republic faces a very important decision. Even so, the Czech agriculture has not been exposed yet to a real danger of high overproduction of food and the resulting liquidation of a part of agriculture and the leaving of the extensive area of agricultural landscape by its inhabitants. It is time to begin immediately considerable restructuralization under the conditions of effectively utilized agricultural soil. Adapting of agriculture to non-food production will be necessary. As a result of changes in internal and external conditions, the size of Czech agricultural production experienced considerable adjustments in the course of the transformation period. Save a few commodities, the agricultural output in recent years has been considerable lower than that before the beginning of the transformation.

Since 1989, the share of agriculture on the gross domestic product (GDP) has gradually declined to 4.36 % in 2004 compared with 7 % in 1989. Over the period of 1989-2004, gross agricultural output dropped by more than 30% with livestock production shrinking more than crop production.

State of the agriculture in relation to state of the environment

The exploitation of renewable natural resources in the Czech Republic has recently undergone substantial changes. These changes can be explained both in terms of a sounder approach in the individual branches of the economy exploiting these resources, and also in the creative and renewal activities that minimize detrimental impacts on the environment. A realistic chance of ensuring the ecological stability of a landscape is based on the precondition that the ecological stability of the cultural landscape as a whole is to be understood not just as a simple average of the degree of stability of individual patches. It is also a function of their arrangement and of their positioning within the landscape as a whole (Bucek et al, 1996).
The high degree of cultivation of agricultural

Table 3: Gross agricultural output (CZK million in constant 1989 prices)

Indicator	1989	1997	1998	1999	2000	2001	2002	2003	2004	2005
Gross agricultural output	108 633	76 803	77 351	77 798	74 269	76 135	72 752	67 227	77 261	73 558
of which – crop output	44 694	35 138	34 535	36 250	33 700	35 443	32 483	28 124	38 879	36184
– livestock output	63 939	41 665	42 816	41 548	40 569	40 692	40 269	39 103	38 381	37 375

Source: CSO 2001, CSO 2006

land, corresponding to 71% of its total area, on the one hand, and the need for suitable maintenance of permanent grasslands (meadows and pastures), which are no longer used because of the cut-back in agriculture, on the other hand, are on-going problems in this area. Similar to forests, these grasslands are able to resist various stress factors and are capable of retaining about 80% of precipitation water. Thus, they contribute substantially to protection of the soil against erosion.
The rapid development of environmentally sound farming (ie organic farming) was reflected in the number of environmentally sound farms, corresponding to 829 enterprises in 2005, compared to only 3 enterprises in 1990. The structure of the environmentally sound agricultural land fund is characterized by a predominance of permanent grasslands of 82.4 % compared to 8.1 % arable land, where permanent crops and other areas correspond to only 0.3 % and 9.2 % of this land fund, respectively (MoA 2006). The predominance of permanent grasslands leads to a high production of bio-beef, with a production in CR in 2001 of 1 062.7 t (0.96 % of the market in beef), along with 20 t of bio-mutton (0.44 % of the market in mutton) and 1 150 t of bio-pork (0.28 % of the market in pork) (MoA 2005).

Table 4: Occurence of farms oriented on ecological management 1997-2005

Year	No. of farms	Area (ha)	Share from the total (%)
1997	211	20 239	0.47
1998	348	71 621	1.67
1999	473	110 756	2.58
2000	563	165 699	3.86
2001	654	218 114	5.09
2002	717	235 136	5.50
2003	810	254 995	6.00
2004	836	263 299	6.20
2005	829	254 982	5,99
2006	963	281 535	6,61

Source: MoA, 2005

Table 5: Subsidies for ecological agriculture per ha in 2003, 2007

Type of land use	(CZK/ha) 2003	CZK/ha) 2007
Permanent grassland	1000	4620
Arable land	2000	2650
Permanent cultures	3500	25285
Vegetables on arable land	3500	16790

Source: MoA, 2007

Table 6: Disbursements for ecological agriculture in years 1998-2002

Year	Disbursement (CZK)
1998	48,091,000
1999	84,168,000
2000	89,101,971
2001	167,966,104
2002	210,861,131

Source: MoA, 2005

In the area of land use and protection, the period from 1990 to 2001 can be characterized by:

- a decrease in the intensity of agricultural production and gradual implementation of the non-productive functions of agriculture (about 20 % of agricultural land laid in protected areas with special management regimes in 2001);
- a decrease in the area of agricultural land (a decrease of a total of 11 thous. ha);
- a slight increase in the area of forest land in the second half of the 90's (an overall increase of 9 thous. ha);
- a change in the structure of the use of agricultural land, manifested mainly by an increase in the fraction of permanent grasslands (an overall increase of 133 thous. ha), with contributions from the Landscape Program of MoE and support programs of MoA;
- a gradual decrease in the percentage cultivation of agricultural land (an overall decrease of 3 %); nonetheless, the decrease in cultivation is considered insufficient;
- a high proportional area of arable land left fallow (an increase of 63 % compared to 2000).

Land ownership

Land ownership is very fragmented in the Czech Republic. Natural and legal persons own a prevailing part of agricultural land – over 3,400,000 hectares. The state owns more than 400,000 hectares of agricultural land.

On the market in agricultural land, there are more than 3 million potential small sellers with an average parcel size of 0.44 ha. On the other hand, there are relatively few buyers of land for agricultural purposes. Only 0.2 % of agricultural land was sold in 2000, in 2006 2.7% of agricultural land was sold (113tis. ha). At present, most owners of agricultural land do not farm it themselves and lease it. It follows from the Agro-census 2000 survey that farms in the CR are characterized by a high share of leased land (91.9 %).

Historical changes in the Czech lands

The changes in the land areas of individual types of lands, or property designated for forest and agricultural production, were mainly in favor of forestlands. The values of land areas are given in table no. 7.

Table 7: Land areas of individual properties in the Czech lands

	Year 1833	Year 1996
Total land area (mil. ha)	5.501	5.278
Population (mil.)	3.630	6.304
Density of population (inhabitants/1 km2)	66	119
Agricultural land –total (mil. ha)	3.140	2.833
– arable land (mil. ha)	2.248	2.064
– meadows and pastures (mil. ha)	0.811	0.618
Forestland (mil. ha)	1.333	1.769

Source: Allgemeines Forst und Jagd, 1833; CSO 1996

The shift of borders in the past years has caused the differing values of the total land area. The difference does not reach values high enough to prevent the possibility of using comparative methods. From the given figures, it is evident that the relatively high ratio of agricultural lands in 1833 in relation to the size of the population is due to the methods of farming. Presuming the course method, i.e. one third of the land is fallow, about 2 mil. ha of agricultural land contributes to nurturing the population. This roughly corresponds to today's state of the total agricultural land area fund and today's population size. Furthermore, it is evident that the decrease of agricultural land area in 1966, by roughly 300,000 ha, is compensated by a corresponding increase of the forest land area.

What is essential is the practically doubling in size of the population. Also, the structure of settlement has changed dramatically. From contemporary materials (Statistic review, 1887) it may be deduced that more than half of the population lived outside

of town complexes. In 1996, almost two thirds of the population lived in towns (CSO, 1996). There are two consequences to this phenomenon.

In the past century, the habitat was highly influenced by people's activities in the country. This applied mainly to localities near human settlements. On the other hand, there was practically no tourist traffic, recreation etc. at the time. Today the size of the population in the country is practically the same as the size in 1833. Far less people now work in forest and agricultural production and in this respect human activities have significantly decreased. But tourism and recreation underwent an enormous increase. In attractive localities or areas near large city agglomerations there is almost a fivefold increase of population due to recreation and tourism (data from survey – Influence of recreation on the lower Sázava river area, 1995). This situation has, besides putting extreme pressure on nature with all its negative consequences, undoubtedly caused an effect on the life rhythms of wildlife animals. The lack of tranquility during the reproduction time of animals has definitely contributed to the decreased numbers of some species.

Changes in the landscape structure are evident also from the table below featuring the trends in agricultural production in the last 8 decades.

Table 8: Area of permanent grassland compared to area of agricultural and arable land (thoush. ha)

Year	1935	1949	1960	1970	1980	1990	1997	1999	2005
Agricultural land	4978	4744	4573	4465	4374	4288	4280	4282	4259
Arable land	3835	3490	3370	3315	3294	3219	3091	3096	3047
% plough	77,0	73,6	73,7	74,2	75,3	75,1	72,2	72,3	71,5
Meadows	745	726	697	639	578	577	668	665	-
Pastures	318	367	302	289	273	256	285	285	-
PG – total	1063	1093	999	928	851	833	953	950	974
PG rate within agricultural land (%)	21,4	23,0	21,8	20,8	19,5	19,4	22,3	22,2	22,9

PG – ie "permanent grassland (including meadows and pastures)

Source: COSMC 1999, COSMC 2006b

Historical changes in selected regions

In selected historically important regions, such as Český Krumlov – South Bohemia and Kutná Hora – Central Bohemia, historical changes were assessed from the viewpoint of total forest land and agricultural land area. Furthermore, the changes in the length of forest land biocenoses boundaries (forest/non-forest boundary) were assessed in individual regions. It is this boundary especially which significantly influences the total diversity. There are sufficiently diverse vegetation communities, which allow settlement of small mammals and birds, for example. This ensures the occurrence of a number of predators. The edges of the forest also provide cover and food for larger animals.

The changes in forest land and agricultural land areas in both regions are given in the Tables 9 & 10.

It is necessary to state that the borders of regions in the last century did not correspond to those of today. While the Český Krumlov region roughly corresponds to today's region by location, the former Čáslav region overlaps into more regions and most of the land area is today a part of the comparative region Kutná Hora. It further overlaps into today's Kolín, Pardubice and Chrudim regions. However, the data given in the tables confirms the trends of the wider republic survey. That means there is a slight decrease of agricultural land in favor of forest land.

Table 9: Area of forest lands and agricultural lands in the Český Krumlov region

	Year 1850	Year 1996	Difference
Total land area (thousand ha)	121.77	161.50	x
Agricultural land (ths. ha)	76.42	81.88	x
% of agriculture land	63	50	-13
Forest land (ths. ha)	43.79	76.11	x
Forest cover (%)	36	47	+11

Table 10: Land area of forestlands and agricultural lands in the Kutná Hora, formerly Čáslav region

	Year 1850	Year 1996	Difference
Total land area (thousand ha)	67.58	93.72	x
Agricultural land (ths. ha)	52.71	63.73	x
% of agricultural land	78	68	-6
Forest land (ths. ha)	13.52	22.53	x
Forest cover (%)	20	24	+4

Source: Vereinbeschrift für F. und J., 1850, CSO, 1996 – modified

II.II Forestry sector – national situation and strategies

Czech forestry has a long and outstanding tradition since medieval times, and it is obviously one of the most developed in the world. In all Czech regions, there is a long tradition in silviculture. It started in the 14th century with the first recorded attempts to regenerate the forest by artificial seeding and the first restrictions on tree felling documented in *acta imperii – Maiestas Carolina* by the Czech and European emperor Charles the 4th. Forest management and planning of the present-day concept began in the Czech lands approximately 260 years ago. Such efforts led into one of the oldest forest acts in Europe – set by Empress Maria Theresa in 1754, which was valid in Austro-Hungarian Empire and historical Bohemia of that epoch. Since the latter half of the 18th century, various forest management methods were developed by offices of individual large forest owners. The establishment of Czechoslovakia in 1918 brought about further developments as a result of the new government's interest in elucidating guidelines for a harmonized forest methodology and policy. Despite the fact that technology improvements are tremendous in sense of availibilty of up-to-date computerized high-tech in detail forest management planning (eg maps at scale 1:10,000 are not common in countries with developed forestry at all) or in development of forestry mechanization for harvesting, skidding, logging or road construction, sensitive approach to all forest ecosystem processes of either man-made forest or close-to-nature woodland is till present-days driven by dedication of professionals. They usually consider their job as a life mission in one forest area, instead of a short-term business where one easily moves where better fees are offered.

Way of logging the wood from mountain areas, Sumava

Forests play an essential protective role in the preservation of the natural environment notably regarding water and soil protection, improvement of the quality of the air, prevention of avalanches, contributing to the climatic stability, etc. The Czech Republic is a country with high forest coverage. Currently, forest land covers the area of 2 647 416 ha, representing 33.6% of the total country's area (CSO 2005). The forested area has been systematically increasing since the second half of the twentieth century.

A majority of forests is situated in specially protected areas delimited in accordance with provisions of Act No. 114/1992. In existing specially protected areas (SPA), the total forests area is about 700 000 ha. It is ca. 25.3% of total forested area in the CR.

Forest inventory – fieldwork by "Holan´s tachytaxator" (1923)

High-tech Czech hardware and software tool "Field-map" for tree mensuration and forest stand computation (www.ifer.cz)

The share of deciduous wood species is currently 22.6 %, which is still insufficient in terms of the desired environmental plan (in spite of the positive trend shown in the recent years), since the recommended share of deciduous wood species is 35.6 %. The so called environmental stability of forest eco-systems is from the perspective of "natu-

ral state" little impaired, apart from other reasons as well due to lower biodiversity. The condition of forests is improving gradually; nevertheless, the problem of emission load from the past carries over. The weakened forest stands are exposed to further risks such as weather impacts, insect pests and regionally by excessively high populations of game animals. The combined effect of air pollution and long-run cultivation of even-aged conifer monocultures resulted in serious damage to the forest soil (acidification, elutriation of nutrient cations from the soil and release of toxic aluminum) with negative impacts on eco-systems, particularly in mountain areas along the northern country border.

Forestry GDP has been stable amounting to CZK 11.2 billion in 2001 and accounting for 0.6% of the Czech Republic's GDP. To a certain extent, the scope for further development of forestry is restricted. Therefore the share of forestry in GDP will decline with the foreseen revival of industrial production.

After a restitution process of majority private and communal forests, a predominant proportion of forests are in state ownership. State forests (including forest property of forest schools) cover 60 %, municipalities and their forest co-operatives are owners of 16.9 % of forests and private owners possess 23.1% of forests.

Privatization of state forest land is not anticipated. The market is forest land that has not yet developed. Support for the establishment of associations of forest owners shall partly overcome the disadvantages of the fragmented structure of ownership and should create preconditions for easier management. Investments focused on providing access to forests for modern and environmentally friendly management methods, systematic monitoring, the use of recreation and sports, the modernization of outdated facilities and small water reservoirs in forests should strengthen the economic situation of owners. It should also contribute to an increased economic, ecological and social value of forest holdings and to an extension job offers.

The Regulation EC 1257/99 on the measures for rural development is an important document for the forestry sector because it specifies the areas of aids in this sector, including support of afforestation of agricultural land. The support for the afforestation of land not used for farming will increase the share of usefully managed areas with an opportunity to positively affect the species and spatial composition of forests in these areas. In this respect, it is essential to delimit „less favored areas (LFA)" in detail. The introduction of a new compensatory payment along these lines would constitute a relevant step towards the preservation of the most environmentally valuable forests within whole EU. It will support the protective function of forests, particularly those whose protective and ecological functions cannot be solely assured by income from silviculture, ie complete chain of wood sales.

Table 11: Share of Forest Land (in 2005)

	ha	%
Forest land	2 647 416	33,6
Other land	5 239 297	66,4

Source: COSMC 2006b

Table 12: Forest Ownership Changes (status in 2004)

Forests	1990	1997	1998	1999	2000	2001	2002	2003	2004
State	95.8	64.4	63.4	64.3	63.1	61.5	60.7	60.5	60.0
Municipal		12.5	12.8	13.0	13.6	14.4	15.0	15.1	15.4
Counties						0.2	0.2	0.2	0.2
Churches									0
Forest cooperatives		0.7	0.8	0.9	0.9	0.9	1.0	1.0	1.0
Public High Schools					0.3	0.3	0.3	0.3	0.3
Private	0.1	22.4	23.0	21.8	22.1	22.7	22.8	22.9	23.1
Total (ths. of ha)				2 634	2 634	2 634	2 639	2 644	2 646

Source: MoA 2004

After Forest Inventory Institute2003

III. POTENTIAL OF ALTERNATIVE LAND MANAGEMENT APPROACHES IN THE CZECH REPUBLIC

The physical landscape is inextricably linked to the farming practices, which have shaped it. As with biodiversity, the landscape may be threatened by the **abandonment of farming** or by changed practices. In other words, the abandonment of land use for agricultural purposes, which is taking place mainly for economic reasons, creates pressure on landscape and biodiversity. When the farmed landscape was created, the driving force was economic necessity and the response of farmers was the adoption of the best available agricultural technology. Thus stonewalls were needed to clear fields and to control stock. However, technology has moved on the extent that imperatives are now completely different. No commercial farmer would today contemplate building a stone wall in place of a fence; the market for pollarded willow is no longer there. Instead, the farmer who chose economically efficient agricultural practice in 1998 found that many traditional landscape features had to be sacrificed.

In marginal farming areas, preservation of the cultural landscape faces a double challenge. Not only does society desire farmers to adopt certain environmental practices, but they must remain on the land in the first place. Abandonment or near-abandonment manifested as under-use, neglect or farm amalgation, is a reality in parts of the EU and it is clear that when farming declines, scrub and forest encroach and the open landscape will disappear. In productive areas, farmers are under both – the pressure and temptation, to maximize output and remove certain landscape features (EU, 1999).

On the other hand, the main objective in areas where intensive agriculture is less productive or not desired is quite challenging. Either it is just to assure continued modified or alternative farming,

Cattle at the pastureland

Farm crop monoculture – man-made ecosystems

to contribute to the maintenance of a viable rural community, or to preserve the landscape where it is necessary for the protection of the countryside. Such areas which impose limits on land management are defined with reference to the handicaps to farming incurred by altitude, slope, climate or poverty of the soil which lead to pressures for abandonment. Such areas are also often of high nature and landscape value, where the cessation or diminution of farming care would threaten the landscape and lead to a loss of biodiversity value. In these areas, the continuation of environmentally beneficial agriculture may require a substantial effort on the part of the farmer, and costs can exceed the level of compensatory allowances. In addition to the mountain and other less-favored areas, the Czech Republic is enabled by EU to continue to designate areas subject to specific handicaps where farming should be continued in particular to protect the environment or to preserve the tourist potential of a region.

Potentially, the CR has currently almost 1 million hectares of soil which is not necessary for the production of food. Historical changes in the Czech landscape occurring during the last century have markedly influenced and modified the environment of man, livestock and wildlife. The cause of the changes in the landscape consists particularly in changes of agriculture and forest management. These changes are not caused only by changes in the areas of agriculture and forest land but above all by changes of the horizontal and vertical structure of the managed phytocoenoses. At present, large-scale and monoculture management is almost prerequisite characteristic of both basic environments (forest and field) of the landscape. In agricultural production, the acreage of particular production areas has been increased and the diversity of vegetation reduced. In forestry, monocultural forest stands have resulted among others in woodlands which are characterized by very low carrying capacity for wildlife. The richness of a herb layer has also lowered and thus food supply has been reduced. The quality and quantity of the most valuable sites in ecotones (i.e. transitional lines: field towards forest, field by field, forest towards forest) has therefore markedly decreased. The character of the mankind movement through the rural landscape changed remarkably in last 20 years, tourism has increased significantly in the border regions (previously restricted military areas) while the working staff usually decreased there. On the other hand, heavy seasonal tourist invasions occur in forested regions, bringing both – pressure on recently untouched ecosystems and satisfactory public order of recreation.

Grassland phytocoenosis with high biodiversity level

However, as the public order changes in the course of time and landscape thus develops continuously, one should considerate that the mere conservation of natural biocoenoses preserved so far or endeavours to return to the year X of romantic state *"savage & wilderness"* are neither wise nor sustainable solutions. Under the present disturbance of self-regulation mechanisms of ecosystems and anthropogenic stress, it is evident that the cultural landscape will develop into new forms.

The challenges proposed by both the intensification and abandonment of farming therefore raise questions concerning the relationship between agriculture and the environment and the future basis for the wider European model of sustainable agriculture.

EU agro-environmental policy in the Czech Republic – perspective for 2007 till 2013

Current set up of the agroenvironmental programs in the Czech Republic is mainly aimed at solving problems of increased erosion (intercrops, grassing, grass strips), eutrophication (fertilization intensity reduction), land abandonment (in fact all the titles dealing with grasslands). Biodiversity issues are the main targets for measures focused on management of waterlogging meadows, localities of waders and crakes occurrences, biostrips and grassing by using regional seed mixtures. There is a big lack of measures support for making conditions for keeping or increasing the species diversity in warm, low situated areas, which are at the same time noted for their most intensive agricultural management.

From the nature conservation point of view, it is advisable to emphasis more species rich biotopes which are part of meadows and pastures (waterlogging and peaty meadows, springs, steppes) and a prevention of species diversity decrease in phytophagous groups of invertebrates on the regularly mown meadows. There still remains a problem of a small part of extensively mown meadows showing up a small number of nesting birds. As for the arable land, it is necessary to focus on increasing, and maintaining biodiversity especially in intensive agricultural areas (warm one with low altitude). It is important to try to offer some modified measures to farmers solving problem of a high agricultural land loss.

There is a preliminary proposal of measures in the national strategic document for the European Agricultural Fund of the Countryside Development.

In the strategic document, there are measures of agroenvironmental principles that are proposed in all the three main articles (Art. 36 – payment in Natura 2000 areas, Art. 37 – Agroenvironmental measures, Art. 38 – unproductive investment). The majority of measures have been included in Art. 37 where it is assumed that present measures will continue: ecological agriculture, intercrops growing, biostrips establishment, integrated production of fruit and vine, rotation of crops in protection zones of caves, management of meadows with waders occurrence (with advanced term of the first mowing) and corncrake, management of the waterlogging and peaty meadows (with variable mowing term in certain years), grassing of arable soil (slopy lands and grassing lands situated in the protection zones of caves and in the floodplains were suggested as convenient) and moving meadows mowing (partly to apply it out of especially protected areas). These measures mean only small or no changes. However, there is also suggested a principal change of the key sub-measure about grasslands based in distinguishing between meadows and pastures and in higher variability of management types on the species rich grassland sites.

As a new measure, there is prepared and discussed a superstructural title for support and care of hardly accessible meadows and pastures, i.e. land clearing from natural seedings and a regular management of the grassland sites in the protected areas. Possibly, a big outcome can result from the measure of grassing of the strips along the water streams. Newly has been suggested a measure for decreasing management intensity in fishponds, including some compensation possibilities for fishponds with otter occurrence (Treml et al, 2005).

Relevant Czech – EU subsidy frame in agriculture

Since 1998, the main objective of agricultural policy has been to halt the decline of the size and performance of agricultural production, which continued despite the stabilizing measures of the previous government's policy. Agriculture had been permanently unprofitable and the accumulated debt from the period of 1990-1998 amounted to CZK 40 billion. A policy concept for the pre-accession period became a basis of the policy. It envisaged a revitalization stage with an objective to stabilize the economic situation of farms and an adaptation stage starting in 2001

with an objective to approximate the policy mechanisms to the instruments of the EU Common Agricultural Policy.

The Czech Operational Program of "Rural Development and Multifunctional Agriculture" (2004-2006), states that agricultural policy of the Czech Republic currently stands on 4 main pillars:

- *Market regulation and support of farmers' income*
- *Support for non-production functions of agriculture*
- *Modernization and transformation of establishments*
- *Institutional preparations for accession to the EU*

The MoA uses as a legal basis for supports:

- agriculture and the processing industry Act No. 252/1997 Coll., on agriculture,
- forestry Act No. 289/1995 Coll., on forests and on the amendment of certain laws (the Forest Act),
- water management Act No. 254/2001 Coll. on water and on the amendment of certain laws (the Water Act), as amended and Act No. 274/2001 Coll. on public water supply and sewerage systems (Act on Water Supply and Sewerage Systems),
- the market in the products of agriculture and the processing industry Act No 256/2000 Coll., on the State Agricultural Intervention Fund.

THE BASIC REGULATIONS FOR INDIVIDUAL SUPPORTS ARE IN PARTICULAR:

1. *Government Decree No. 505/2000 Coll., laying down aid schemes to support non-production functions of agriculture and the activities involved in landscape maintenance and an aid scheme to support less-favored areas, as amended by Government Decree No. 500/2001 Coll.*

This Government Decree governs support for non-production functions of agriculture (agri-environmental schemes including afforestation) and the assistance for less-favored areas. Based on Government Decree No. 505/2000 Coll., the MoA grants support to less-favored areas amounting to some CZK 3 billion annually providing for landscape maintenance and environmentally friendly farming in these areas and thus preserving (a synergistic effect) also the population in these rural areas. Therefore, this Government Decree is considered to be a key instrument for maintaining the stability of highland and mountain areas and the schemes implemented under this Decree will become a basis for horizontal rural development measures under the HRDP.
The aid schemes designed pursuant to this Decree to support non-production functions of agriculture and the activities involved in landscape maintenance are as follows:

The aid scheme for less-favored areas supports

- farmers operating in mountain areas, other less-favored areas and areas affected by specific handicaps,
- farmers operating in large-scale special protected areas (national parks and protected landscape areas).

Agri-environmental schemes support:

- change in the structure of agricultural production by converting arable parcels to grassland,
- maintenance of grassland on agricultural parcels by livestock grazing with the exception of hop gardens, vineyards, gardens and orchards,
- partial offsetting of losses incurred as a result of organic farming,
- preservation of biodiversity, cultural landscape and traditional farming methods
- bee-keeping

Aid schemes *for agricultural activities focused on the* ***protection of*** *components of the* ***environment*** *support:*

- liming of arable parcels with soil pH of not more than 5.5,
- establishment of the elements of territorial systems of landscape ecological stability including post-planting maintenance.

Aid schemes supporting changes in agricultural production structure support:

- changes in agricultural production structure through afforestation of agricultural land including the protection of thus established forest stands,
- changes in agricultural production structure through the planting of fast-growing tree species designed for utilisation in energy generation.

2. *Government Decree No. 86/2001 Coll., laying down the conditions for the granting of financial aid for putting land into set-aside and financial compensations for putting* ***land into set-aside*** *and principles for the selling of oilseed rape grown on set-aside land, as amended by Government Decrees No. 454/2001 Coll. and 294/2002 Coll.*

This Decree allows each farmer who farms more than 10 ha of arable land to set-aside 5-10% of his arable area and to grow on this area under specified conditions crops, the produce of which shall be used for purposes other than the production of foodstuffs, feeding stuff and seed.
In return for compliance with the stipulated conditions, the grower receives:

- financial support for putting land into set-aside for each hectare of land put into set-aside,
- financial compensation for putting land into set-aside for each hectare of the remaining arable land not put into set-aside
- support for selling the oilseed rape grown on the set-aside land for the production of renewable energy sources – biodiesel

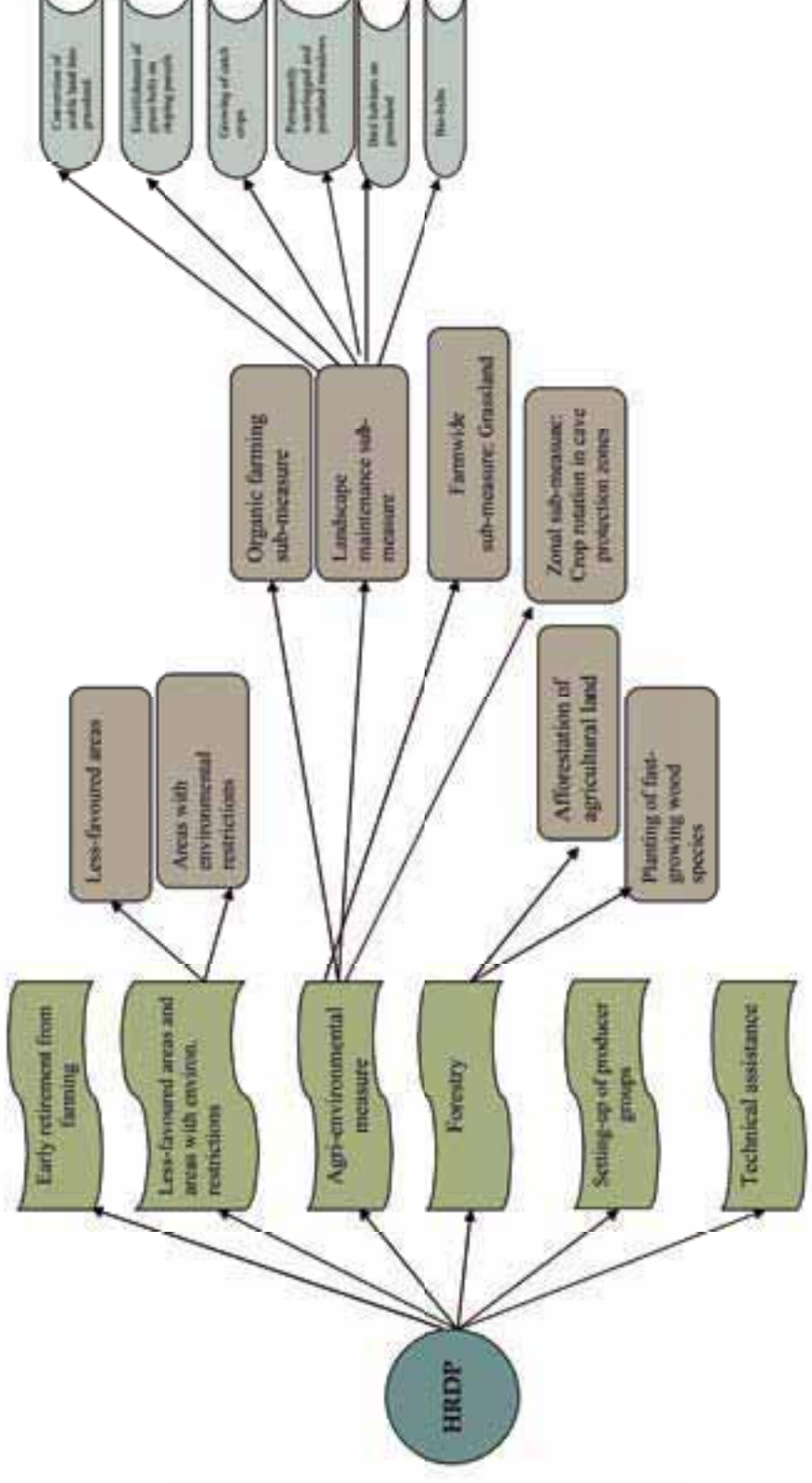
3. *some provisions of the Forestry Act (Act No. 289/1995 Coll., on forests and on the amendment of certain laws, as amended) and binding rules for the granting of financial aid in forestry,*

4. *Article 102 of the Water Act (Act No. 254/2001 Coll. on water and on the amendment of certain laws (the Water Act), as amended) for the supports granted in public interest,*

5. *The Rules for aid schemes pursuant to Article 2 (1) of Act No. 252/1997 Coll., on agriculture, as amended.*

The following aid schemes are provided pursuant to Article 2 (1) of the Agriculture Act:

- Renewal of vineyards, hop gardens, orchards, technical and spatial isolates,
- Support for the establishment of drip irrigation in orchards, hop gardens and vineyards,
- Support for the utilisation of bioethanol,
- Keeping of suckler cows, sheep and goats,
- Support for beef marketing,
- Maintenance and improvement of the genetic potential of selected livestock species,
- Maintenance of the genetic potential of seeds and seedlings,
- Support to improve the health conditions of crops,
- Support to improve the health of field and special crops,
- Support for the National Horse Studs in Kladruby n. Labem, and the Country Studs in Písek and Tlumačov,
- Genetic resources,
- Setting-up of young farmers,
- Disease Fund and subsidies for agricultural insurance,
- Advice and education,
- Support for the establishment and operation of producer marketing organizations,
- Support for the European integration of non-government organizations,
- Support to increase the competitiveness of Czech food industry.



Overview of the main Czech agricultural subvention measures follow; kindly give special attention to considerate landscape management corresponding to overall agro-environmental strategy of the EU (simplified from OP-HRDP, MoA, 2004).

OVERVIEW OF RELEVANT SUBSIDY TITLES

- Early retirement from farming (to allow elderly farmers of +55 years to terminate active farming granting their adequate living conditions)

- Setting up producer group (to promote the competitiveness of agricultural producers on the market)

- Technical assistance (to support the activities that are necessary to monitor the success in the implementation, the management and use of HRDP, and to improve the measures covered by this HRDP)

- Less-favored areas and areas with environmental restrictions

– farmers operating in mountain areas, other less-favored areas and areas affected by specific handicaps

– farmers operating in bird protection areas or large-scale special protected areas (national parks and landscape protected areas)

- Forestry

– Afforestation

– Planting of fast-growing wood species designed for use in energy generation

- Agri-environmental measures with 4 sub-measures

A. Sub-measure of Eco-agriculture (ie Organic farming)

B. Sub-measure of Grassland maintenance - in farm-wide scale (to promote and preserve a favorable extensification on grasslands used for agricultural production within the entire farm as the grasslands are threatened on the one hand by a growing intensity of farming and on the other by abandonment)

C. Sub-measure of Landscape maintenance

– C1 Conversion of arable land into grassland

– C2 Establishment of grass belts on sloping ground

– C3 Growing of catch crops (another anti-erosion protection)

– C4 Permanently waterlogged meadows and peatland meadows

– C5 Bird habitats on grassland (only grasslands as nesting sites of Corncrake and Waders

– C6 Bio-belts (to increase food supply for wildlife animals)

D. Zonal sub-measure: Crop zonation in cave protection zones

Recent history of state support to alternative land management

The fast development of organic farming (i.e. agro-ecological alternative in general) and the growth of the number of agro-eco farms in the past years have been due, in particular, to the reintroduction of the state financial support. The first financial funds to subsidize the establishment of farms using alternative farming methods were released as early as the end of 1990. These subsidies were provided until 1992 and were the main reason behind the growth of organic farming areas up to 15,000 hectares. The state support to alternative farming stopped in the years 1993-1997 and was renewed in 1998. This was the main reason for the increase in the number of organic agro-eco farms. State support has been provided to organic farmers since 1998 under a government regulation setting up programs of support for non-productive functions of agriculture.

Table 13: Funds provided to agro-eco farming in 1998-2006

Year	Paid funds (CZK)
1998	48,091,000
1999	84,168,000
2000	89,101,971
2001	167,966,104
2002	210,861,131
2003	230,810,809
2004	?
2005	276,700,000
2006	330,000,000

OVERVIEW OF THE ALTERNATIVE APPROACHES PRESENTED BY THIS PUBLICATION

Putting the next sub-chapters of alternative approaches of agricultural land management into logical order, one would start with the most point-blank option – **afforestation** which completely change original land cover category of "agriculture land" onto "forest" or "forest land" according to FAO Land Cover Classification System. Furthermore, a similar but penetrative alternative is intensification of land use through cultivation of energetic trees or herbs for **biomass production** for heating or other energy purposes. The next land use option for abandoned grounds is **sound grazing management** on meadows and pastures which work with animal husbandry and naturally contain enchantment *of auld lang syne* and harmonious landscape beautified by herds of peaceful biblical animals. Such an approach inherits nostalgia and groundwork for an **agro-tourism** alternative which shall be managed, developed and stimulated accordingly. And finally, the extensive chapter on the **game management alternative** (in the best sense of its traditional meaning), which on one hand remains closest to natural processes in a land use sense and on the other can also embrace very intensive land management and sophisticated animal breeding technologies.

III.I Afforestation

Afforestation in forestry sense (FAO, FRA 2000) means artificial establishment of forest on lands which previously did not carry forest within living memory; hence reforestation means artificial establishment of forest on lands which carried forest before.

The present division and area of the land holding owned by individual users is virtually a result of the historical development of the settlement. Accordingly, the alteration of land use resources in the history of European cultural landscape has been characterized by changes of proportion of agricultural versus non-agricultural land, including forest land. Recently, we have witnessed the tendency of a surplus (temporary or permanent) of agricultural land. This area, which is not quantified exactly, oscillates (depending on applied parameters) within a wide range and it can concern up to hundreds of thousands of hectares of agricultural land that is not managed. The decision about the change of utilization of land is rather demanding, as it includes interdisciplinary and cross-industrial aspects. Possible restructuring of the land resources has impacts on the production, economic, social, environmental, legislative, institutional and political areas. An indispensable problem is also the harmonization of interests of private owners with all-society interests. One of the possible ways of utilization of this land may be the afforestation thereof. This trend has been evident in developed European countries for many decades. Extensive afforestation works have taken place e.g. in Spain, France, Netherlands as well as in other countries. It is estimated that in the European Union only up to 17 million hectares of agricultural land has been afforested in last years.

Afforestation of set-aside lands, as regards the Czech Republic, refers to those lands that were recorded in the land register of real estates as agricultural lands but they had not been used for agricultural production and had not been cultivated in the last three years. The owners of such lands have left them lying fallow for various reasons. Wide-spread weeds occurrence can threaten the neighboring cultivated agricultural lands. Weed control is difficult and contentious as a number of allochthonous uncontrolled-born weeds (eg Cow parsnip and Hop-tree) frequently eliminate autochthonous natural phytocenosis. Moreover, natural seeding of tree species appears in some areas. Therefore, purposeful afforestation of those lands is very significant from the hygienic

Afforestation in Kardašova Řečice

and mainly ecological standpoints. Finally, afforestation of agricultural land makes a space for production diversification that should contribute to the strengthening of the economic and social dimension of agricultural and rural sustainability. It can reduce the share of ploughed land without risking the increase in the share of unmanaged agricultural land (MoA, 2004).

Aims of afforestation in CR are following (Lossmanová , 2003):

- permanent reduction of the agriculturally less suitable or unsuitable areas for ongoing agricultural utilization
- related expansion of the forested area and reinforcement of landscape biodiversity
- improving socio-economic conditions of the rural areas
- change of the agricultural farm structure with a view to ensure other income through diversification of their activities
- improving ecological balance of the rural area.

When looking at the large areas of uncultivated agricultural lands especially in some parts of the Czech Republic and related claimed interest in afforestation of such areas, and considering also indisputable material capacities (viable in a relatively short time), it seems that the extent of afforested agricultural lands is too narrow today. Nevertheless, afforestation of agricultural land has potential and definitely it is not negligible, even though over the period of 1999-2002, it reached 3,695 ha only.

Economics of afforestation

Support granted in the form of financial aid and assistance in preceding years is described further. Currently, it takes the form of subsidies which are direct and non-returnable. The amount spent on afforestation reached CZK 379.7 mil in total between 1994 and 2001 out of which CZK 226.5 mil was spent on afforestation of agricultural lands covering 3.753 hectares and CZK 153.2 mil was provided for the young forest stand protection. In 2002, subsidies of CZK 88.9 mil in total were granted for afforestation of 1.203 hectare-farm land.

Financial aid for afforestation of Czech agricultural land is granted in accordance with the Government decree No. 505/2000 Coll., laying down aid schemes supporting non-production functions of agriculture, activities taking part in tending the landscape, assistance programs to support less-favorable areas and the criteria for their assessment, as amended by the Government decree No. 500/2001 Coll. In 2002, the aspect of "Land-soil Valuation Ecological Units" was applied for the first time when providing the funds. They express soil and climatic conditions affecting the land capability. Hence, it concerns expressing the yield level in the production sense. This change makes afforestation of agricultural lands which are less suitable for agricultural production more advantageous as compared to valuated quality areas. Within the meaning of the Article of the government decree, the term "agricultural plots" means arable land, hopfields, vineyards, gardens, orchards, permanent grasslands and other areas.

CASE EXAMPLE BOX

Subsidy details

The object of subsidy is:

1. First afforestation
   – with soil-improving and stabilizing species
   – with other species
2. Repeated afforestation (at the most 30% of the amount of the individual seedling types used for the first afforestation)
   – with soil-improving and stabilizing species
   – with other species
3. Young forest stand protection (until they are established in accordance with the law No. 289/1995 Coll.)
   – against weed
   – against animals
4. Building up new enclosures to protect the stands or their parts with 30% and more of soil-improving and stabilizing species in the enclosure.

Logic of the subsidy

Non-utilized agricultural non-forest land means agricultural land that was not utilized agriculturally for two years before the afforestation started. This condition is met even when the agricultural land proprietor rented his lands to another operator for agricultural management (e.g. cooperative, stock company, farmers). Applications concerning compensation for loss of income resulting from termination of agricultural production can be submitted for a maximum period of 20 years.
In compliance with the statement above, subsidy can be provided especially for:
1. Afforestation of non-utilized agricultural and non-forest lands.
2. Tending young forest plantations until the establishment of forest stands in accordance with § 1.

Subsidy type: direct non-returnable subsidy
Means of financing: shared financing
Subsidy amount: up to 75% of the reasonable costs depending on the project approved, own fulfillment of the subsidy beneficiaries can be taken into an account up to 80% of the reasonable costs laid down by the project.
Applicant:
Any natural person or legal entity that carried out afforestation on its own agricultural plots or protected forest stands thus formed until they are established in accordance with the Law No. 289/1995 Coll. concerning forests and amending and supplementing certain laws (forest law), as amended, can apply for subsidy.

The Horizontal Rural Development Plan assured from early 2004 the following support for the afforestation of agricultural land:

1. Support for the foundation of the tree stand is as follows:

Subject of support		rate in CZK	rate in EUR
First afforestation			
1. soil improving and stabilizing tree species	Ha	92 000	2 893
2. other tree species	Ha	74 000	2 327

Source: PULKRAB K. 2003

2. Support for securing the tree stand (it will be provided for the period of five years at the amount of 12 000 CZK/ha)

3. Compensation of lost income incurred due to the termination of agricultural production (it will be provided for the period of 20 years)

Beneficiary of compensation of income lost incurred due to the termination of agricultural production	arable land CZK/ha/year	forested perm. grassland CZK/ha/year
Physical or legal entity (pursuant to § 2 of the Act No. 513/1991., Commercial Act) operating in agricultural basic production	8 600 (ie 270.44)	4 210 (ie 132.39)
Other owners of agric. land	5 880 (ie 185)	4 210 (ie 132.39)

Calculations show that total real actual costs of established forest culture may range within 55.5-250.6 thousand CZK/ha and the support provided by the state at the amount of 134.0-152.0 thousand CZK/ha.

Table 14: Development of afforestation in the period of 1994-2002

Total	1994		1995		1996		1997		1998		1999		2000		2001		2002	
	ha	000' CZK	ha	000' CZK	ha	000' CZK	ha	000' CZK	ha	000' CZK	ha	000' CZK	ha	000' CZK	ha	000' CZK	ha	000' CZK
Private	287	12 907	507	21 448	519	20 946	306	11 843	283	13 402	324	15 669	616	28 810	764	36 300	821	32 300
Municipal	12	461	57	3 018	107	5 304	88	4 086	116	6 315	161	9 006	283	16 345	327	16 600	382	13 800
Other	0	0	3	169	24	1 042	39	1 203	4	266	8	530	9	808	-	-	-	-
Total	299	13 368	567	24 635	650	27 292	433	17 132	403	19 983	493	25 205	908	45 963	1 091	52 900	1 203	46 100

Source: MoA 2003

Table 15: Succession on abandoned meadows

Deciduous stands, nearest forest max 3 km	Coniferous stands, nearest forest max 3 km
Initial stage 2-10 years: grass cover, rare occurrence of bushes (blackthorn, hawthorn, hazel-tree)	Initial stage 2-10 years: grass cover, rare occurrence of deciduous bushes and juniper
Preparatory stage 10-50 years: discontinuous occurrence of bushes of an island type, hazel, occurrence of light demanding species (aspen-tree, birch, poplar, pine)	Preparatory stage 10-30 years: occurrence of bushes of island type cover, juniper; occurrence of light demanding species and spruce, event.of larch
Transient increscent stage 50-200 years: groups of light demanding species, bushes, occurrence of forest-tree species (pine, oak, beech, maples), perennial plants, blackberries, etc.	Transient increscent stage 15-30 years: groups of forest-tree species, bushes in the etage E2, perennial plants. Development of vertical canopy by tree species
Climax stage After 150-500 years	Climax stage After 150-500 years

Sources: Křížová & Ujházy, 1997

Feasibility of natural seeding

Considerations about the issues of afforestation of agricultural lands may also include opinions which prefer spontaneous formation of forest stands. The advocates of this approach have the conviction that by utilization of natural kinds of "primary" succession, the costs of planting trees may drop significantly. Furthermore, they believe that spontaneous development of forest on non-forest lands corresponds to the environmental aspects of strengthening the natural potential of the countryside. Nevertheless, as the findings about natural succession show, the process of natural, spontaneous formation and development of the forest (which would be capable of satisfying and providing environmental and material benefits) is excessively lengthy. Relatively fast spreading initial and preparatory stages of succession (in which desirable forest-tree species may also appear) are followed by slowed down development (see Table 15). However, there is a possibility of using both ways of afforestation –man-made and also natural regeneration from surrounding forests – on the lands, where natural seeding has taken place and spontaneous spreading of forest-tree species is remarkable. Additional man-made afforestation of seedless and poorly stocked areas may be realized.

Related cost-effective calculations in forest production

Nowadays, there is a consensus concerning the most acceptable technique of financial evaluation of long-term forest projects, which is considered to be the analysis of discounted „cash-flow" (CF).

For the calculation of the current value of cash-flow, the standard formula is used:

$$CVCF = \sum_{i=0}^{n} \frac{Ei - Ci}{(1+p)^i} = \sum_{i=0}^{n} \frac{Ei}{(1+p)^i} - \sum_{i=0}^{n} \frac{Ci}{(1+p)^i}$$

where: CVCF is the current value of cash-flow
Ci – total costs of the project
Ei – total emblements from the project
p – discount rate
i – time period
n –term of existence (project life)

Current value of the cash-flow is finally calculated on the basis of effect of wood-production function of the forest and quantified non-wood production functions, when:

$$CVCF_{FP+NWP} = CVCF_{FP} + CVCF_{NWP}$$

$$CVCF_{NWP} = T_{NWP} * (1.0p^u - 1) / 0.0p * 1.0p^u$$

where: $CVCF_{FP}$ is the current value of cash-flow in direct forest production
T_{NWP} – effects of non-wood production functions of the forest

Consideration of non-wood production functions of the forest (except wood production) is based on the quantification made by Šišák (1996, 1998). Research of collections of mushrooms and five major forest berry plants was made (blueberry – *Vaccinium myrtillus,* raspberry– *Rubus idaeus* L., black elder – *Sambucus nigra* L., blackberry – *Rubus fruticossus* L., cranberry – *Vaccinium idaea* L.). Findings confirm that forest berries represent a very extensive and rich group of products, which have, as a complex unit, a considerable socio-economic importance in the Czech Republic. With respect to the forest management, the collection of the said products takes place outside the market, but for the community the collection has both non-market (ie recreational or social) and market (economic) meaning resulting in a material benefit for the consumer.

Finally, the most valuable-but until now monetarily not reflected- functions of forest environment are characterized by the formula where current value of the cash-flow is calculated on the basis of the effect of wood-production function and weight of non-production functions of the forest, when

$$CVCF_{FP+ONPF} = CVCF_{FP} + CVCF_{ONPF}$$

$$CVCF_{ONPF} = TNPF * (1.0p^u - 1) / 0.0p * 1.0p^u$$

where: T_{ONPF} – effects of non-production functions of the forest

The calculation of the effect of non-production functions of the forest is based on the Annex to the Act No. 289/1995 Coll., which defines the calculation of the fee for a temporary conversion of forest lands as

$$CFL = PP * PW * f\ (CZK.ha^{-1})$$

where: CFL – fee for temporary conversion of forest lands,
PP – average annual potential production of forests of the Czech Republic in $m^3.ha^{-1}$,
PW – average price of wood on the hauling place in CZK per m^3,
f – factor of ecological weight of the forest.

The average annual potential production of forests in the Czech Republic is fixed in the long-term and reaches the level of 6.3 m^3. ha^{-1}. The average price of wood in the hauling place is established from the achieved realization prices after the deduction of costs for the production and transport to the place of hauling. The price is established annually by the Ministry of Agriculture. The factor of the ecological weight of the forest is also specified in the Annex and ranges from 1.4 to 5.0 depending on the category of the forest.

Of course, this calculation may be criticized from many sides, but, on the other hand, it is necessa-

ry to realize that any, even a more complex, construction of evaluation of the effect of outside-production functions of the forest will not be more accurate. Among others, this calculation has been approved by the CR Parliament and forms an integral part of the most important forestry legislative regulation.

Analysis of discounted cash-flow of agricultural land afforestation projects

As it was said above, the most accurate method of evaluation of long-term forestry programs is the analysis of cash-flow. From this perspective, all calculations performed till now can be considered auxiliary or orientation analysis of the examined issue.

In this part, all considerations are related to the duration of the afforestation project, which may be theoretically within the range of the rotation period in dependence on the tree species, site class quality, etc. For an agricultural firm (owner) that considers increasing efficiency of management of the agricultural land in the form of afforestation, the crucial role will be played by the calculation considering all pros-and-cons of such land utilization.

The following conclusions can be derived from the example of afforestation of agricultural land (i.e. formation of spruce stand of 3rd quality with 70% share of spruce and 30% share of soil-improving and site stabilizing tree species, totally healthy and undamaged, for the 80-year rotation period), based on the comparison of calculated CVCF:

- A foundation of forest growth without any intervention results in loss and, from a purely economic standpoint, no owner will realize it (CVCFFP is –59,100 CZK/ha).
- If the owner establishes a forest stand on arable land (and we anticipate that the provided support for afforestation is adequate to the incurred complete costs of the established tree plantation), he/she will obtain 127,700 CZK/ha as a compensation of loss of incomes (for the first twenty years) and 52,000 CZK from the main felling/wood sale for the period of the project existence (ie 80 years).
- If the owner establishes a growth on a permanent grassland (under the same conditions as specified above), he/she will obtain a compensation for loss of income in the amount of 62,4000 CZK, but he/she will lose the equalizing subsidy for grassland maintenance in the range of 114.0-148.7 thousand CZK/ha (for the first 20 years). One can sum up that the afforestation of permanent grassland is not attractive economically. The effect will only be equalized after 80 years when further 52,000 CZK will be earned from main felling/wood sale.

Calculations above concern inputs which characterize average conditions. However, as it is evident from the above said facts, possible amplitude of profitability for both forest and agricultural productions is quite wide. A wide spectrum of profitability of realized projects will correspond to it.

Conclusion

By studying available literature sources, one can conclude that though there are numerous papers solving many aspects of rational utilization and protection of land in a technical or biological sense, there are very few papers that deal with economic analyses.

By enforcing the program of Afforestation of agricultural lands, the European Union pursues the achievement of two major objectives:

1. economic, i.e. – decreased overproduction of food,
   – decreased sales deficit of raw timber,
2. environmental – strengthening biodiversity, fixation of CO_2, etc.

It can be said that even within European Union itself and under Czech conditions in particular, it still would be practical to examine numerous very difficult issues, especially in the area of basic agricultural production. To have a balanced overview of the afforestation issue, further partial studies should be realized:

1. Define natural criteria (limits) of agricultural lands suitable for temporary or permanent afforestation. In the analysis, it is necessary to consider poly-functionality of agricultural and forest productions (major production functions, quantifiable non-wood production functions, other non-production functions).
2. Identify principles of procedure of foundation, protection and management of forest stands with consideration of soil properties, climatic conditions and possible anthropogenic effects.
3. Identify optimized ratios of forest land and permanent grassland for individual regions of the Czech Republic.
4. Evaluate economic and social impacts of afforestation of agricultural lands within the Czech Republic in dependency on probable or variant range of considered afforestation scale.
5. Analyze the impact of institutional, economic and administrative tools of environmental, agricultural and forestry policies on the implementation of land use changes – both on the acts of a corporate sphere and on the national level.

Such a task is not unrealistic, as the basic documents influencing the program of afforestation (e.g. HRDP and others) are limited to 2006 and are of temporary nature. Therefore it would be desirable to prepare tools of higher quality for the following period, covering 2007-2013 (Pulkrab, 2003).

CASE EXAMPLE BOX

A procedure for identifying the efficiency of afforestation of agricultural land is depicted by an example of a shortened procedure of the calculation of the current CF value (calculating negative $CVCF_{FP}$ minus 59.100 thousand CZK) for spruce stand (with site-improving species) of the 3^d site class quality and 80-year rotation period under consideration. For the owner, crucial is a variant of $CVCF_{FP}$, which only evaluates the effect of the wood-production function (a standard forest owner and standard economic objective of the firm are assumed).

Calculation of $CVCF_{FP}$ of forest production (in thousands of CZK/ha)

Tree species: SPRUCE, 3^d site class

Total own costs Type	Amount	Year	Earnings	Cash-flow (for 3%)	Discount	CVCF
Total Afforest. Costs – first planting	32.3	1	0.0	-32.3	0.9709	-31.4
Total costs for the stand care untill age of 4 years	68.2	4	0.0	-68.2	0.8885	-60.6
stand thining	9.5	10	0.0	-9.5	0.7441	-7.1
All tending costs		1 – 80	0.0	-12.1		-12.1
harvesting costs/wood sale	21.4	80	768.1	553.6	0.0940	52.0
$CVCF_{FP}$						-59.1
$CVCF_{NWP}$						20.9
$CVCF_{ONPF}$						222.9

Similarly, SHCF of other parameters of the comparison shall be calculated (in thousands of CZK/ha)

Parameter	Amount	Year	CVCF
Subsidy for afforestation	74.1– 92.0	1	77.1
Subsidy for tree stand care	12.00	1-5	54.9
Compensation of lost on earnings incurred due to termination of agricultural production			
– arable land	8.60	1-20	127.7
– permanent grassland	4.21	1-20	62.4
Equalization contribution for grasslands for LFA:			
– mountain area	4.46	permanently	148.7
– other LFA	3.32	permanently	110.7
– specific LFA	3.42	permanently	114.0

III.II Biomass in agriculture

Agriculture and biomass energy – an overview

According to the 2004 World Energy Report from the International Energy Agency (IEA), worldwide energy needs will increase by 60% by the year 2030. Two thirds of the additional needs will come from developing countries. If these needs were to be satisfied with the use of fossil fuels such as oil, gas, or coal, it would result in a substantial increase of carbon dioxide emissions. The search for alternatives is a worldwide challenge.

The surplus of food on the world and domestic markets forces farmers to stop utilizing the soil. A large part of these areas could be effectively utilized for intentionally growing energy crops. Such a circumstance opens an entirely new program for farmers and can ensure reliable long-term sales of the produced energy biomass. The development of "phytoenergy" is therefore of great significance for the stability of agricultural activities and consequently, for keeping the landscape cultural. Literally "if all the soil area is properly farmed, there will be no undesirable weeds which otherwise help considerably to improve the appearance of the landscape". Another significant type of biomass is secondary products (wastes) which are created during the processing of crops or during different agricultural activities. This includes straw, plant remnants, green mass, animal excrements and waste from agricultural products processing or wood-chips from wood harvesting. These must be processed and utilized more efficiently than it has been up to now. And it is their utilization for energy purposes that creates another economic contribution for the growers.

The need of diverting shares of fertile lands from food crops to non-food crops is becoming more and more pressing. Many questions arise in trying to find alternative destinations to the surplus agricultural lands – e.g.:

- Which types of alternative vegetable species are to be planted?
- Are vegetable fuels the most attractive non-food products?
- Which are, if any, the expected benefits of energy plantations?
- Will the farmers be willing to cultivate the alternative plants, and what conditions will they claim?

At present, these questions cannot be exhaustively answered, especially if the alternative crop is conceived for the sole purpose of producing vegetable fuels (biofuels) as a substitute for fossil fuels. The investigations so far performed by national institutions and international organisms are incomplete and the results often contradictory. Moreover, in facing the problem, a systemic approach is seldom adopted and some important non-technical aspects are sometimes neglected. Although phyto-energy is very promising branch of industry, the number of active countries actually interested in investing human and financial resources in the crop fuel sector is not growing massively. Particular attention should be dedicated, therefore, to the data collection for energetic and economic analysis, including accurate evaluation of the energy budget for each growing trial, and allocation of all the costs for production. Nowadays in the states of the European Union, most biomass is used for energy production. Moreover, the main share of future renewable energy rising in the EU belongs to biomass – about 85 %.

Under the term of energy crop or e-plant, botanical taxa of trees, perennial plants or herbs are labelled with their cultivars, clones, natural or artificial hybrids which are exploited or tested for purposeful production of biomass for energetic purposes (combustion, bio-gas production). Energy plants can be divided into fast growing trees and plants of herbal character. Advantages of energetic herbs are their short life-span (usually one vegetation period), easier seeding, opportunity to process the yield for other than phyto-energy purposes and quick potential to change plant species.

Overview of the energy plant species examples:

1. Production of ethyl-alcohol: sugar-beet, cereals, potatoes
2. Production of oils and methyl-esters: Swedish turnip, Sun-flower, flax
3. Energy crops: rape, hemp, pigweed *(Amaranthus)*, sorrel, topinambour, white melilot, ribbon-grass, deer´s foot, oat-grass, fescue grass, etc
4. Energy trees: willow, poplar, alder, sycamore, hazel

One of the "historical" investigations from Italy (*Anonymus,* 1997) focused for instance on further species:

- Annual species: fibre sorghum (*Sorghum* sp.); kenaf (*Hibiscus cannabinus*);
- Perennial herbaceous species: cynara (*Cynara cardunculus*); miscanthus (*Miscanthus sinensis*); giant reed (*Arundo donax*); topinambour (*Helianthus tuberosum*)
- Perennial woody species: ailanthus (*Ailanthus altissima*); black locust (*Robinia pseudoacacia*); broom (*Spartium junceum*); eucalyptus (*Eucalyptus* sp.); willow (*Salix alba*); poplar (*Populus* sp).

According to official research records – in CR and similar climatic conditions – over 160 plant taxa were tested and in the last European survey of potential energy plants, 37 are in evidence including 10 tree species (Weger, 2004c). The growing pace of such intensively cultivated plants distinctively surpasses average yields of other crops under given growing conditions. Above-average tree production means a value over 10 m^3/ha/years; it means over 4.5 tons of dry mass/ha/year. Biggest areas of energy tree plantations are represented by ***Eucalyptus*** sp. – 500,000 ha (eg Portugal – pulpwood) and by ***Salix*** sp. – 18,000 ha (mainly wood-chips in Sweden, Venendaal et al, 1997). As regards energy herbs, these plants should provide the yield of approximately 7 to 10 t of dry mass per 1 ha – eg sorrel of Uteush as a highly productive perennial crop achieving on average to 220-260 cm of height and yields 14-16 tons of dry matter of above ground biomass from 1 ha. However, continuous testing of some of these plants is desirable to obtain further details concerning the technology of growing all potentially suitable species.

Potential of biomass utilisation in the Czech Republic

The common composition of agricultural areas is very suitable for alternative agricultural production, in particular for biomass production. This is because the total area of unused unfertilized soils, which are usually suitable for biomass production, achieves 880 000 ha or about 1/5 of the total agricultural area Váňa & Usťak (2003). The importance of renewable sources of energy is continuously growing; nevertheless, biomass utilization for energy purposes has not been fully appreciated in the Czech Republic so far. It is partially due to the fact that the general public has not been sufficiently informed about this new prospective program. The research and studies of the real potential of renewable energy resources completed over the past ten years have shown that biomass is the best exploitable renewable resource to replace fossil fuels, mainly coal and oil, in the CR. As shown in the diagram below, only one-tenth of the potential of biomass is currently being used.

SUMMARY BOX

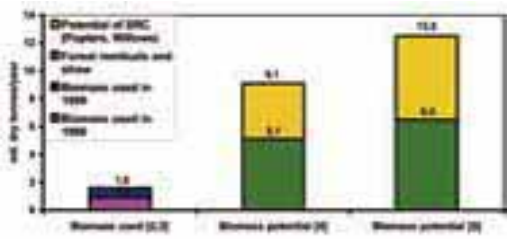
Agricultural biomass production is an important part of sustainable development and it solves a number of economic, social and environmental problems. Summarizing, it:

- ensures renewable energy sources and increases national energy security
- contributes towards green-house gas reduction
- keeps the landscape cultural (weedless regularly farmed fields)
- efficiently utilizes surplus soil and supports agricultural market innovation
- creates new jobs
- stabilizes countryside space
- strengthens energy self-sufficiency in regions

EU SUMMARY BOX

In many countries, there is an increasing interest in biofuels as a clean and renewable source of energy, such as biodiesel, bioethanol, biomethanol, bio-FT-diesel and biohydrogen. The transition towards a sustainable transportation system does not only take place in Europe, but also elsewhere, like in the USA and Canada. Such a transition will require high investments, not only for the technology for the production of new, alternative, organic-based fuels, but also for infrastructural changes in the distribution of these fuels and for automotive technology developments.
In the draft directive of the European Parliament and of the Council on the Promotion of the use of Biofuels for Transport, Member States are challenged to introduce legislation and take the necessary measures to ensure that, as from 2005, a minimum share of 2% of all transport fuels sold on their territory is occupied by biofuels. This share is supposed to increase to 5.75 % in 2010.
To reach these ambitious goals, huge land areas are needed (an estimate of an additional 6 million hectares for energy crops). However, good quality land in Europe is limited and the production of biofuels will compete with food production and demands from the forest industry, as well as from carbon sequestration and environmental protection and conservation considerations. Furthermore, a major extension of biofuel production and use will only occur when their prices can compete with those of fossil fuels. Lower cost biofuel options are needed in the future.
At the same time, the expansion of the EU and inclusion of Central and Eastern Europe Countries (CEEC) in the agricultural as well as energy policies of the EU has created potential difficulties as well as opportunities (Weger, 2004 a). Given that the bioenergy potential is large enough, CEEC could contribute substantially to meeting the EU's Kyoto commitments of reducing CO2 emissions by supplying biofuels to the European market.

Currently, the CR participates in the total of all primary energy sources and by almost 3% of renewable sources only. It has been decided that by the year 2010, the share of renewable energy sources shall increase to 6% of primary energy sources and to 8% of gross energy consumption. This is more than multiplying the current state, which is a very demanding task.



after WEGER (2002)

Adapting agriculture to non-food production will be necessary. This means the production of plant raw materials and the production of bioenergy in less productive areas. The present energy needs in the Czech Republic represent annually about 1750 PJ and it is covered by 62.7% ecologically inconvenient brown coal, 26% imported natural gas and oil, 10.5% nuclear and water energy and only 0.8% is covered by energy from biomass (Strašil, 1999). Advantages of these energy resources are that they are uniformly distributed regularly in the whole state territory. The utilization of wastes and of agricultural land could represent a significant contribution for solving local energy problems and could play an important role in decreasing the consumption of imported conventional energy resources.
In 1999 in the CR, about 1,600 thousand tons of dry biomass, largely wood and waste by products from woodworking, were used for energy purposes. Biogas from wastewater plants and dumps came in second place. Straw has to date been used minimally, but farmers in some areas are starting to use it more (Cooperatives in Tošanovice, Bystřice, Selekta Pacov, Milk factory in Raděšice). In the current energy balance, renewable energy resources account for approximately 2.4 % and of this 1.4 % is biomass. If the economic conditions change with the deregulation of fuel and energy prices, then in the current economic conditions it is realistic for the share of biomass in the energy balance to reach 12%.
The total annual consumption of energy biomass in CR is about 1.8-2 million tons. The annual production of standardized biofuels (pellets and briquettes) achieves 140-160 thousand tons, 80% of which are exported to the states of the EU. The total production of energy from biomass which in 1995 was estimated at 3,200,000 MWh (11.5 million GJ) grew in 1999 to 5,600,000 MWh (20,160,000 GJ).

Table 16: Actual and potential (by 2010) production and use of renewable energy in the Czech Republic

Renewable source of energy	actual use TJ/ year	usable potential by 2010 TJ/ year	% of total	total capital costs Mil. EUR	investment costs EUR/GJ
Biomass	18 650	61 770	3,53	536	12
Waste	1 520	3 560	0,30	822	402
Sun energy	140	11 500	0,66	2915	257
Photovoltaic effect	0	80	<0,01	164	2176
Thermal pump	30	6 670	0,38	688	104
Wind energy	30	3710	0,21	607	165
Small hydroelectrics	2 340	5 660	0,32	524	158
Large hydroelectrics	4 500	4 500	0,26	0	0
In total	27 210	97 500	5,60	6258	–

Source: Weger, 2004a

Even though this shows a great shift in a five-year period, it is far from utilizing the real potential of biomass (Weger, 2004a).
From the evaluation of the energy biomass potential, it is clear that to achieve the established indicative goals till year 2010 it is necessary to acquire almost half of the biomass (47.1 %) by intentional growing, as can be seen in the following outline:

Biomass kind	Energy: total in %	Pj	out of which: heat PJ	electricity GWh
Wood and wood waste	24.0	33.1	25.2	427
Grain and oil plant straw	11.7	15.7	11.9	224
Energy plants	47.1	63.0	47.7	345
Biogas	16.3	21.8	15.6	535
Total	100.0	133.6	100.4	2231

Source: http: www.Biom.cz (2003)

The actual share of renewable energies in the total energy consumption of the CR is about 2.5 %. The potential share of renewable energies is estimated about 5.6% of total energy consumption by 2010. The main potential share of energetic biomass after 2010 belongs to firewood (up to 35%) and cereal straw (22%), but after 2020 – to energy crops (30%) and woods (25%).

Perspective of new jobs at the national level

The development of phytoenergy naturally means new jobs. Energy biomass must be produced, gathered, transported, processed, turned into fuel and utilized efficiently in the new types of technological devices, which again have to be manufactured. In accordance with the extent of biomass utilization for energy in the CR, approximately 15, 000 new jobs can be created in the year 2010. Considering only the costs per one unemployed person of approximately 100 to 150 thousand CZK, such a range of new job sources would mean a savings of 1.5 to 2 billion annually. These jobs would be evenly distributed across the whole territory of the state, in accordance with the desirable diversification of energy sources. This should concern remote countryside areas, too, where unemployment is typically very high. The construction of small energy facilities (boiler houses, pellets and briquettes manufacturing facilities, etc.) for biomass utilization also enables certain

ENERGY CROP - ENERGY VALUES

The combustion of straw, wood, tree bark and agricultural wastes is the most commonly used way of thermal utilization of biomass in the Czech Republic. In the substitution of fossil fuels by the biomass, it is necessary to solve all tasks as a whole with respect to the local conditions, particularly with regards to the technical problems, economic tasks and matter of organization.

Table 17: Energetic values of energy crops

Crop	Mean yield of dry matter ($t.ha^{-1}$)	Yield of energy ($GJ.ha^{-1}$)	Equivalent in brown coal (t)[x]
Cannabis sativa	10,52	190,0	15,83
Sorghum vulgare	11,48	201,9	16,83
Reynoutria	20,43	397,2	33,10
Helianthus annuus	8,31	138,8	11,57
Brasica napus	4,74	82,9	6,91
Camelina sativa	4,71	88,9	7,41

energy self-sufficiency, which, doubtlessly, together with new jobs will ensure an increased stability of the countryside. Biomass utilization for energy can thus considerably contribute towards the solution of social issues such as unemployment and moving into towns.

Subsidy frame for biomass and energy plants growing

Dealing with environmental issues, the Ministry of Agriculture has introduced a whole range of programs which establish environmentally friendly goals. Within these programs, a large amount of biomass is produced that can find its energy utilization mainly in bio-gas stations. The support of the Ministry of Agriculture for goal-directed growing of crops for energy purposes can be broken up into **four basic areas described on page 43.**

Simultaneously with the restructuralization of agricultural production and its transition toward biomass growing for energy utilization, it shall be necessary to ensure the subsidy of business activities during the development of new manufacturing capacities for biomass. The Ministry of Agriculture aims to make this area active in the Operational Program of the MoA. It involves especially the following programs:

- Deepening the diversification of agricultural activities, production and processing of biomass originating from the growers´ own agricultural activity and its launching on the market.
- Diversification of agricultural activities and activities related to agriculture – utilization of alternative energy sources – max. up to 5 MW.

This includes the subsidy of investment projects. The subsidy shall be in the form of a direct non-returnable subsidy and as joint financing. The subsidy adds up to 50% of acceptable costs.

Essentials on fast-growing tree species

In Western Europe – Sweden, Great Britain, Austria and Germany in particular, and in some parts of North America, a new form of farmstead based on continuous testing and practical management of fast growing trees has developed on constantly growing land-area in the last 2 decades. Under conditions in the Czech Republic, it means using clonal archive species, especially poplar (***Populus*** sp.) and willow (***Salix*** sp.). Established plantations and forest stands of these species are called short rotation coppice, energy plantation or energy forest (Weger et al, 2004b)

One approach, shortening the otherwise naturally long rotation period of the forest stands, is „coppicing"- which has a long tradition in Europe. It consists of cutting & regenerating tree shoots from stumps, and harvesting the growth after 3-5 years during the winter season. Then new growth comes up from the stump and the cycle is repeated. Coppicing was not just a way of increasing the yield of fuel wood from stumps near the village; it was a means for securing construction timber of the right size other than by selection

1. The production and manufacturing of densely sown grains for the production of bioethanol as a partial replacement of petrol for engines.

Through intensive negotiations, the Ministry of Agriculture succeeded to negotiate the guarantee of the program for the production of 2 mil. hectolitres of bioethanol to be utilized in transport. This means to process grains from approximately 130 ha. Currently, the implementation of distilleries construction is in the initial stage with the aim to fully utilize their production of bioethanol in the full extent starting with year 2007.

2. The production and processing of the rape-seed for the production of methylesther of rape oil and its utilization as a partial replacement of diesel oil.

This program has been supported by the Ministry of Agriculture since year 1999. The direct support of the production of methylesther of rape oil for the production of mixed fuel with diesel oil was notified in the EU and is submitted in the form of the Draft of Governmental Regulation to be discussed in the government. The production of 100 thousand tons of methylesther of rape oil shall be supported which means processing approximately 280 thousand tons of rape from the area of roughly 100 thous. ha.

These two above stated programs of biomass utilization for the replacement of fossil fuels in transport should be fully implemented starting with year 2007 in the system of assortment mixing of biofuels in petrol and diesel oil pursuant to European standards (predominantly up to 5% of the bio-fuel content). The realization of these programs is legislatively complemented in the amendment to the Act No. 86/2002 Coll. on air protection.

3. The production and processing of plants and fast growing woody species grown for energy purposes.

The Ministry of Agriculture offers direct subsidies for the growers, such as:

* Subsidy of plant growing on arable land for energy utilization. The subsidy is ensured for year 2004 through SGFFF (Support and Guarantee Fund for Farmers and Forestry) and starting with 2005, the support should be ensured by the Ministry of Agriculture from national subsidies. The extent of support is 2000 CZK per 1 ha of the grown plant.
* Subsidy of fast growing woody species. The subsidy is realized within the Horizontal Plan for the Countryside - Development. The subsidy is allocated for planting of:

- propagation plantation in the amount of 75 000 CZK per 1 ha (ie 2358.49 EUR)
- productive plantation in the amount of 60 000 CZK/ha (ie 1886.79 EUR). No other subsidy is allocated in the course of production years.

4. Production of other biomass.

Dealing with environmental issues, the MoA has introduced a whole range of programs which establish environmentally friendly goals. Within these programs, a large amount of biomass is produced that can find its energy utilization mainly in bio-gas stations.

Another significant source of biomass are the secondary products which are created during the processing of crops or during different agricultural activities, such as straw, plant remnants, green mass, animal excrements and waste from agricultural products processing. These must be processed too and be utilized more efficiently than up to now. And it is their utilization for energy purposes that creates another economic contribution for the growers. Forest production includes yet another source, and not a small one, of biomass. Here, too, the sources are utilized in a relatively low extent.

from a natural mixed forest. These coppices also furnished the wood for the enormous quantity of baskets, barrels, tubs, and pails. Coppicing has two important advantages over mature timber. First, the yield/hectare/year can be many times greater; and secondly, repeated harvestings at intervals of 3-7 years provide a much shorter-term return on invested capital (Stanford, 1976). Another approach – short rotation forestry (SRF) – is regarded as a silvicultural practice employing high-density plantations of fast-growing tree species on fertile land with a rotation period of fewer than 10–12 years. Poplars, aspens, and willows are superior in boreal SRF because of their fast growth rate in combination with good cold hardiness. These trees can enrich the coniferous forests of boreal regions but also increase diversity of open agricultural landscape in Central Europe as well. Further, SRF plantations can serve as tools for the amelioration of environmental problems at local (e.g., phytoremediation) and global (e.g., increased greenhouse effect) scales (Weih, 2004).

The cultivation of wooded crops for energy use can produce a quicker return on the capital invested when the rotation time is short and the planting density is high. Production data from Italy (Anonymus, 1997) indicates that the best growth rates seem to be obtained with Poplars (15-20 odt/ha/yr), Locust tree (10-15 odt/ha/yr), and ***Eucalyptus*** sp. (15-20 odt/ha/yr). Willows (***Salix*** sp.) are also interesting and promising forest trees because of their high growth rate, their good performance in lowlands, their capacity for use as a renewable source of short fiber and biomass for energy, their positive effect against the erosion, and value to the landscape. There is broad variability in the ***Salix*** genus. However, the number of studied species and forms is very small, so

SPECIFIC CONDITIONS FOR UTILISATION OF BIOMASS

Czech PROS – Positive conditions

1. Brown coal contributes 65% to the total state energy balance. As the procurable coal supplies are estimated to be exhausted by the year 2040, the State Energy Policy calls for a gradual decrease in mining and therefore the replacement of coal by other energy resources.
2. The CR participates in the General Agreement on Climate Change. The CR comes in second after the USA in the OECD for the high production of greenhouse gasses in the per capita and GDP calculations. Changes need to be made in the production and consumption of energy to decrease these emissions.
3. Eliminating price deformations of fossil fuels and energy greatly increases the competitiveness of biomass.
4. The 1998 National Support Program for Energy Savings and the Utilisation of Renewable Energy Sources which was drafted and approved as part of the Action plan of the European Union has been implemented since 1999. In this program, among the renewable energy resources the utilisation of biomass is supported the most.
5. The production of technology for the utilisation of biomass has a long tradition in the CR. The technical, economic and operational parameters of the domestically produced technologies meet European and world standards.
6. The potential to use biomass under the present economic and technical conditions is estimated to be yearly 6 million tons of dry mass. Only 1.6 million tons were used in 1999, which means that from the existing resources, three times more biomass could be used.
7. The total area of agricultural land unsuitable for producing food goods is estimated to be more than 1.3 million hectares (Ministry of Agriculture, 1999). Of this land, about 800,000 hectares was not used at all or was maintained with state subsidies. Of this at least 500,000 hectares could be used for biomass production. Another 35,000 hectares is available in devastated areas. This increases the estimation of available dry mass production (e.g. from SRIC – short rotation intensive culture) by 6 or 7 million tons.
8. The results of the research completed to date enable the offering of a wide range of types and sorts of plants to start this type of plantation in all conditions except in the case of extreme dryness. From the year 2000, the State program also supports the founding of long-term plantations.
9. According to the State's ecological and agricultural policies, the unacceptably high 74% of ploughed land must be reduced by 10%, approximately 300,000 hectares. This can best be achieved by planting permanent crops or by afforestation.
10. The more than 1 million tons of biomass available yearly from unused grasslands and unploughed arable soils is excellent material for producing biogas. Thus far, biogas is not utilised very much in the CR.
11. In many businesses and factories, solid fossil fuels are being burnt in furnaces, which have surpassed or are reaching their lifespan. Renewing these appliances is inevitable above all for business and economic reasons. Heating plants in the community sphere, including schools and hospitals are in a similar situation.

Czech CONS – The main barriers and risks

1. There is a lack of capital on the side of the investors in all spheres and the long-term loans with low interest rates that are needed to finance these type of investments are either unavailable or non-existent. Therefore, very few prepared and approved projects are carried out. This is true especially in the community and agriculture spheres and it even pertains to projects prepared with foreign assistance.
2. The total capacity of financial resources that the state can provide yearly to support these investments is many times lower than the real need. In 1999 and 2000, the state provided only about 15% of that which was needed.
3. On the legislative side, to date effective measures to encourage the use of biomass are lacking.
4. Neither goals nor measures to motivate farmers to use biomass to cover their own energy needs and to start to produce their own energy are set down in the agricultural policy.
5. To date there is a very weak biomass market for the small consumers.
6. There is a lack of public awareness on biomass utilisation and the effects, which it brings. As a result, there is also little political will to make the needed changes.
7. In last years, massive gasification (extending of natural gas pipelines) has been carried out in many rural and forested areas, which biased biomass development as advertising for natural gas. It also drained financial resources and the space possibilities for biomass.
8. The strong lobby of large energy producers, miners and distribution companies is able to influence not only the governmental activity, but also the creation of new legislation in parliament. The result is a lack of legislative measures, which could motivate consumers to use biomass and other renewable energy resources.
9. Public awareness and education in relation to renewable energy resources is just beginning.
10. There is an underestimation of the significance of the production of greenhouse gasses and the importance of decreasing it.
11. There is a lack of an institutional secure process to replace fossil fuels with biomass.
12. A proper energy agency established by law is missing. The existing Czech Energy Agency falls under the Ministry of Industry and Trade and it is not professionally or technically equipped to solve the problems of replacing fossil fuels with renewable energy resources and few financial resources, i.e. yearly only tens of million CZK are allocated to support this goal.
13. There are continual attempts to replace the declining coal energy with nuclear energy.
14. There is a separation of the liberalization of the energy market and the limiting & extending of the reparation of fuel/energy prices.
15. There is a risk that the amendments to the Law on energy, which would cancel the present mandatory buy up of renewable energies, will be accepted. (The Law is now in the Parliament.)
16. There is a prevailing opinion to leave agricultural land, which is now non-profitable for food-production unused.

Source: Weger et al, 2004b

the commercial clones in the world are based on a restricted genetic base (Cerrillo, 1996).
Successful growing of poplars is due to silvicultural techniques that are more similar to agricultural activities than to routine silvicultural procedures in forestry management. Tree species planted in the arable land are called plantations or lignicultures in European countries. They are established to produce the best quality, pre-defined assortment. To achieve a maximum economic effect, reproduction material of selected or bred clones is used and/or a generative posterity of verified combinations of parental individuals. Breeding programs have been the most successful in poplars during last one hundred years. High-yield poplar energy plantations (*Populus x euramericana* clones) are therefore economically very feasible. In Hungary, harvesting is usually based on a 3-4-year rotation period (Diner & Sacit, 2000). Potential energy from SRP there is quite high, with 240-310 GJ/ha/yr resulting in 700-1,250 GJ/ha at the time of the harvest, especially if the most suitable clones are selected.

Plantation of fast-growing trees

Silvicultural methods in general do affect wood quality, maybe more so than tree breeding and selection. In the Czech Republic, the species spectrum of trees which can be reproduced vegetatively has been extended. This is due to increasing possibilities in biotechnology application and the economically important quality of the clones being selected by advanced breeding methods. So the interest has focused as well on valuable broad-leaved trees with colorful wood, such as bird cherry, pear wilding, sycamore maple, ashes, mountain ashes and walnut trees. These trees grow rather quickly (compared to traditional forestry rotation periods ranging from 80 to 160 years), and they can be valorized in 20 to 40 years after their planting if the silvicultural care and their location are good.
Intensive silviculture in the Czech Republic has developed gradually in parallel with other countries. In CR, an increase of the plantations has grown just slowly (i.e. 5-10 ha/year) and nowadays area is around 30-40 ha. In 2004, a meaningful increase of up to 70 ha Weger et al (2004 b) occurred due to the state subsidy frame under line of renewable resources and rural area development (ie redemption prices of electricity and HRDP subsidy). First short rotation plantations were established in 1994-95 under the influence of positive biomass use in neighboring Austria and Germany. However, experimental poplar plantations of FGMRI, antecedent to the achievements of last decade, has gained the standing volume of 450 to 600 m^3/ha at the age of 25 years. The most profitable clones of variable European origin were tested until the most recommended varieties for the CR had been identified. Final selection of lignicultures (ie plantations with a short rotation period) was represented by a group of 9 hybrid Populus x euroamericana clones intended for the best quality poplar locations in the 300-400 m altitude. Four other clones from the section of balsam poplars can grow up to 700 m.
Lignicultures have some signs in common, regardless of the tree species grown. They are planted at locations meeting the requirements of the given tree. Quality seedlings are planted in the prepared soil in the wide spacing. Overall ground cultivation is performed for 5 to 10 years. Regular pruning, tending and tree release through thinning are the basic principles of the silvicultural procedure necessary for successful propagation of the required assortment. This kind of silviculture shows that these are so-called intensive cultures.

When selecting hybrids for plantation, both the silviculturist´s requirements for the final product and ecological demands of each clone should be taken into consideration. Optimum locations for hybrids such as Populus x euroamericana have heavier but aerated soils with sufficient stock of nutrients and available subsoil water. Balsam poplars tolerate even poorer, gravel ground with a good water supply. If even the best poplar clones are planted at unsuitable locations, they can grow but then they play the role of a ground cover more so than that of the producer. European aspen has a special importance, as it has a great ecological amplitude. However, its modesty as to the location is, on the other hand, balanced by its greater demands for raising the seedling material. The FGMRI breeding program has brought, as a result, verified hybrid combinations with above-average growth in its posterity. White and grey poplars have high yields at locations with a good supply of water and nutrients. Yet they are not planted purposefully in the CR now and the investigation of their silvicultural application is at the initial stage only. The planting of fast-growing wood species has been supported within the national system of aids from 2000. The support has been provided in the form of a direct non-repayable aid. A total of CZK 131 000 was paid for the planting of fast-growing wood species and 3 ha were planted in 2000. Aid amounting to CZK 566 000 was granted and about 10 ha were planted with fast-growing wood species in 2001. In 2002, aid totalling CZK 475 000 was granted to support the planting of approximately 8 ha of fast-growing wood species.
Marginal lands in CR can be well used for an extensive form of forest management, regardless of which final target of production is preferred – traditional commodities or energy biomass. Better quality lands can be further valorized through intensive lignicultures of effective yields of pulp-wood, sawn wood, wood for industry or for energy application or yields from valuable assortments of precious deciduous tree species.

Growing energy crops

As already mentioned, the Czech Republic has almost 1 million hectares of soil that is not necessary for the production of food. Biomass utilization for energy purposes has not been fully appreciated in the Czech Republic so far (Petříková, 2003). It is partially due to the fact that the general public has not been sufficiently informed about this new prospective program.
Despite the growing number of newly constructed bio-boiler houses, there have appeared signals indicating the shortage of forest and wood waste. This is usually related to their increasing price. Apart from these masses, another very important source of energy biomass is the intentionally grown energy plants. The produced biomass can be then separated into wooden mass, which is obtained by growing fast growing woody species, and phytomass, obtained through growing crops in field cultures. The following overview of some of the energy-herb species shed some light on field cultivation.
In case of energy herbs, these are mainly plants of high growth which produce a large amount of above-the-ground mass. These plants should provide the yield of approximately 7 to 10 t of dry mass per 1 ha. For the rapid development of "phytoenergy" all potential suitable species are stated here, even though for some kinds their growing technology is not known in detail because there are only results from experimental plots of land. This knowledge must be further expanded for practical recommendation and, simultaneously, growing these plants in operational conditions must be verified. It is necessary to draw attention to these plants to obtain further details concerning the technology of growing all potentially suitable species so that the group of energy crops would be sufficiently varied. Anybody can become involved in this program, as it was in the case of energy crop. Eg fodder sorrel of Uteush – named Rumex OK 2 – highly productive perennial crop, achieving on average to 220-260 cm of height and yields 14-16 tons of dry matter of above ground biomass from 1 ha (in the case of only 1 cutting per year in dry state as energy biomass). This remarkable plant is described in detail in the following text together with many

others recommended for growing in field conditions by Czech farmers.
In case of energy herbs, these are mainly plants of high growth which produce a large amount of above-the-ground mass. These plants should provide the yield of approximately 7 to 10 t of dry mass per 1 ha. Experiments should be further expanded and practical recommendations drawn up and, simultaneously, growing these plants in operational conditions must be verified. It is necessary to outline. Attention to these plants can result in further details concerning the technology of growing all potentially suitable species.

Grains

Energy grains can be localized in the less fertile regions with higher altitude since they do not have especially high demands on the place and in the fertile lowlands the more demanding corn and wheat can be grown.
Growing energy grains has an undisputable advantage in the fact that the farmers are familiar with the technology of their production and harvest and no special mechanization is necessary. The harvest can be performed by cutting the grains into rows and after they have dried they can be gathered and pressed into bales. For straw combustion (even for whole plants, including the grain) in larger boiler-houses (e.g. communal), it is better to utilize squared bales of large dimensions, weighing 300 kg or 500 kg, than low volume bales or bales of cylindrical shape. Their shape depends mainly on the type of the boiler house furnace where the bales are combusted. For smaller boiler-houses it is possible to shape bales of smaller dimensions (see e.g. Sladký 1995). However, it is necessary to determine the date of the harvest of the whole plants, including the grain, for combustion in such a manner that the grains are not overripe which could then result in higher losses due to the crumbling away of the grain. When these bales are stored, it is necessary to protect them against rodents.

Sorghum *(Sorghum vulgare Adams.)*

Sorghum plants rank among the C4 type which means that they tolerate well dry periods because they have good water management. To produce 1 kg of dry mass they need only 200l of water which is, compared to maize, 100l of water less. However, sorghum is demanding for heat. For energy purposes, mainly sorghum – Sudanese grass (Sorghum vulgare var. sudananse) can be utilized. Sugar sorghum is less convenient for direct combustion because due to its large amount of sugar it is in the state of "water retention" until the harvest and it is difficult to dry it afterwards.
Sorghum is sown in late spring when the soil has sufficiently warmed up (approximately 10-12°C) which ensures successful germination of seeds. Sorghum for energy purposes is sown into more narrow rows, 20-30 cm wide, approximately 30-50 kg/ha of the seed is sown. Sorghum – Hyso does not have any specific demands for temperature thus it provides good yields even in areas with medium altitude, not only in traditional agricultural soil but also in soil, re-cultivated after industrial devastation. The results were verified on average for 5 years and sorghum Hyso was grown e.g. on mine spoil grounds and ash dumps in the Chomutov regions, where 10 to 12 t of dry mass was obtained from 1 ha.

Maize straw

This group of annual plants includes the generally known maize. Maize corn from growing maize for the grain can be successfully utilized for energy purposes. The harvest is performed when the maize is fully ripe; that is in the time when the whole plant is well dried up. The maize straw can be then cut into rough chopped straw and utilized for direct combustion, similar to wooden chips. The maize cob can be utilized likewise after the grain has been removed. If necessary, the cob can be ground into small particles, e.g. on a grinder utilized for small wooden mass such as brushwood etc.

Sown hemp *(Cannabis sativa L.)*

Hemp is sown in April, in its second half. It is planted in rows 12-15 cm wide, with a depth of 3 cm. Approximately 37-65 kg of seed per 1 ha is needed. When growing hemp for energy purposes, the amount of seed nearing the upper limit should be selected.
The hemp can be utilized for a whole range of various products and also for phytoenergy purposes. After the hemp has been processed for fibres, paper etc., bullen and other waste can be successfully utilized for direct combustion. Very good results were achieved when combusting the whole plants because the hemp has a relatively rich energy content. Combustion heat of the hemp reaches up to 18 MJ/kg.

Amaranth *(Amaranthus sp. L.)*

This plant, know mainly in the Central and South America, began to be grown in the Czech Republic too (starting in 1993). This is a very old plant with a high amount of nutrients which has an optimally balanced ratio of the individual parts, namely sugars to proteins. The seed of amaranth therefore started to be utilized in the program of a healthy diet. Some kinds that originate mainly from Asia (from Europe too) are grown as leaf vegetable too.
The amaranth is a robust, very high plant which has a large amount of variants. After the grain is separated there remains a large amount of above-the-ground mass and therefore this plant is interesting for phytoenergy for direct combustion. The amaranth has been grown specifically for this purpose but in this case the main task was not to obtain the seed but only the total above-the-ground mass. The amaranth provided relatively satisfactory results with an average yield of approximately 6-8 t/ha of dry mass. However, these results are not clearly beneficial for direct combustion because the amaranth harvested in this manner had before become fully ripe, a relatively large amount of leaves which needed lots of drying up. This mass can be utilized for bio-gas production. For these reasons it is not beneficial to grow the amaranth only and exclusively for the total above-the-ground mass but it is better for phytoenergy purposes to utilize the amaranth "straw" only after the grain has been removed. Amaranth phytomass is then substantially drier than when the total, not fully ripe above-the-ground mass is harvested.
The most suitable time for sowing is in May or in the first part of June. The amaranth adapts well to high temperatures and shortage of water. It is therefore suitable for warmer maize and sugar-beet growing areas, for medium to lighter soils, neutral and slightly alkaline. Areas with heat-loving kinds of weeds are unsuitable. The amaranth creates a large amount of mass, thus it requires a good stock of nutrients, especially P in the amount of 60-80 kg / ha and K in the amount of 120-140 kg/ha. Concerning nitrogen, the average dosage is sufficient, which is approximately 50-60 kg/ha. Before sowing it is necessary to eliminate the weed, both mechanically and chemically. The suitable agents to do so include Roundup SG (2-2.5 1/ha) or Touchdown (2 1/ha). The amaranth seed is very good and it is necessary to prepare the soil in such a manner that it is correctly rolled so that the seed could germinate evenly. The time-tested amount of seed is approximately 1.2–1.7 kg/1 ha in the depth of maximally 1.5 cm. The recommended row width here is approximately 20-35 cm, however, the range utilized abroad is from 12.5 to 70 cm.

Sown hemp (Cannabis sativa)

Amaranth (Amaranthus sp.)

Fodder mallow
(Malva verticillata L.)
The mallow is an annual very high robust plant with many branches which is suitable due to its height for utilization as an energy plant. The mallow was grafted as a large volume fodder plant.
The sort, permitted in the Czech Republic, is called Dolina from year 1993.
The mallow is sown from April to May; the recommended amount of seed is 5-8 (10) kg/ha. It is interesting due to its relatively fast germination and rapid growth. This feature enables growth in soils which are not very carefully prepared and which can contain a small amount of weeds. As the plant has broad leaves, it can resist relatively successfully a large amount of weeds and can secure good yields. In poorer areas with lots of weed it is recommended to increase the amount of seed up to approximately 10 kg/ha. The recommended row width is up to 50 cm, however, from practical experience it is obvious that it can be sown in narrow rows, similar to grains. This manner is suitable also in the case of soil with weeds when the seed is spread more evenly across the area and the plants can then resist the weeds better. Another advantage is the utilization of the common sowing machine, without any requirements for special machines. The only necessary thing is to adjust well the amount of seed for the small sowing dosage in advance.
The whole plant, including the seeds, can be utilized for direct combustion. In this case it is necessary to harvest the plants before they are fully ripe so that the loss of grain is prevented. The plants should be harvested in dry weather, if possible, so that it should not be necessary to dry up the mass which would be cost demanding. The average yield of the dry mass of the mallow is from approximately 6-10 t/ha.

Oil rape *(Brassica napus L. var. napus)*
The Czech farmers are familiar with growing rape which has a long tradition, therefore it is useless to state here the detailed data concerning its growth. The rape is grown for seeds from which high quality oil is obtained. Recently, the rape has been utilized to a large extent for bio-diesel production. The yields of rape straw range from approximately 2.8-4.5 t/ha. These yields do not reach the total yields required for the intentional growing of energy plants, however, it is necessary to emphasize that only the byproduct is utilized here.

Abyssinian mustard (Crambe)
(Crambe abyssinium)
The crambe is a spring oil plant which is not well known in the Czech Republic. Some time ago it began to grow, but its sown areas were not of major importance.
It is sown early in the spring, no later than the middle of April. The amount of seed is 20 to 30 kg/ha and it is sown in the depth of approximately 2-3 cm.
The crambe is harvested with a common combine harvester, the straw gathered from the rows can be pressed into bales, similarly as with grain straw. Considering the short vegetation period, the crambe is not a very efficient crop. The grain yields are from 1.2-2.4 t/ha and the yields of straw approximately 1.4-3.2 t/ha which is not very much for phytoenergy purposes. Therefore crambe growth is only of marginal interest for phytoenergy. Its straw can be successfully utilized only where the conditions are suitable for it.

Safflower *(Carthamus tinctorius L. partim)*
This daisy family low-volume oil plant is of similar interest for phytoenergy as the crambe, even though it provides better yields. It is recommended to utilize mainly the straw for direct combustion, in connection to growing areas focused on seed production. Recently, growing and harvesting the whole plants including the seed has been recommended for energy purposes. The growing areas are usually located in southern Moravia because the saflor is a heat-loving crop.
Average safflower straw yields are around 4-5 t/ha. This straw provides relatively high combustion heat (approximately 17.8 MJ/kg) and thus it can be fully recommended for combustion, especially where it suits local conditions, taking into account transport distances.


Oil rape (Brassica napus)

Sown oil flax *(Linum usitatissium L.)*
For direct combustion, the flax is utilized only as a by-product, i.e. when using the straw after the oil seeds have been separated. The straw contains certain amounts of fibres (even though they are not of good quality for spinning). It is relatively energy rich and thus it can be fully recommended for energy purposes. The limits will depend on specific local conditions and transport distances.
The flax is grown in the Czech Republic in two permitted sorts: Atalante (1997) and Flanders (1996).
The technology of flax growing will not be changed in any way for its possible utilization for energy; it is well known and thus it is not necessary to describe it here.

Gold-of-pleasure *(Camelina sativa L. Crantz)*
To provide complete information, it is necessary to mention the Camelina too, even though it is of marginal importance for phytoenergy. This is a low-volume plant which used to be grown a lot in the Czech Republic. It is interesting because of its oil seed, containing a large amount of linoleic acid, important for human nutrition. For direct combustion, mainly the straw can be utilized. The plant is, however, rather small and thin and thus the yields from the above-the-ground mass are not very large. The plant is modest with a very short vegetation period.
The Camelina is sown as early in the spring as possible. The amount of seed is 8-12 kg/ha. It is sown in the depth of 1-2 cm. It has tiny seeds and thus it requires a very careful sowing preparation. It is usually sown into narrow (grains) rows, even though wider rows used to be recommended.
Due to the short vegetation period, the Camelina becomes ripe before the winter rape, i.e. approximately after 3.5 months of vegetation. It is then harvested at the beginning of July (or even at the end of June) with a common combine harvester. The harvested seed must be dried in time so that it does not become moldy, which would damage it. The straw, if it is utilized for combustion in boiler-houses, can be gathered from the field and pressed into bales, similarly to the grains straw. However, the yields from this straw are relatively low, only 2.5-3.5 t/ha. That is why the Camelina straw can be utilized only in a small extent for direct combustion and only in the areas which are located close to a boiler-house and where there is no other more suitable usage for the straw.


Safflower (Carthamus tinctoria)

Common evening – primerose
(Oenothera biennis L.)
This plant is known in the CR as a wild plant, originating from North America. It began to be grown in the country only sporadically as a healing herb. Its oil seeds contain a large number of outstanding natural substances which are processed in the pharmaceutical industry. In the past few years, however, there have appeared certain problems with obtaining the seeds and thus it is grown only exceptionally. Only the byproduct, that is the straw, is suitable for energy.
The evening primerose is sown from May to August in rolled soil. In the year when it is sown it only grows the roots and does not grow in winter. Only in the spring of the second year it forms a robust, relatively high stalk which branches out, with frequent fruit that ripen gradually. After the seeds are removed, there remains a large amount of straw which can be well utilized for direct combustion.

White sweet clover *(Meliotus albus Medikus)*
Mainly the sort called Krajová is of importance for energy purposes since it can live in its location for several years – 7-8, possibly more. The melilot – Adela is also suitable because it grows well in the following years and is often complemented by new plants from its own seeds which are lost during the harvest.
The melilot is sown in the spring, by direct sowing in the prepared soil, without a cover crop. It can be possibly sown into thin grains that can serve as the cover crop. The melilot prefers neutral to alkaline soils and can tolerate dry locations. The recommended amount of seeds is approximately 14 to 25 kg per 1 ha.
This form of "phytofuel" too can be well utilized for combustion in bio boiler houses. The melilot provides the full yield of the above-the-ground mass from the second year when the yield reaches approximately 5 to 7 t/h of dry mass.

Goats – rue *(Galega officinalis L.)*
This plant is of similar character as the melilot. It is also know as a clover family plant (healing plant), however, due to its high content of bitter alkaloid galegin, it is of low value as fodder crop. Nevertheless, it can be utilized for energy purposes.
It is sown like the melilot, into a cover crop or as direct sowing, approximately 15 to 25 kg/ha. It grows well in warmer areas and in damper soils. It is harvested before it becomes fully ripe to prevent the loss of seeds but the stalks must be wood-like. This is beneficial for phytofuels since this above-the-ground mass is sufficiently dry. The plant provides annually (starting with the second year after sowing) around 5-6 tons of dry mass from 1 ha which is acceptable for the economy of direct combustion.

Topinambour tuberus *(Helianthus tuberosus L.)*
The plant is known mainly for growing the tubers. In the CR, they are most frequently used for feeding forest animals or they can be utilized in the food industry, especially for their content of fructose, glucose and insulin.
The plant is perennial, of daisy family and creates not only numerous irregularly shaped tubers but also a large amount of above-the-ground mass. It reaches the height of up to 2.5 m. The stalks are firm and straight and branch out in the upper parts. It is this above-the-ground mass that is of major importance to energy purposes and it can be a good raw material for phytofuels.
The plant is sown in the spring, most frequently in April. The tubers weighing 40–60 g are sown, and for 1 ha about 50 to 55 thousand tubers should be sown. Sowing is performed with a potato-sowing machine, into the depth of 6-12 cm. The care is similar to potatoes, only the "little graves" are not created, or only very low ones so as not to interfere during the harvest.
The yields of the total dry mass of the above-the-ground parts have not been sufficiently proven so far, however, it can be estimated that they can reach 8-10 t/ha. The harvest is performed with a harvesting cutting machine and the chaff must be aired well.

Fodder sorrel
(Rumex patientia)
Based on operational testing performed so far, it can be supposed that the cultivation of Rumex OK can last up to 10 years in one location. It is sown in the spring but is not harvested for energy purposes in the first year. It can be sown until the end of June but due to the need to utilize the winter moisture stocks, the earlier sowing is preferable. Late sowing, e.g. as late as in July, cannot guarantee the creation of fruit bearing stalks in the following, that is the first utilization year which can decrease the yield of energy biomass since the high stalks reaching up to 2 m are the most important thing for the harvest. When the years were dry, sowing in the autumn was good too.


Topinambour (Helianthus tuberosus)

Sowing is performed with a common sowing machine but the maximum depth for the seeds is 2.5 cm; the seed must not be "drowned". If the soil is sufficiently moist, the depth can be only 1.5 cm; when the weather is dry, the depth can be bigger. The amount of seed is established as 5 kg/ha, possibly up to 7-8 kg/ha. The rows are either narrow – 12.5 cm, or wider – 25 cm. The more narrow rows are suitable for poor soil where the dense connections of the vegetation are good for the growth because it covers the soil surface better and restricts the weeds. Based on experience, the difference in the rows width has not been of major importance so far in the development of vegetation. After sowing, it is suitable to roll the field with a grooved roller, especially when the weather is dry.
For energy purposes for direct combustion, the sorrel is harvested as the whole above-the-ground mass, including the seed. The sorrel becomes ripe relatively early, usually by the middle of July. It is harvested immediately before full ripeness to prevent the loss of seed because the seed increases the energy content of the harvested sorrel. When the whole above-the-ground mass is harvested, the sorrel achieves good yields which differ according to the fertility of the soil and the manners of treating the vegetation – from 6 to 10 t/ha of dry mass.
The sorrel is harvested with common agricultural mechanization such as a silage cutter or, preferably, a mowing crusher. When harvested with a silage cutter there is chaff which is combusted similarly to wooden chips. More frequently the whole cut above-the-ground mass is pressed into bales that can be squared of circular and then can be combusted in boiler-houses like straw bales. The sorrel can also be utilized for the manufacture of standard phytofuels such as bio-briquettes or small pellets. Pellets and briquettes have been manufactured from the sorrel in an experiment and the results were good. The dry sorrel phytomass has a large energy content. By measuring the combustion heat the values that were determined were around 17.5 MJ/kg of dry mass.

Cup plant *(Silphium perfoliatum L.)*
Due to its robust height, this plant can be utilized as an energy plant because it achieves relatively large yields, approximately 8-10 t/ha of dry mass. The plant is perennial which is suitable for energy purposes. It prefers warmer regions, even though it can tolerate well the regions with medium altitude. It exploits well fertile soil, but if the soil is poorer it should be sufficiently fertilized. It is sown usually in the spring in April. The amount of seed is 12 – 15 kg/ha and it is sown in the depth of approximately 3 cm. It becomes ripe at the end of August or in September.

Pink hollyhock *(Alcea rosea L.)*
This is a mallow family plant which is known in the CR also under the name "Chinese rose" because it is often grown in traditional gardens as a decorative plant. Apart from this purpose, it is grown as a healing herb when the blossoms are gathered. For these purposes a variant of the pink hollyhock is recognized in the CR: Black Country. The seeds are sown into free soil from the spring till June (Autumn sowing can possibly be made too). The amount of seed is approximately 5 kg/ha. The plant reaches an average height of up to 2 m; in some cases it can be even higher. It has a relatively long vegetation period because the blossoms usually appear during the whole summer. For energetic purposes the plant should be always harvested dry, if possible. That is why a later date of harvest is more suitable, the earliest in September. The mass harvested in this manner provides yields of around 6-8 t/ha of dry mass. The harvest in operational areas can be performed by common agricultural mechanization such as a silage cutting machine. To speed up drying it would be preferable to verify the possibility of vegetation desiccation, however, this has not been realized in operational conditions.

Dyer's woad *(Isatis tinctoria L.)*
This is a kohlrabi type plant. It is of medium height and reaches approximately 1.2-1.5 m. It can be kept in the culture for more years. It is sown in the spring, in April to May. The amount of seed is 10-12 kg/ha and it is sown in the depth of appro-

ximately 3 cm. It prefers warmer areas and fertile soils. It can be harvested by cutting the whole above-the-ground mass which can then be gathered by gathering press and thus standard bales can be created, similar to straw bales.
The yield of the total dry mass is approximately 5-6 t/ha. Introducing this non-traditional species in the system of plants growing can be suitable also due to the fact that the species variety shall be strengthened which is always beneficial for the biodiversity in the cultural landscape.

Chinese silver grass

(Miscanthus sinensis Andersson)

The miscanthus is a large robust grass, reaching up to 4 m of height, which resembles reeds. It is perennial, and should last up to 20 years in its location. The data from abroad state very high yields of this crop – approximately 20 t/ha (the record being 30) of dry above-the-ground mass.
The miscanthus thrives also in Germany, mainly in Bavaria. On the basis of a recommendation from this region of Germany we initiated the testing of its growing also in the CR (in 1990). We used the imported seedlings for starting an experimental plantation by Research Institute of Phyto-Production in Chomutov. However, the result was not satisfactory because most of these plants die in winter due to sub-zero temperatures and the plantation thus did not survive. Later, the growing of the miscanthus was tested in other locations, as stated by Strašil 1999. Here the results were better, mainly in warmer regions near Prague or Brno (with average yield: Ruzyně – 18.50 t/ha, Troubsko – 14.47 t/ha of dry mass).
The harvest is usually performed after the first frosts (from November to March), when the robust stalks of the miscanthus are sufficiently dry. After the first frosts it is necessary to consider harvest losses, which can account for approximately 30–40 %. This material does not have to be dried additionally which is of extreme importance. For energy purposes the harvest is usually performed with a self-automotive silage cutting machine which gives rise to rough chaff. This can be combusted either directly, like chips, or fuel pellets or briquettes can be pressed from it. It is also possible to make large bales from the straw. If the miscanthus stalks are to be utilized as a building material, the straw is harvested completely.
To conclude the information on the energy miscanthus, it is useful to state some practical experience with its operational growing in Germany. When starting the miscanthus plantations, it was generally supposed that the plantations would last for twenty years. However, not all the plants reached this age. In some areas the plants started to become dry and thin only after 15 years which was then reflected in lower yields (approximately 10-15 t/ha). This experience shows that it is not possible to always guarantee the clear success of the miscanthus growing, i. e. to ensure high yields during the period of 20 years in all the areas. The miscanthus is doubtlessly an interesting plant, however, it is necessary to consider carefully its operational growth in our conditions and to decide in every case its advantages and disadvantages.

Knotweed (reynoutria)

(syn. Pleuropterus Turzc., syn. Polygonum)

The biggest attention in the group of wildly growing sorts that can be utilized in phytoenergy is drawn to the Reynoutria. It creates record-breaking yields of above-the-ground mass with a high-energy content and therefore it seems to be beneficial for phytoenergy utilization.
Energy utilization of the Reynoutria is therefore significantly limited, however, it is not completely out of the question as it is stated. Its continuous utilization in phytoenergy would necessitate further verification and further experience would have to be obtained. The record-breaking yields of up to 30 t/ha of dry mass (frequently ascertained so far) would doubtlessly deserve this attention. From the experience, obtained up to now, it is clear that even after 12-year-long growing the plant does not expand from its location to its surroundings if its growing area is regularly mechanically taken care of. Its expansiveness can be easily restricted and thus it would be very interesting to extend the controlled system of growth in CR, obviously under very strict supervision.

Common reed

(Phragmites australis Cav.)

Other sorts of wild growing plants, potentially suitable for energy utilization, include grass – reeds. This is a very robust perennial plant whose firm stalks reach the height from 1 to 4 m. Here it commonly grows on the banks of water flows and in marshy location. On average it reaches approximately 10-15 t/ha of dry mass (the record-breaking yield was up to around 40 t/ha). Marshy areas, unsuitable for normal farming, could be utilized for its intentional growing. The technology of the intentional reeds growing for energy purposes has not been tested yet. It is necessary to test especially the manner of harvest and to determine its dates. An important restricting factor is the marshy terrain since reeds can be harvested only when the terrain dries up or after it becomes frozen. It would be necessary to verify operationally these important conditions to ensure a safe mechanized harvest.

Energy grasses

The utilization of grasses for phytoenergy brings substantial advantages, mainly due to the fact that it is possible to select perennial grasses that do not require annual sowing. Another advantage is the timing of the harvest so that the grass blades are as dry as possible and there is no necessity of their additional drying. In this case it does not matter that the blades are rough and with no good fodder value which is what is usually demanded when harvesting grass vegetation for hay. On the contrary, the firmer and older the blades are, the more suitable they are for direct combustion. Young vegetation of fine grasses, required for feeding farm animals, is unsuitable for direct combustion since the grasses usually have a higher content of nutrients, especially of nitrogen, which is undesirable considering the emissions creation during combustion. Generally it is possible to utilize for these purposes the grasses that are fully ripe, dried up when the nutrients from the above-the-ground parts of the plants are already drawn in the root system. This is in direct relation to the manner of growing these "energy" grasses.
Therefore general attention started to be paid to the selection of the suitable grass sorts for energy purposes, both abroad and in the CR. For example in Sweden they focused on grafting grass sorts especially for direct combustion. The grasses for industrial or energy utilization are grafted in such a manner that they have a larger ratio of blades against the leaves with a low content of ash and some elements, such as silicon, potassium and chlorine, which is beneficial for phytomass designated for direct combustion.

Reed Canary – grass

(Phalaroides arundinacea (L.) Rauschert)

This plant is naturally spread all across Europe. It grows well in the CR too, especially in the location with sufficient amount of soil moisture. This is a high perennial grass which reaches the height of up to 2 m. It tolerates well a short supply of water or shade.
Starting the phalaroides vegetation for energy purposes is not difficult. It is sown early in the spring as direct sowing or in a covering crop, possible also in the autumn (the latest is August 25). The amount of seed is approximately 8–10 kg/ha, the rows are narrow, approximately 12.5 cm (or up to 30 cm) wide. When sowing, it is necessary to ensure suitable nutrition. In the first year, it is recommended to fertilize it with nitrogen in the dosage of 70-100 kg/ha and in the following year 50-80 kg/ha, depending on the fertility of the soil. In the course of vegetation in the first year no special treatment is necessary if the plant has been sown into a weedless soil. If there are wide-leafed dicotyledonous weeds, herbicides common for spring grains can be utilized.

Tall fescue *(Festuca arundinacea (L) schreb.)*

This grass is also perspective for energy utilization since it is robust, reaching the height of 1.2–1.5 m, with a high yield potential. It is characterized with reliable resistance and can tolerate frost and thus it grows well in our conditions. The fescue is usually sown in rows which are 25 cm wide (possibly even more narrow), in very small depth (just 1 cm). The amount of seed is only 15-16 kg/ha because it has tiny seeds. It is recommended to fertilize it with nitrogen and phosphor before

sowing in the dosage of approximately 40 kg/ha and with potassium in the dosage of 70-80 kg/ha. In the following year the fertilizer is usually nitrogen in the dosage of 40-60 kg/ha. The yields of the total above-the-ground mass are satisfactory from the point of view of phytoenergy since they reach approximately 6-8 t of dry mass per 1 ha.

Black bent *(Agrostis gigantea Roth.)*
This plant is a perennial grass of winter crop character, creating short underground branches. It seems prospective for phytoenergy purposes due to its deeper blade of medium height, reaching the height of approximately 80–100 cm. It grows well in the CR because this is a grass occurring in our natural conditions. It has no strict demand for the location, it can grow well in extensive meadows too, especially in harder and moister locations.
The growing of the big bent for phytoenergy purposes is suitably ensured by its growing for seed since even in this case the harvest of sufficiently dry mass is beneficial which is indispensable for seed cultures. Sowing is performed in the spring in the suitable cover crop which is spring wheat with decreased sowing (decreased by 20-40 %) so that the big bent would not suffer from too much shading. Sowing is done as early in the spring as possible, optimally by the end of April, in the rows that are 20-25 cm wide, into the depth of only 1 cm. The amount of seed is 10-12 kg/ha. It is fertilized mainly by nitrogen, usually 80-100 kg/ha in the first two years, and P+K, depending on the soil. The amount of the total dry above-the-ground mass, which is important especially for energy utilization, is estimated at approximately 6-8 t/ha.

Tall oatgrass
(Arrhenatherum elatius (L.) Beauv. Ex J. et C. Presl.)
This relatively high perennial grass can be also utilized for direct combustion. It has a rough blade, reaching approximately 80-130 cm. This is a domestic grass and that is why it grows well in our conditions. It is a grass of spring character. It is not suitable for tougher conditions but can tolerate a period of dry weather so it is suitable

Tall oatgrass (Arrhenatherum elatius)

for drier locations. It is sown in rows 20-25 cm wide and into the depth of approximately 35 cm; the amount of seed is 27-30 kg/ha. When starting the vegetation and in the following year, it is fertilized mainly by nitrogen, in the dosage of approximately 80-100 kg/ha, P+K according to the soil.
The plant, grown for seed, becomes ripe usually as early as the beginning of July and at that time its harvest is suitable also for phytoenergy utilization. After the removal of the grains, the dry straw can be pressed into bales and used as fuel in bio boiler-houses. The yield of seed is approximately from 0.3-0.6 (1) t/ha. The total above-the-ground dry mass reaches yields of approximately 6-8 t/ha. These yields are not really high from the point of view of energy needs, however, utilization of this grass for the stated purposes is suitable also due to the fact that it expands the biodiversity in landscape.

Rescuegrass *(Bromus catharticus Vahl.)*
It has vertical clumps and reaches the height of 80-100 cm with a large yield potential. These characteristics also enable its successful utilization for energy purposes. For energy utilization, the culture of this plant can be started in a manner similar to seed culture since there is no necessity to take into account the aging of the vegetation, as it is in the case of fodder crops harvest. It is sown early in the spring, in the same manner as for the seed culture – approximately 20-35 kg/ha (for fodder there is full sowing: 30-40 kg/ha) into a thinly sown cover crop (e.g. in spring wheat with sowing decreased by 20-25%).
The total yield of above-the-ground dry mass is from 8-10 t/ha. The plant is harvested when fully ripe and the harvest is performed with a traditional combine harvester.

Smooth brome *(Bromus inermis Leyss.)*
This grass is high. It creates a dense net of underground branches which ensures it reliable resistance and large importance for anti-erosion protection. Regarding energy utilization, an advantage of this plant is faster aging which makes sufficient drying up easier. The fully ripe plant is harvested with a combine harvester, then the "straw" is gathered and pressed into bales. For energy purposes, the total above-the-ground mass, including the seed, is harvested. Either it is cut with a silage cutting machine or it is pressed into bales after being cut into rows. The total yield of the above-the-ground dry mass of the variant Tabrom is from 8-10 t/ha. The relatively high yield of both the stated plants represents a good guarantee of their utilization in phytoenergy. Their promising outlook can be further verified, mainly in the manner of harvesting.

II.III Grassland and Pasture management

Grasslands are thought to be one of the most ancient vegetation types in the world. Climax grass-herb communities where graminoids predominate extend **from the equator to the arctic circles**, from savannahs through velds, pampas, prairies and steppes to tundra. They include various communities at very different often extreme sites (from dry to moist) which usually do not make possible field crop cultivation but very often are used for pasture or for green fodder. On continents with the great proportion of developing countries (**Africa, South America**), the proportion of grass communities predominates over other ways of using agricultural land. For example, the ecosystem of savannahs is not only the center of high biodiversity important for the development of agriculture but also the original cradle of the development of the first man (*Homo habilis, H. erectus*).
Grasslands cover 40 percent of the world's land surface. These ecosystems provide livelihoods for nearly 800 mil people, along with forage for livestock, wildlife habitat, carbon and water storage, renewable energy, recreation and tourism. Changes in grasslands have been brought about primarily by conversion of these ecosystems to agriculture, and more recently, the growth of towns and cities. This is especially true in **North America and Europe**.
Climax communities of forests show the greatest homeostatic stability in the landscape (Míchal 1994). Other forest-replacing communities including also meadows and grasslands or pastures do not exhibit the potential of permanent separate existence and thus, to preserve them in the landscape it is necessary to spend constant supplementary energy, thus the more energy the more distant a new ecosystem is from the original one. Grasslands everywhere are seriously declining in spite of their importance for biodiversity. A great number of species depend on them because they reflect long-term and stable management. On average, about 40% of Red List plant species are connected with these habitat types.
On the other hand, even in the cultural landscape of Europe, marginalization and abandonment of intensively used agricultural land sometimes cause a paradox of accruement of grass-like land. In some countries (Estonia, Bulgaria) up to 30% of the agricultural land has already been abandoned. On semi-natural grassland this percentage may be even higher (in Estonia 60% of the semi-natural grasslands are no longer managed). On the other hand, there are also many areas where intensification is expected which also means a loss of characteristic grassland biodiversity.

Most of **Central Europe** would be covered without anthropogenic activity by forest. This means that grasslands are often substitute plant communities that evolved after deforestation due to human activity. Only spatially limited areas above the natural tree line, and steppes with insufficient precipitation and boggy wetlands, would have been covered by natural herb and grasslands. Accordingly, grasslands can be divided into three categories:

- Natural grasslands (see above)
- Semi natural grassland, i.e. habitat that evolved a long time ago and so the species constitution has adjusted to local conditions and to human involvements; these are relatively stable communities.
- Newly established (temporary, artificial) grasslands, i.e. having evolved through the strewing of mostly cultivated species of grasses and clovers; they are characterized by a high production of high quality forage, but they are unstable and their plant constitution alters significantly within a few years after their establishment.

The landscape of the **Czech Republic** was affected by intensive large-area agriculture in the second half of the 20th century. Thus, the CR ranks among regions with a high proportion of ploughed land and a low proportion of permanent grasslands. Nevertheless, the agrarian and ecological policy of EU is naturally affecting also this proportion. New trends in the use of "abandoned" agricultural land dealing also with the protection, conservation and restoration of valuable landscape elements are an objective of many research projects (e.g. Bogenrieder & Wilmanns 1981; Bakker 1989; Hopkins & Biber 2002).
CR is one of the few OECD member states that will likely not have difficulties in complying with the commitment following from the Kyoto Protocol on the Framework UN Convention on Climate Change (decreasing of emissions of the principal greenhouse gases by 8% comparing 1990 to the 2008-2012 timeframe). Some remarks on circumstances of grassland management follow:

- a gradual slight increase in the area of permanent grasslands and forest land

Since 1990, there has been a decrease in the overall area of agricultural land (by 0.3 %). However, there has been a substantial increase in the area of permanent grasslands (by 16 %) and also a slight increase in the area of forest land (by 0.3 %) till the year 2000.

- a gradual decrease in the area of arable land

A favorable decrease occurred in the area of arable land by almost 5 % in the 1990-2001 timeframe, particularly in favor of permanent grasslands.

- a marked increase in the number of environmentally managed entities

The rapid development of environmentally sound farming was reflected in the number of environmentally sound farms, corresponding to 654 entities in 2001, compared to only 3 entities in 1990. The structure of the environmentally sound agricultural land fund is characterized by a predominance of permanent grasslands of 89.7 % compared to 8.8 % arable land, where permanent crops and other areas correspond to only 0.4 % and 1.1 % of this land fund, respectively. The predominance of permanent grasslands leads to high production of bio-beef, with a production in CR in 2001 of 1 062.7 t (0.96 % of the market in beef), along with 20 t of bio-mutton (0.44 % of the market in mutton) and 1 150 t of bio-pork (0.28 % of the market in pork).
From the social point of view, the grassland fulfills further important functions other than the production of forage. These so-called additional functions of grasslands are doubtless more important for society than the actual production of forage. The major functions are:

- prevention of erosion (probably the best land protection against wind and water erosion),
- the hydrological aspect (increased filtering of underground water, quality of drinking water),
- evolution of soils (high humus increase, intense microbial activity),
- aesthetic function (flower meadows),
- landscaping function (alternation of forests and grass growths evoke peace in human minds),
- genetic function (GG provide cover and environment to many endangered species of plants and animals, especially insects)
- and demographic function (agricultural landscape can support more people than forested landscape).

Table 18: Trends in areas of agricultural and forest land (1990-2005) /thoush. ha/

Year	Agricultural land	Arable land	Fallow arable land	Permanent grasslands	Forest land	Cultivated land (%)
1990	4 288	3 219	3	833	2 630	75.07
1992	4 283	3 175	6	872	2 629	74.13
1995	4 280	3 143	56	902	2 630	73.43
1998	4 284	3 101	51	947	2 634	72.39
1999	4 282	3 096	59	950	2 634	72.30
2000	4 280	3 082	71	961	2 637	72.00
2001	4 277	3 075	116	966	2 639	71.90
2002	4 273	3 068	...	968	2 643	71,80
2003	4 269	3 062	...	971	2 644	71,73
2004	4 265	3 055	...	972	2 646	71,62
2005	4 259	3 047	...	974	2 647	71,54

Table 19: Example of financial subsidies provided to "alternative" farming in 2003

Crop	Amount of subsidy CZK/ha
perennial grasslands	1,000
arable land	2,000
perennial crops	3,500
vegetable on arable land	3,500

The reasons presented above show that the state subsidy policies will in the future aim towards a greater support of the extension of managed grassland and toward the grassing of arable land.
Grass-herb (meadow) plant covers can be natural, semi-natural and artificial. Natural plant covers occur with the spontaneous species composition which is the result of development corresponding to site conditions. Semi-natural ones are those where the intervention into natural communities was marked but their development was headed towards balance with site conditions or where site factors were partly changed and thus also the species composition. Artificial plant covers originating by land reclamation and sowing the desirable species are much more productive but their self-regulation stability is decreased and species diversity lower.

Meadows and grazing in CR

Up to the first half of the 20th century pasture was not regulated and it was either completely free or it was limited to pasture at the stables. The development of forage systems and their introduction on the large scale began in the second half of the 20th century because following WWII the need to increase agricultural production rose. The forage system's development in the past 50 years has been influenced by a rotation forage system, which developed from unregulated forage through fenced forage to belt forage. With the development of nitrogen fertilizing a forage system with high pasturing pressure on the pasture was reintroduced.
Grasslands, whose existence and character had been largely determined by human-induced conditions such as cutting, grazing and fertilization, accounted for a large proportion of the abandoned land. The situation was worst in marginal, low-productivity and less accessible, mainly mountainous, parts of the country where almost all the farmed land, including many mown meadows, was abandoned. The meadows, however, formed the character of the landscape, with their aesthetic value and recreation potential also being of importance. Moreover, unique plant communities have developed in these meadows. The Krkonoše Mts. (the western part of the Sudeten Mts.) in the

SUMMARY BOX

According to planned utilization period there are distinguished three main types of land, covered by grass-like herbs:

A. Short term grassland (intense clover-grass herbage) that can be used for 1 to 3 years. These are part of strewing techniques for arable land and they are used for the production of ensilages, green forage or hay. They are composed of two to three parts. The major part is represented by red clover, sometimes with the addition of alfalfa, and grasses turf species with rapid initial growth are used (annual ryegrass, perennial ryegrasses triploid, meadow timothy, tall oatgrass, interfamily hybrids Bečva, Perun, Lofa, or even Felina and Hykor). The clover part varies from 80 % (for use for 1 year only) to 60 % (3 for three years).

B. Temporary grassland that can be used for 4-6 years. These are intense regularly refreshed growths, usually in the vicinity of the stables, where there is the highest pressure in the time of pasture, further more in places where farm fertilizers have been used extensively and finally in places where high quality and volume of forage is the objective. In this group free turf grasses with rapid development and high effectiveness are used. These need to be persistent and have to be able to utilize higher doses of nutrition. Grazed grassland shall be enriched by a certain portion of sprouting grasses (Kentucky bluegrass). The proportion of clovers lowers to 30-35 % and white clover shall be dominant.

C. Permanent grasslands that can be used for 7 or more years. In order to achieve the correct mix setup, the local conditions have to be taken into account. Here, more than in the two previous cases, the rule of professor Klapp applies: "Growth is the property of location". That means that if suitable composition is not provided, the grassland will completely change within several years and other species (often unwanted), which accept the local conditions better, will grow there. Environmental requirements of individual grass and clover species should be known, and species growing in surrounding grassland should be studied and the knowledge used for establishing the new permanent grassland.

northeastern Czech Republic are a typical example (Krahulec et al, 2001). Meadows established during the colonization of the mountains in the 16th and 17th centuries form an almost continuous chain connecting natural alpine vegetation in the highest parts of the mountains to meadows in the foothills. High species richness and diversity of the meadows is due to coexistence of original forest plants, plants descending from high altitudes, plants ascending from low altitudes and plant species (usually endemic) arising in the meadows. The meadows account for a large part of a national park.

Traditional management of the meadows – mowing for hay in mid-summer, cattle grazing for the rest of the vegetation season and rare but regular manuring – has been abandoned since World War II. Conservation efforts have been aimed at new ways of management of the spontaneous succession in the original meadow communities which have resulted in the development of degradation phases and grassland community recovery. Re-introduction of traditional management is impossible because it does not lead to the formation of the original communities and its large-scale application is impossible for economic reasons. Several studies from Krkonoše Mts. (Pecháčková & Krahulec 1995, etc.) verified the effectiveness of sheep grazing and analyse changes in vegetation after cessation of grazing. Sheep grazing provides an alternative management regime due to the relative ease of sheep breeding. Permanent cattle grazing can rarely be used due to disturbances created by cattle. However, there has only been experience with cattle grazing in the Krkonoše Mts. in the autumn.

SUMMARY BOX

overview of subsidies for grassland and meadow management in the period (2004-06)

In summarizing HRDP measure/submeasure options where grassland or meadow is considered for financial support, farmers or cooperatives can use following donations:

Average rates of compensatory allowance for individual types of LFA's

	Grassland
Mountain areas	4460 CZK/ha (i.e. 140.25 EUR/ha)
Other LFA's	3320 CZK/ha (i.e. 104.40 EUR/ha)
LFA's affected by specific handicaps	3420 CZK/ha (i.e. 107.55 EUR/ha)

Agro-envi sub-measure ***A. Eco-agriculture*** *(i.e. Organic farming)*

Rates of compensatory allowance

Recommended rate of payment	**CZK/ha**	**EUR/ha**
Arable land: Percentage of the income foregone/additional costs: 100%	3 520	110.69
Grassland: Percentage of the income foregone/additional costs: 100%	1 100	34.59
Perennial crops: Percentage of the income foregone/additional costs: 30%	12 235	384.75
Vegetables and special herbs on arable land: Percentage of the income foregone/additional costs: 30%	11 050	347.48

Scope of the sub-measure

Possible coverage	**Expected coverage**	**Targeted at**
Agricultural land area of the CR	375 000 ha	Agricultural land of the CR

Sub-measure ***B. Grassland maintenance*** *(in farm-wide scale)*

Average rates of compensatory allowance

Recommended rate of payment	**CZK/ha**	**EUR/ha**
Meadows – no fertilization (or max. 40 Kg of N/ha + mowing regime alternatives)	1 920-5 130	60.37-161.32
Pastures – grazing by livestock		
Fertilization max 40 Kg of N/ha	2 890	90.88
No fertilization	4 330	136.16

Scope of the sub-measure

Scheme	Possible coverage	Expected coverage	Targeted at
Grassland maintenance	900 000 ha	750 000 ha	Grasslands of the CR

*Sub-measure **C. Landcsape maintenance** of the state subsidy frame*

Average rates of compensatory allowance

Scheme	CZK/ha	EUR/ha
Conversion of arable land into grassland	4 465–9 210	140.40–289.62
Establishment of grass belts on sloping grounds	9 440	296.85
Growing of catch crops	4 580	144.02
Permanently waterlogged and peatland meadows	12 100	380.5
Bird habitats on grassland	2 380–5 550	74.84–174.52
Bio-belts	10 630	334.27

Scope of the sub-measure

Scheme	Possible coverage	Expected coverage	Targeted at
Conversion of arable land into grassland	1 000 000 ha	20 200 ha	Vulnerable land (sloping, permeable)
Establishment of grass belts on sloping grounds	40 000 ha	20 000 ha	Sloping land
Growing of catch crops	150 000 ha	60 000 ha	Arable land (vulnerable one)
Permanently waterlogged and peatland meadows	5 000 ha	2 000 ha	Waterlogged meadows
Bird habitats on grassland	20 000 ha	12 000 ha	Defined nesting sites
Bio-belts	150 000 ha	15 000 ha	Wildlife

*Sub-measure **D.** Zonal sub-measure: **Crop rotation in cave** protection **zones***

The exclusion of maize from the most productive areas causes a need to grow this source of feed in less productive areas, which entails reduced income and additional cost for the movement of machinery.

Average rates of compensatory allowance

Scheme	CZK/ha	EUR/ha
Crop rotation in cave protection zones	540	16.98

Scope of the sub-measure

Scheme	Possible coverage	Expected coverage	Targeted at
Crop rotation in cave protection zones	200 ha	150 ha	Arable land above karst formations

Organizing the use of pasture

Nowadays there are two completely contradictory approaches to pratotechnology (pratum means a meadow in Latin and pratotechnology is thus a collection of measures aimed at the tending of grass growths). On the one hand solutions for grassland improvements are sought through resowing, fertilizing, utilization etc. with the aim of achieving high quality forage and a high production volume in order to ensure the cost effective breeding of animals. On the other hand however, there are many neglected grasslands that have not been mown for several years. These deserted growths suffer from the gradual introduction of weeds and later even woody species; saving them for future use would demand much effort.

T surplus of forage due to a decrease in number of ruminants, but there are great regional and annual differences.

Depending on the land-use approach of the owner, pasturing systems that allow high intensity forage and pasturable nutrition production are used. These requirements are best met by the system of enclosure pasture and dose pasture. The total area of pasture depends on the size of the herd and its total consumption, on yield and quality of pasture growth, on duration of pasturing period and on distribution of growing of forage throughout this period.

When calculating the areas needed for forage, losses must not be neglected, such as trodding, staining or unfinishing of particular forage. These losses are called unfinished forage.

Size of such losses is determined by the system of pasture, by the quality of the pasture growth, level of grazing machinery and age of the animals. The total losses increase due to a higher movement rate of younger animals. These also do not finish the grazing growth as well as the older animals. Table 20 shows range of losses in different pasturing systems.

Grazing has almost disappeared in the second half of 20th century

Table 20: Losses with different pasture systems

Pasture system (forage)	% of loss
Section pasture	40–60
Enclosure pasture	20–30
Doze pasture	15–20
Belt pasture	10–15
Stable feeding	5–10

The length of pasture period is related to the length of vegetation period. It begins at the point when the earliest grasses reach the pasture size.

The end is the same as the end of vegetation period. The average length of pasture periods in different production areas is given in the table 21.

Table 21: Average length of grazing period in various production areas in days

Production area	No of days
Maize and rootbeat (irrigated)	175
Maize and rootbeat	165
Potatoes, lower elevations	165
Potatoes, higher elevations	150
Mountainous	120
Alpine	80

The yield of pasture forage can be ensured by the mowing and balancing of representative plots of growth. Roughly it can be deducted from yield of harvesting. Pastures can be divided as follows based on yield of fresh green forage:

1. extensive	up to 15 t . ha^{-1}
2. low intensity	15 – 20 t . ha^{-1}
3. medium intensity	25 – 35 t . ha^{-1}
4. highly intensive	over 40 t . ha^{-1}

GRAZING ECONOMY

An experiment carried out under Czech Republic conditions dealt with the economic evaluation of cattle grazing (cattle is the most frequently bred species of domestic animals in Central Europe). The costs on the pasture area operation were expressed in Czech crowns (CZK) per one ha of the pasture. Direct material expenses such as field seeds, fertilizers and plant protection products were not included in the calculation as the experiment was performed on permanent pastures. They were not established just for this experiment and neither fertilizing nor protective spraying were carried out. The other expenses and services are given in the table:

Costs related to the pasture management

Indicator	CZK/ha
Labor and personal expenses – direct	61
Labor and personal expenses – auxiliary activities and overhead	483
Depreciations of fixed assets (direct)	92
Costs on auxiliary activities (mechanization)	373
The other direct costs and services	47
Total costs	1056

Yields – the yield of the dry matter from the pasture areas in the form of harvested green forage of hay was low as just the surplus of unstripped forage was gathered. The average dry matter yield was 2.5 t/ha. The pasture yield can be, however, expressed using average increase in weight of heifers in kg per one ha and by its subsequent assessment. The total heifer increase for a grazing cycle was 403 kg/ha in case on intensive grazing, the extensive method brought 269 kg/ha. Then, for the next evaluation, a usual price of beef in the Czech Republic in the period of the experiment, i.e. 28 CZK for one kg of heifer increase will be used. The result in case of intensive grazing will thus be 11,284 CZK and using the extensive method will be 7,532 CZK/ha. Prices for selling hay are not calculated as it was not produced and, on the contrary, it had to be bought in winter.
The difference between income and costs shows profit in both kinds of grazing (intensive and extensive). In the former case it was 10,228 CZK and in the latter 6,476 CZK per one ha. We must say, however, that the actual profit was obviously lower as not all expenses were included in the calculation. Such not included costs were, however, in both kinds of grazing almost the same. This means that the above economic assessment gives sufficiently accurate results for the purpose of the comparison. Pasture yields converted to growths of live weight of heifers were approximately 1.5 times higher in case of intensive grazing than those from the extensive one.
Just for information, total average production of agricultural holdings owned by physical persons in the Czech Republic in 2001 is given here. The values were determined keeping with standard EU methods. Plant production in the mountain regions and foothills was 5,334 CZK/ha and in the other not so favorable regions 12,832 CZK/ha. Livestock production in the mountain regions and foothills was 7,011 CZK/ha and in the other not so favorable regions 7,163 CZK/ha. The results of the experiment evaluating production of different kinds of grazing (cattle) range around average values achieved in the Czech Republic in the given period.

BREEDING AND GRAZING BY DOMESTIC ANIMALS

The grazing is the most important animal "task" with regard to the dynamic of their overall circadian activity. Feeding strategy is notably different among various species of herbivores. The physiology of animals and also their ethology is coherent with their feeding strategy. Some species have many short periods of grazing (eg roe deer), and other have longer periods of grazing and also ruminate for a longer time (red deer). One could say that all species among free living ruminates are important and dedicated „landscape engineers". For example in Central Europe there are common ungulates heving potential to change conversely trend of succession – from final forest seral stage to the steppe biotope stage. Grazing activity of animals is therefore agent which increase plant biodiversity (meadow is more diverse than forest biotope) and so increasing as well wider biodiversity of landscape.

Cattle, pigs and poultry – overview of selected figures

The average number of dairy cows continued to decline in 2001 with a slightly lower milk production. At the same time, the average annual dairy yield per cow grew by more than 6% compared with previous year. A total of 1 582 300 head of cattle were registered in the Czech Republic in 2001, which is an increase by 0.6% relative to the previous year. Pig numbers declined by about 5% since 2000 and the overall production of pig meat stagnated at 584 000 t of live weight. Poultry numbers experienced a year-on-year increase by 4.1% reaching a total of 28.9 million head.

Table 22: Domestic animals – decade 1996-2005

Indicator	1989 (000' head = 100 %)	1996 (%)	2000 (%)	2001 (%)	2003 (%)	2005 (%)
Total cattle	3 481	57.14	45.22	45.45	42.34	40.15
of which – cows	1 248	60.18	48.96	48.96	47.32	45.99
Total pigs	4 685	85.72	76.71	74.06	71.77	66.40
of which – sows	312.0	101.92	93.91	92.31	90.50	74.42
Total poultry	32 479	85.82	98.66	88.87	82.74	78.12
of which – hens	15 699	76.63	74.38	44.58	44.87	37.84
– geese	180.0	87.78	70.56	16.11	-	-
– ducks	192.0	213.02	234.90	150.52	-	-
– turkey hens	731.0	94.66	98.91	109.44	-	-

Source: www.czso.cz

Table 23: Number of ruminants and horses in CR in selected years and loading of agricultural land and permanent grassland

Year	1935	1956	1970	1980	1990	1997	1999	2002
Livestock – total	3.105	2.856	2.958	3.499	3.360	1.701	1.574	1474
of it cows	1.852	1.454	1.303	1.323	1.195	647	615	590
Annual efficiency dairy cattle (l)	N/A.	1781.6	2487.9	3089	3949.3	4366.2	5021.7	
Sheep	40	413	283	308	430	86	84	103
Goats	847	337	198	N/A.	42	35	32	13
Horses	402	337	66	24	25	21	24	20
Number of ruminants and horses (LU/100) ha	N/A.	79.3	71.7	67.9	68.2	34.3	32	

CATTLE

Breeding

Cattle breeding represents one of the most important sectors of livestock production. The production of milk is, thanks to its nutritious value, an irreplaceable food source, especially for young growing organisms. Another important outcome of cattle breeding is the meat. This product has to be understood within the whole range, including the dietary veal. Non-productive functions of breeding cattle cannot be neglected either, such as keeping and improving of soil quality or the role it plays within the landscape and the aesthetic function. These last two functions mutually influence the functions of the landscape as the opposite to anthropogenic activities of the man in the landscape. A cattle breeding is connected with tending of the land. The production of food for cattle is in the hands of the breeder. Only under such circumstances can we speak of economic implementing of minimal expense breeding, where the feed cost represents, according to technologies used, from 40-60% of total cost.

Cattle at the pastureland

Cattle breeding has to be considered important these days and it has to be approached with adequate care. The needs of cattle breeding have to be evaluated from two sides. First, there are the intensive breeds, usually with a higher concentration of animals. These breeds are generally productive and their main focus is profit and revenue of the produced products. The non-production functions are less visible in this example, as the animals are usually kept in the enclosed area of the stables and the possibility of freer movement in the landscape is fairly rare.

On the other hand, there are breeds with lesser numbers of animals. These breeds are semi intensive or extensive, and the production itself is more limited and often it is only auxiliary aimed to improve some other activity of the breeder. The products are used more or less for the personal use of the farmer and they help improve the main activity. Such breeds possess significant non-productive function. This originates from the endeavour to make the best possible economic use of feed base. A typically seasonal feeding is used in these cases with focus on the maximum use of pasture.

During the summer feeding period (from mid-May to October), pasture is utilized to the maximum capacity. Pasture is the most economic item of the cost of the breed. Harvesting technology costs and actual feeding application costs disappear. Large costs decrease significantly, too. Such breeds are related to all the non-productive functions of the cattle breeding. There is also a possibility to connect the breeding with the farmer's other activities, such as agro-tourism. Prerequisites for the use of the production are created due to the production itself, as are those for the use of the surrounding environment, and possibilities of recreational activities are created. At the same time such organization activity helps eliminate almost all negative anthropogenic influences on the landscape.

Heifers can be fed by all kinds of feed used for feeding of milkers. The base of the dose is bulky feeds. Bulky feed shall account for 70-100% of the total dry mass of the dose. It depends especially on the quality of bulky feed. With growing age and the state of pregnancy, the part of bulky feeds gradually diminishes. From this point of view and taking into account the body development of the heifers, the pasture breeding of heifers seems ideal. The daily consumption of feed depending on the weight of the heifers ranges between 10 to 25 kg of feed. As an addition 1.5 kg of hay and 0.75 kg of grain feed shall be supplied. In winter silage or fodder root plants replace the pasture.

Table 24: Use of grasslands

Grasslands	Use number of mows and grazing cycles
Absolutely extensive	1 mow (+ grazing)
Non-cultivated, non fertilized	1 – 2 mows (1 mow + grazing)
Semi-cultivated, little fertilized	2 mows (+ grazing)
Cultivated, little fertilized	3 – 4 mows (+ grazing)
Temporary strewn, intensely fertilized	4 – 5 grazing cycles
Cultivated pasture depending on fertilizing	Permanent grazing of meat producing cattle

Table 25: Average daily consumption of grazing forage, dry mass 20 – 22% with cattle

Cattle category	Daily consumption in kg / head
Young cattle 6 – 12 months	20–25
Young cattle 13 – 18 months	30–40
Pregnant heifer over 19 months of pregnancy	40–60
Milker 550 – 600 kg of life weight., 10 – 15 kg of milk / day	50–70

Heifers are bred in free stables, and thus associating of groups of animals of the same age and weight is advisable. Such a setup prevents fighting for food. Groups are advisable to be kept even for pasture grazing. Each heifer shall have 0.2–0.3 ha of pasture, depending on its quality.

Grazing

Cattle tear forage using the tongues and lips, they do not graze selectively, but they avoid wet and urinated and befouled areas with excess of nutrients. The height of grazed growth depends on growth quality and on the offer of forage, but it is never lower than 3–5 cm. Cattle do not graze significantly selectively as, for example, sheep. On sloping pastures, heavier animals can cause damage to the turf and water erosion. Turf damage can be prevented by using smaller herds (up to 50 heads). Milkers have to be grazing in the vicinity of a milking facility, up to 1 km away. This provides for maximum concentration of 300 heads in a herd. Quality and production of forage has to be high. The most suitable pastures are intense, temporary and regularly refreshed.

The daily consumption of cattle providing sufficient amounts of good quality forage, if available, is, on average, 13 kg of dry mass, i.e. 2.5 % of life weight per head. Taking into account the average contents of dry mass in grazing forage, the dose represents 60 kg of fresh forage, i.e. 12 % of life weight per head a day. The actual forage consumption of cattle depends on its digestibility.

The more digestible the forage is and the less fibers it contains, the faster its passage through the digestive tract of an animal. The tract rids faster of indigestible remnants and the animal is able to accept more forage, digestible nutrients and thus increase its production effectivity. Poor taste of the forage caused by deteriorated plant composition (higher proportion of weeds), incorrect unbalanced fertilizing by N and K, and unsuitable fertilizing with farm fertilizers causes a decrease in forage consumption.

Maximum forage acceptance and maximum effectivity can be reached through rotation grazing, provided the height of the growth after grazing is

White clover (Trifolium repens)

100 mm. With continual grazing, heights of 70-120 mm are suggested. The most suitable time for the initiation of grazing is usually when the yield of grazing forage is around 5 t/ha. The given yield corresponds to a grazing growth height between 100 and 150 mm.
It is important to increase the continuity of the growing of forage throughout the grazing period in order to meet requirements of fluent grazing. More balanced growth of forage can be achieved through differentiated fertilizing, partial application of N, irrigation and by establishing growths of different growth rhythms.

A clover often found on cattle pastures is white clover *(Trifolium repens)*. It is the most important clover in the temperate zone all over the world. It is found on pastures and often also on mowed growths, where it has sufficient light in the lower tiers (for example even in lawns). It reproduces generatively (through seeds) and vegetatively through prolonging and rooting of stolons. Its perenniality is given by the use of the growths (intensity), i.e. it is much more perennial on the pastures than on the mowed areas. There are three forms of the clover:

1. forest (silvestre) – it has large leaves and forage yields and in comparison with others it provides a higher yield of seeds. It is suitable for intense sheep breeding and for non-farming use.
2. intermediate (hollandicum) – most common, medium growth (20-30 cm), suitable for cattle pasture
3. Ladino (giganteum) –this is most often grown on arable land; it provides high yields and it develops large leaves, but it does not tolerate grazing very well and its perenniality is limited.

Transitional forms exist, too. They can spontaneously show up on the pastures even in cases when it has not been seeded. It does not have to be sown again.
Due to the fact that the harvested forage of the white clover only contains leaves and blossoms, but the ground stalk (stolon) stays on the surface of the soil, the quality of forage is higher than with red clover and alfalfa (most fiber and ballast substances are contained in the stalk). However, forage yield is, due to that fact, significantly lesser than with the two mentioned plants. White clover unfortunately can represent some risks to the grazing animals. Its proportion should not exceed 40% of the overall plant composition. As with higher participation, the risk of tympany symptoms (swelling out) and poisoning by cyanogenic glycoside exist. With intense grazing, lower nitrogen fertilizing and dryer climates, this situation can hardly be achieved and in autumn some years pastures tend to be pure growths of white clover. It easily spreads over grazed plots through zoochory, when seeds pass through the digestive tract of the animals.
An example of an intense temporary grazing mix (for 3-4 years) is the following: semi-annual red cover 4 kg, white clover 2 kg, perennial ryegrass (2n) 10 kg, perennial ryegrass (4n) 10 kg, *MRH loloid* 10 kg (interspecific hybrids type *Bečva + Perun*).

HORSE

Breeding

Since the time of domestication (approx. 4000 BC), the horse has been a useful and indispensable animal for mankind. First it was used for pulling. Later it was used for riding and carrying material. The focus on horse use was always in work, which differentiated horses significantly

Horses at the pastureland

from other domesticated animals. Horses have had a wide range of uses, from war use, through transportation use, to the use as a physical power for farming. As technology developed however, the use of horses has declined and the main focus shifted to sports and culture (horse chasing, racing, tourism, recreation, hobbies etc.). Horses are still used as a pulling power in forestry and in farming for production of materials (milk, meat, hides, horse hair, furs, hooves, blood serum and inoculation substances for veterinary and human use and for manure).
Nowadays horse breeding has undergone many changes caused by both problems in agriculture and by economic difficulties of many subjects who breed horses.
The lessening economic importance of horses has caused a shift towards the breeding of sport and racehorses in compliance with European trends.
Horses are uniparous animals. Mares give birth to a single foul on average after 335 days of pregnancy. An average number of births per a single mare are 6-12; an exceptional mare can stand up to 20 pregnancies. The rutting cycle repeats in 21-29 day cycles and it lasts for 3-9 days. The mare is stud by a stallion several times during the rutting period (Once a day for 2-3 consecutive days at the peak of rut). Besides natural studding, which dominates, the mare can be inseminated by fresh or frozen sperms. The only exception is breeding the Thoroughblood, where insemination is forbidden worldwide.

The basic prerequisite of successful foal breeding is the combination of free stabling with sufficient movement and pasture time. Breeding consists of three parts: the sucking period from birth until weaning, the weaning itself and the period from weaning until introduction of actual training.
A mare milks 15-20 liters of milk a day, a total of 1 800–2 000 l of milk during the period of 6 months. At the age of 14 days, foals can be introduced to grain feeds. They are gradually accustomed to hay. Foals are weaned at the age of 6 months. The condition for weaning is the acceptance of grain feed at the rate of 3-5 kg per day.
The main foodstuffs for horses are meadow hay, quality pasture growths, and grain feed represented by freshly pressed oats. Lately special feeding mixes have been introduced. Of the root plants these contain fodder rape and carrots. It is necessary to provide a sufficient amount of water. That consists of 20-40 liters per day, and during the summer period even more. The actual amount and consistence of feeding depends on the type of horses, their weight and their work use. It is crucial to decrease feeding doses of grain feed in the period of lower work involvement or lesser movement. An average yearly consumption of feed per horse that weighs 500–600 kg is 1.1 tons of hay + 1.1 tons of oats + 6.3 tons of pasture.
In connection with letting farmland sit, the new possibilities for development of pasture and grazing arise. Grazing of domesticated animals is one of the oldest farming methods of the mankind. Grazing is closely related to breeding.
Pasture for horses is highly recommended not only from the economical point of view (saving the cost for feed, caring for feed etc.), but also for health reasons, and for tending to the cultural landscape.
Foal grazing and horse pasture in general is one of the first conditions of breeding that respect the requirements of so-called "welfare" of the breed. One of the basic attributes of a horse is movement, which is allowed on a pasture. The foals become strong thanks to movement during pasture; their skeleton strengthens and their muscles develop better. Their immune system strengthens, too. From the breeder's point of view, horses bred in groups on a pasture are mentally and physically stronger and fitter for use.

Grazing

Horses graze the growth very low, similar to sheep, but they are extremely selective (they avoid "greasy" areas) and leave behind an isle structure of growth. Due to great weight and to wide movement activities, the pastures are often damaged. Horses deposit excrements in a particular area of the pasture where they do not graze and it leads to creation of ruderal communities.
Horses can be foraged in two basic principal manners. It occurs extensively in open pastures with thinner growths in sub-mountainous (less favorable) areas. The use of grass growth is low though, at less than 50%. Foraging also occurs intensely on fenced cultivated pastures. In this way pastures are better used. It follows pasture pattern and the pasture is better and more intensely tended. By setting up individual enclosures, foals can be

gradually presented sufficient amounts of fresh green forage. The enclosures with later pasture can be mowed and dried. The best time for forage is the period before the spunning of grasses.
The need of forage area depends on the age of horses foraged. A freshly weaned foal starts at 0.17 ha/ind. (6 ind./ha). Yearlings require 3 ind./ha (0.33 ha/ind) and for forage of 2-3 year-old horses require 0.50 ha/ind. (2 ind./ha).

Perennial rye-grass (Lolium perenne)

Mares with foals are always foraged on pastures close to stables, so that they would be able to retreat to stables in case it became necessary.
Pasture has to be tended with adequate machinery. And it needs to be fertilized and mowed. Hardening and leveling of the surface of the pasture is crucial. It has to be done in the spring using a heavy drum full of water. According to the condition of the pasture, this can be repeated more times throughout the year, every time the soil is sufficiently moist. Non-grazed areas have to be minded and mown in time, otherwise there is a risk of quick change in botanical setup and the quality of growth deteriorates. The pastures must not be grazed bare in the autumn and the growth shall be 8-10 cm tall before the winter sets in. This ensures faster regeneration in the spring and more outcomes.
Foals and adult horses shall be protected against parasites by regular deworming treatment.
The forage growth for horses should be diverse; the more components, the better. The growth shall consist of 70-80% of short grasses, 20-25% of perennial clovers and 5% of aromatic herbs is also recommended.

Fencing of the pastures is usually wooden or metal, but it is unfortunately quite expensive. Electric fencing is also suitable. It can be used either for fencing of the whole pasture or for fencing off segments of the pasture. Electric fencing has to be used with electric tape 2-4 cm wide. The cables used for cattle pasture are dangerous for horses as they barely see it and it could hurt them if they tried to escape from the pasture. Horses and especially foals have to be trained to mind the electric fence.

A very valuable plant on the pastures for horses is perennial ryegrass *(Lolium perenne)*. It is a basic forage grass for humid areas near the sea in Western Europe. It provides a high production of tasty digestible forage high in sugars. It is suitable for pastures (especially diploid types) and even for ensilaging. The seeding is cheap and easy to get. In natural environments it indicates solid soils *(animal paths)*. In higher altitudes it suffers from pink snow mold, which causes mass disappearance of the plants in the beginning of spring.

This type of grass requires nitrogen fertilizing and sufficient equally distributed rainfall. In times of droughts it shoots only a few leaves, it drops seeds quickly and it suffers from fungi. Such forage has lowered feeding value and the animals refuse to accept it. Due to high sugar content the forage is hard to dry for hay, because it is hygroscopic (draws humidity from air) and it increases the risk of self-heating.

Table 26: Composition of forage mixes for horses

Plants in the mix	Moist	to	drier area
	Participation of plants in the mix in kg		
Perennial ryegrass	12	10	4
Meadow timothy	7	6	5
Meadow fescue	5	7	15
Red fescue	2	4	5
Kentucky bluegrass	5	5	6
White clover	2	2	2
Scorpion weed	-	-	1
Seeding in kg . ha-1	33	34	38

Table 27: Composition of pasture mixtures for use for 4-6 years

Plants in the mix	Intermedial use for 4–6 years, Participation of plants in the mix				
Perennial ryegrass					
– early	-	18	-	-	-
– medium	30	12	24	16	9
– late	-	-	6	8	9
Meadow timothy	-	-	-	6	6
Orchardgrass	-	-	-	-	6
White clover	2	2	2	2	2
Seeding in kg . ha-1	32	32	32	32	32

Table 28: Composition of pasture mixtures for use for 8 years or more

Plants in the mix	Long term use for 8 or more years, Participation of plants in the mix				
Perennial ryegrass					
– medium	-	6	24	18	-
– (or late)	30	18	(24)	(18)	14
Meadow timothy	-	6	6	6	6
Orchardgrass	-	-	-	8	-
Red fescue	-	-	-	-	12
White clover	3	3	3	3	3
Seeding in kg . ha-1	33	33	33	35	35

SHEEP

Breeding

Sheep belong among the oldest domesticated animals. This breed was domesticated 8 to 10 thousand years ago and hence it numbers amongst

Sheep at the pastureland

one of the most modest domesticated animal species. Sheep are mainly pasture-grazing animals that are able to make use of remote and barely usable pastures and areas of little or no use. The main advantage of sheep breeding is use of pastures for production of quality products both for direct human use and for technical use.
The products of sheep breeding are wool, meat, milk, hides and furs. The meat is very nutritious and easily digestible. Lamb meat is considered dietary. Sheep milk is more valuable than cow milk. Cheese can be made from it. Sheep bowels are used in sausage production. Wool fat is used to produce lanolin, which is further processed for cosmetic and pharmaceutical industries and for medical purposes.
The basic attribute of sheep is the production of wool. The amount of wool production is expressed in so called clip (amount of wool in kg per year). The clip varies from 3-0 kg.
Milk production is strongly influenced by breed and feed. Sheep in the III and IV lactation cycles provide the highest production of milk. After giving birth the milk production increases up until around the 5th–6th week; it stays on the same level until the 12th week and then it slowly decreases.
Sheep mature at the age of 6-10 months. Sheep and rams are used for breeding only at the age of 16-18 months (meat breeds earlier, at the age of 10-12 months). The sheep are used up to age 6-7 years. Rutting is seasonal and the most intense is in the beginning of Autumn. It lasts 18-48 hours and the cycle repeats in 18-21 days. Pregnancy lasts 146-156 days. Then comes the birth itself. After 2-3 hours the fetal covers come out. At standard conditions no assistance from the side of the farmer is needed. After treatment (sanitation of navel stub, drying the lamb dry) the lamb joins its mother. Lamb has to be provided with sufficient amount of colostrum as soon as possible. It contains protecting substances. Lambs are weaned at the age of 3 months (traditional weaning), but early weaning can be as well applied at the age of 40-50 days. Fertility breeds is 150 %. Breeds reach 200% fertility.
The basic fodder for most of the year represents pasture dosed at 7-8 kg per ewe a day. In winter

basic forage is represented by meadow alfalfa hay at 1.5–2 kg per ewe and day. Additional forage is rye or oats straw dosed at 0.5 kg per head a day. Fodder rape is dosed at 2-3 kg per head a day. Grain pollard is used as grain feed. The daily dose is usually between 0.15–0.5 kg per head a day depending on the efficiency. Then mineral feeds, salt lick, and mineral licks are presented. An adult sheep consumes daily 3-6 litres of water, in summer more, set at a temperature between 10–15 °C.

The winter period lasts on average 165 days. One ewe with lambs consumes 150–200 kg of hay, 120 kg fodder straw, 350 kg root plants and 12 kg of grain feeds.

Newborn lambs can only accept their mother's milk. As of the 2nd week quality hay and grain feed can be presented to them. The most suitable grain feeds are complete fodder mixes for early weaning of lambs - ČOJ 1 and ČOJ 2 (specific feeding mixtures for weaned lambs). Animals are presented to quality hay and they must have access to usable water. One lamb will from birth until weaning consume approximately:

- 26 kg hay
- 22 kg grain feed
- 13 kg root plants
- 21 kg straw for bedding

When the lambs are fed early their first stomach develops earlier and it starts to work earlier too. The lamb's ratio of third and forth stomach after birth lies at 1:2 and the reversed ratio has to be achieved by the end of weaning to allow intake of nutrients from volume forages.

Sheep are driven into the coop in order to become accustomed to movements during pasture. In fair conditions partial pasture is possible at the end of April or at the beginning of May. The transition to green pasture must be gradual. Hay is placed onto the feed rack in the morning; the sheep are allowed to graze in the afternoon and in the evening more hay is placed on the feeding rack. During hot sunny days sheep are put to pasture in the morning and in the late afternoon. Optimum height of pasture growth is up to 10 cm. Average mountain pastures can feed 5-10 sheep per hectare. Sheep have to be supplied with sufficient water and they have to be able to approach licking stations even during pasture. In the spring and in the autumn the sheep need to get dewormed and free of external parasites. In autumn, the pasture period can be prolonged by grazing on land after harvest of main plants, in orchards and in gardens.

Semi intensive fattening takes place on quality pastures. The lambs are after weaning placed for the whole time on pastures with shelters. They are fed with unlimited hay and grain feed. After the pasturing period is over, the lambs weight 30-40 kg. This type of fattening is suitable for breeds of lesser concentration or in case enclosure pasture is practiced. Sometimes such fattening can be finalized by intense fattening in stables, where hay and grain feed is fed.

Fattening of adult animals is very rare and it mostly occurs at the end of pasture period. Animals are fattened by hay and grain feed. The aim of the fattening is to improve the slaughtering values and quality of meat of the animals. Fattening must not lead to unnecessary fattening of the animals.

Sheep do not require a high standard of stabling, but they require a dry environment without draft. Optimum temperature should be 8-12 °C, 60–70% humidity. The most suitable type of stable is a simple well-insulated building, without heating. The only sources of necessary heat include the heat emitted by animals themselves and the heat emitted by deep bedding. Free stabling on deep bedding is practical and most suitable for sheep. Feeding racks used for hay and gutters are used for grain feed and root plants. Interior conveniences also imply gutters for water and there should be some folds too.

Grazing

Sheep are typical grazing herd animals. They graze significantly more selectively than cattle. They put priority to lower tiers of the growths and avoid seeded grasses. Still they graze even on stained ("greasy") areas and they feed on woody vegetation just like goats do (liquidation of self seeded trees, damaging of trees in orchards and auxiliary wood species on pastures). They leave behind a very low growth (approx. 1 cm). The hoof pressure on soil is three times lesser than one of cattle (lower weight), they give priority to higher elevation areas within the pasture compound. In comparison with cattle, the grazing period can be longer by 30-60 days (begin earlier in the spring and finish later in the autumn).

One of the sheep significant grazing forage is Smooth meadow-grass *(Poa pratensis)*. This is an

Smooth meadow-grass (Poa pratensis)

important sprouting grass for grazing purposes. It creates a lower tier in perennial grass growths and it is necessary at the time of establishment of pastures. Animals accept it well. It forms firm turf on the pastures and if fills bare spaces through root shooting.

One of the disadvantages is its high price and insufficient supply of seeds. Another disadvantage is slow initial growth, which disadvantage it in the plant mixes. It often requires four weeks to shoot, but the perennial ryegrass has had several leaves developed by then. In order to preserve and sustain it in the newly established growths, harvesting has to be done at low heights in order to prevent "suffocation" of ryegrass in dense and tall growth. Once developed, the plants become very resistant and can survive even lack of nitrogen. Still they develop best with intense fertilizing. A partial disadvantage is its sensitivity to leaf rusting during the autumn period.

Constitution of pasture mix for sheep

Table 29: Constitution of permanent universal mix for higher and alpine areas for combined use – pasture after first harvest

Plants of the mix	Up to 1 000 m	Over 1 000 m
	Partition of plants in mix in kg	
Meadow timothy	3	4
Meadow fescue	7	4
Perennial ryegrass	2	3
Red fescue	12	20
Tall oatgrass	8	-
Smooth meadow-grass	3	3
Fowl bluegrass	2	3
Yellow oatgrass	4	8
White clover	1	1
Alsike clover	1	1
Scorpion weed	2	2
Seeding in kg.ha-1	45	50

Table 30: Constitution of pasture mix for sheep

Plants of the mix	Wetter	through	dryer area
	Partition of plants in mix in kg		
Perennial ryegrass	4		6
Meadow timothy	2		5
Meadow fescue	10		5
Red fescue	5		1
Tall fescue	7		-
Kentucky bluegrass	6		6
Yellow oatgrass	1		5
White clover	1		2
Scorpion weed	1		1
Seeding in kg.ha-1	39		40

GOAT

Breeding

Historically goat breeding has been very popular in Czech territory, especially with smaller farmers. Grassy growths that would otherwise not have been used were used. Still in 1945 there were 1.5 million goats bred in Czechoslovakia. A steep decline followed and nowadays there are only 30 000 goats bred in the Czech Republic.

Bezoar goat (Capra aegagrus) is the ancestor of majority of domestic goat runts

The goat is a modest grazing unpretentious farm animal, which reacts well to care and adequate breeding conditions. Goats are generally effective. They provide milk, meat, hides, fur and quality manure.

The main goat product is milk, which, as it was discovered lately, contains a variety of biologically valuable substances. The meat of kids is very tasty and of high quality. The hides are used for manufacturing of gloves, handbags, shoes and suede.

Bucks of sturdy constitution, harmonic body structure and of good health condition are chosen for breeding. Nanny goats mature at the age of 8–10 months. They are studded for the first time at the age of 1–1.5 years. Studding begins in September and October in order to have the kids born in March. Young goats join the herd at the age of 1–1.5 years. The studding rate for one buck is 80 goats. Goat rutting is seasonal; it appears regularly in autumn and it lasts for two days. If the goat doesn't get pregnant, rutting repeats in 2-3 week cycles. Goat pregnancy lasts for 145–155 days. Pregnant goats have to be paid special attention, especially as far as feeding, stabling hygiene and care are concerned. Cotes have to be of sufficient space to allow them free movement. Goats need sufficient movement in a range.

Birth usually takes between 1 and 3 hours and it is fairly hard (kids are born big). The process of giving birth has to be observed by the breeder. A goat gives birth to 2-3 kids. Life weight of a kid after birth is 3.5–4 kg, and the weight of twins 6–6.5 kg. After 2-3 hours the fetal covers come out. After providing necessary care to goat and the newborn kids, the cote has to be cleaned and sanitized. Kids are weaned at the age of 120–180 days. At that time the kids must be able to accept plant feed. The goat can start milking after weaning. The lactation period of goats is similar to that of cows. Milk production culminates at 1-2 months after birth and life weight of goats rapidly decreases after birth. The decrease culminates in the 6th week after birth. Feed acceptance increases slower than milk production and in the initial phases of lactation the nutrients intake can be insufficient and goats lose weight during this period. Increasing the proportion of concentrated feeds increases the dietary state of the goats.

A goat's fertility peaks at the age of 3 to 5 years. For breeding it is used until the age of 8 years. Bucks are used for breeding until the age of 6 years.

The feeding of goats is a decisive factor that influences production. Due to differences in anatomy of digestive tract, goats can accept greater volumes of feed rich in rough fibers and use these more effectively than cattle or sheep. Unlike other species goats prefer a wide spectrum of feeds, though on pasture they are more selective. Goats are very sensitive to the quality of the offered feeds. In intense breeding dietary control is necessary. A feeding dose is to:

- Meet requirements of animals in order to achieve maximum production
- Be constant and allow the same and balanced quality of produced milk throughout the year.

Goat feeding in all phases of production is subject to a very detailed system of standards of meeting the needs of nutrients and energy. Approximate annual total consumption of feeds for an average goat (50 kg) is 680 kg of dry mass, i.e. approx. 1 200 kg of green fodder and 500 kg of hay. This dose is enriched by grain part according to efficiency. (0.5–1.5 kg/head a day). The following feeds are usually combined:

- Summer dose (180 days) – green forage 7–9 kg per head a day + 0,5 kg of hay and the dose is enriched by grain part according to efficiency 0,5–1,5 kg
- Winter dose combination of hay 1.5–2 kg, fodder beet 2–3 kg and grains or hay, maize silage 1 – 2 kg and grains, or hay, haylage 2–3 kg and grains.

Mineral additives can accompany feeding doses.

Goats have to be allowed a constant approach to water. The temperature of the water should be 8–15 0C. The most natural way of drinking for goats is drinking from the water surface, thus watering gutters are at 80 cm of height.

The development of goat farm breeding proceeds in two ways. The first one is the set up of year-round stabled herds of great magnitude, which are fed on the basis of permanent feed dose. The main product is milk, which is, depending on local conditions, either sold to the diary or processed on the spot. The technologies and controls of such breed are technically identical to those of milking cows.

Another possibility is a system that takes into account the local conditions (use of interesting goat products, attractiveness of the animals for tourists on agro-touristic farms, use of land that is not suitable for any other farming use etc.). Such enterprises are characterized by the maximum use of pasture, lesser numbers of animals in the herd and almost exclusively by self processing of production (meat, sausages, leather and fur products). Thus both milking and meat breeds can be used in such breeding operations. Milking is slightly obscured by the need to drive the animals into a milking facility, or by the setting up of movable or temporary pasture milking facilities. Thus a compromising solution is possible. This amounts to a system of generally mostly stabled herd combined with pastured kids and non-milking goats.

The system of breeding chosen should best reflect local conditions. These are options:

- Year-round pasture system
- Temporary pasture

Such a year-round pasture system includes setting up of a permanent pasture area with a shelter, which, after being insulated, can provide a temporary stable in winter. Such a system is only convenient for meat and furry breeds, because the construction of a pasture milking facility and assurance of quality water sources are usually very demanding.

Temporary pasture (150–180 days) is very suitable, but a limiting factor for some goats is the distance from the milking facility. Climatic conditions have to be considered at the time of pasture. Goats are vulnerable in cold conditions and thus shelters are needed. Another necessary investment is the fencing around the perimeter of the whole pasture area. For fencing off 10 hectares of land, depending on the shape, 1 250–1 450 m of fence is needed. The advantage of pasture is decreased feed costs and better health conditions. An enclosed pasture system and dosing pasture are suggested.

Year-round stable breeding allows the use of controlled diet and feed intake control and ensures more or less constant conditions for breeding. Some breeds can combine year-round stabled milking goats and pasture breeding of kids and non-milking animals.

The successful breeding of goats is fully dependent on finalizing and assuring markets. Based on the market knowledge, possibilities of successful marketing can be deducted and the rate of valorization can be predicted. Marketing possibilities are basic prerequisites for setting up structure and volume of production and consequent size of the herd, needs of stable capacities, feeding, workforce and technologies.

Grazing

Goats, unlike sheep, graze the growth higher above the ground; they do not avoid grasses that

Yellow oat-grass (Trisetum flavescens)

have dropped seeds and they are good at the liquidation of self seeded trees. They can easily outrun regular fencing and once they break free, they are capable of causing severe damage to forest growth. (They nibble on coniferous and leafy trees, tops of stems, bark and young trees may perish.)

Timothy (Phleum pratense)

Goat pastures are rich in timothy *(Phleum pratense)*. It is a high grass suitable especially for colder and wetter areas, on heavy and peat soils. It is popular in Scandinavia and Scotland. It is a late grass as far as seed dropping is concerned. From the point of view of forage growth it is considered an early grass. Timothy is capable of providing high yields of forage already in first year after seeding, especially providing it is harvested one mow later. In order to achieve high quality forage, timothy has to be harvested about 10 days prior to dropping seeds. Limited perenniallity is a disadvantage of timothy; after three years it perishes from growths, just like meadow fescue.

Timothy seeds are fairly cheap, easy to get and easy to strew. It has a harmonized cycle with red clover and it used to be a basic grass for short term clover-grass mixes on arable land.

Yellow oatgrass *(Trisetum flavescens)* is another significant grazing grass. It is a typical grass of perennial grass growths. It is abundant especially on mountain meadows and pastures, where it, due to its tolerance, dominates. It drops seeds in subsequent mows and animals are happy to accept it. The seeds are extremely hard to strew (sticky consistency) and brush strewing machinery has to be used for its intense seeding of their mix. In the Alps area there is a disease called calcinosis and yellow oatgrass is an agent that causes it. It contains a substance there that causes hypervitaminosis D, which results in extensive depositing of calcium in the joints, veins and lungs. The animals walk stiffly and suffer from aches and need to be culled from the herd. No cases of calcinosis have been recorded in the Czech Republic, and grazing of yellow oatgrass has a positive effect on the health of the animals.

Permanent unfertilized pasture in the foothill area with diversified plant composition includes:

- Red clover (2n + 4n) 2 kg
- White clover 1 kg
- Scorpion weed 1 kg
- perennial Ryegrass(2n) 5 kg
- MRH festucoid 6 kg
- Meadow timothy 4 kg
- Red fescue sprout. 6 kg
- Yellow oatgrass 2 kg
- Kentucky bluegrass 4 kg
- Cocksfoot (late) 3 kg
- Annual ryegrass 5 kg (cover crop)

VIETNAMESE WARTY PIG

Breeding

Pig breeding plays a very important role in providing meat and meat products to the population. Pork represents one half of the meat consumed in the Czech Republic. It is a very valuable sort of meat and it is very popular. It is usable for both direct consumption and for production of other meat products. At the same time lard and speck remain an important part of the human diet.

Fattening abilities of Czech and European breeds are very good, but fattening is based on a daily dose consisting mainly of grain feed. In order to fatten one pig from 15 kg to 110 kg approximate amount of 280–300 kg of complete feeding mixes or 160–170 kg of additional feeding mixes and 600–700 kg of steamed potatoes or other voluminous feed is needed. These breeds are also very demanding for stabling.

Vietnamese warty pig in the egress

That is why an interest in breeding of Asian pigs has arisen. These are suitable for extensive breeding; they are modest in stabling and feed, they are very tolerant and can survive outdoor breeding from spring to autumn. It is important as well that these can make a good use of farm feeds, remnants of vegetables and pasture.

The Vietnamese warty pig belongs to the family of Asian pigs and is sometimes referred to as the Chinese pig. It belongs to a short-ear family of pigs that evolved from the wild Asian pig. These pigs are of smaller body stature with markedly bent hips, which cause a significant hanging of the belly, something well visible on breeding swines. A long cylindrical body is covered with black bristles, the head is short and strongly bowed, and the ears are straight and small. Legs are short, and stocky. The Vietnamese warty pig is an 'early' breed; fat starts to accumulate very early and older pigs have fat distributed even in the muscles.

There are 3 known versions of Vietnamese warty pigs. The original one grows to a weight of 60–80 kg, the other two to 150 kg.

This group of Asian breeds is further expanded by the Indochina pig, the Indian pig, the Siam pig and the Chinese dwarf pig.

Vietnamese warty pigs mature at the age of 4-7 months. They shall not be studded immediately. They should be used for breeding at a weight of 40-50 kg. Rutting lasts for 2-3 days and the cycle repeats every 18-21 days. Rutting is demonstrated by jumping on other pigs, reluctance to feed, and unrest. Rutting culminates on the second day, when the reflex of passivity develops – the sow stands motionlessly when a hand is pressed on her back. Studding takes place under supervision and takes 5-10 minutes.

Sow pregnancy lasts for an average of 115 days. Birth takes 2–4 hours and it is usually without complications. Piglets are treated immediately; they are dried and laid on dry straw. One litter gives usually 4-43 piglets of average weight of 450 g. At weaning time (two months of age) they weigh about 7.5 kg. Colostrum and mother milk are sufficient for suckling need for the duration of about 10 days. They are gradually getting accustomed to firm feed, which is connected with changes to their digestive tract and with microbial activity within the digestive tract.

Vietnamese warty pigs make a very good use of voluminous feeds and like grazing. That is why they can be pastured from spring to winter and only obtain minimum doses of grain feeds. Feeds must be suitable. They must be fresh, harmless, and well combined. It is a good idea to keep regular feeding times. Feed dose shall be enriched with minerals and vitamins. Drinking water has to be always available.

The base of feeding dose is pasture or green forage (alfalfa, clover) in the summer, and in winter fodder beet, sugar beet, steamed potatoes and quality hay. Of grain feeds pollard grains of mixed feeds are used (especially for breeding animals). Sows consume daily 1.20-1.60 kg of pasture, pregnant sows consume grain feed in amount of 0.2–0.3 kg, and milking sows 0.6–1.1 kg. Potatoes can be added to the dose (0.3–0.5 kg).

The fertility of sows depends greatly on diet. Insufficient proteins and their low biological value lead to serious fertility disorders. Animal feeds have a positive effect (milk), legumes and linen seeds. Of root plants these are carrots, fodder beet and semi sugar beet. Of grazing feeds these are cereals, complete feeding mix for saws (KA – Czech specific feeding mixture for stud saws). Additional vitamins and minerals are crucial too.

At first - piglets are fed by feeding mixes ČOS-Startér and ČOS 2 (complex feeding mixture for weaned piglets). They are fed dry up to the 8th week of age and it is not necessary to add anything to these. Breeding of piglets must not be mistaken for fattening. Weaning piglets are later fed as adult pigs.

The fattening of pigs is best done during the summer period, when pasture and green fodder can be used best. Pigs are fattened up to the slaughtering weight of 45 kg, which is normally reached in 6-6.5

months. Growing is most intense up to this weight and feed is most effectively transformed into meat mass. After the weight of 50 kg is reached, more fat is produced. Castration of saws is performed at the age of ten days. Sows and saws are fattened together and they are served feed twice a day. Only as much feed is served as can be eaten in 30 minutes. Grain feeds are suitable for feeding in the form of thick porridge. Sufficient amounts of drinking water have to be always available.
In winter pigs need adequately spacious and dry stabling. It is important for the floor to be made of firm waterproof material. Part of the floor should consist of planks. Temperature should drop below 100 C in winter. For 1 saw and sow 1.5 m^2 of floor space is needed; weaned piglets need 0.5 m^2 of floor space. The breeding stable shall have a permanent coop, where pigs can be let in even in wintertime. Feed is served in ceramic or wooden gutters. Water is also available from gutters.

Grazing

Pigs are omnivores and thus do not represent a typical herbivore grazing animal. However they are eager to accept green forage of many grazing mixes or monocultures, among which there is, for example, alfalfa.

Alfalfa *(Medicago sativa)* is not a typical plant of perennial grass growths. It originates in steppe areas of Middle East; it has high requirements for quality of soil (requires deep soils, best of all loess and calcium rich location), and warmer and dryer climates. Thus it is grown almost exclusively on arable land, when, in order to ensure better growth in time of summer droughts, it has lately been added even to clover-grass mixes. It is fairly easily dried for hay; it is hard to ensilage. Its perenniallity is supported by a prolonged interval after the last mow, when it should blossom and accumulate sufficient nutrients into the root system for winterizing.

Alfalfa (Medicago sativa)

Alfalfa can last, on good locations, for as long as six years, but it must not be damaged by harvesting machinery or rodents. It does not tolerate classic grazing and thus new hybrids are bred (crossbreds with Medicago falcata), which should be suitable for grazing use and should not have such high requirements for the quality of soil (higher participation of root system within the humus horizon, branching stem root).
Pigs are off course attracted by various grazing mixes, such as spring mix: oats, spring wheat, field pea, vetch, field bean and others (80-100 kg oats +60 kg of vetch, 100 kg oats + 80 kg of field pea).

CHICKEN

Breeding

Chickens represent the largest group of Galiformae fowls in breeding. Small farmers keep about 60% of the chickens. They are mostly self-supplying. Industrial breeding stations generally supply the consumer's market. Consumers prefer eggs from traditional range breeds. Such eggs are available but not to the extent that would satisfy the public demand, and their price is higher than that of standard industry produced eggs. Fattening of chicken broilers is also fairly perspective.
The base of the breed is the layers category. These produce both eggs for consumption and impregnated eggs for the hatching of chicks. The system of natural hatching has been used less and less with chicken and other poultry. Hens do not lay eggs during natural hatching (3 weeks) and chicks leading (6 weeks) and that means a loss of at least 35-40 eggs. This is why the industry shifted towards an artificial method of hatching.
Of course, at small breeding, where intensity is not the objective, the prerequisites for natural hatching under a hen have been preserved. Such hens must not have lost the sitting instinct, which is quite common with laying breeds. Fifteen to nineteen of impregnated eggs of the same size are placed under a hen. The nest for natural hatching should be prepared in a cold, well-ventilated place. The sitting hen has a higher temperature and she pulls her feathers from her belly and uses the feathers to cover the eggs when she leaves the nest. The nest temperature ranges is 35–39 °C. In the middle the temperature is higher. At least once a day the hen must leave the nest to get fed and to drink, and to empty herself. If more hens are sitting together, nests have to be separated in order to prevent fighting.

Traditional practice of hen keeping

Chicken hatch gradually and it is a good idea to take away the chicks from the hen and place them in a closed, well-ventilated box on a warm spot. They will go back under the hen after hatching is over. Chickens hatch after 21 days and hatching takes several hours, depending on egg quality and stocking.
Artificial hatcheries use only about 7% of the egg production, when the majority of eggs are consumed. The eggs of the best layers are used for hatching. Not all laid eggs from these breeds are used either. Only ones of high biological quality are used for hatching. Small eggs from hens that are beginning to lay big eggs are eliminated.
Hatcheries must assure ideal temperature, humidity and even ventilation. The setting compartment also requires turning of the eggs. Small incubators have the same space for all of the period of hatching. Bigger incubators have a setting compartment, where eggs lay for 18 days, and a hatching compartment, where the last phase of hatching takes place.
Before the setting of the eggs in the hatcheries a check is performed. The air bubble in the egg shows the length and quality of stocking the eggs. Eggs with fractured shells and damaged eggs are excluded. The next translumination control takes place on the 6th-7th day on white shell eggs and on the 8th-9th day on brown shell eggs. Clearly non-impregnated eggs and eggs with dead embryos are excluded. The clear non-impregnated egg ration is usually around 10% and 1-3% have a dead embryo.
The last translumination check is executed on day 18 during transfer within the hatchery. Unhealthy eggs and eggs with dead embryos are excluded. Flipping and leaning off eggs is finalized at the same time.
Chickens are taken out of the incubator only after they have dried properly. Hatching takes 21-22 days. Hatched chickens are checked and defected chickens with beak or leg shape disorders or with unclosed bellies are better immediately destroyed. For hatched chicks transport boxes with openings in the sides and covers are used.
Range bred chicken are bought in the spring. Their breeding in the spring and summer is very simple. The range provides them with sufficient natural feed and they are able to collect various insects, worms and so on. It would be wrong to stock the chicken up as soon as in January or as late as in May or June. Chicken become sexually mature after five months, sometime in September. If the breeding conditions are good and the condition of nourishment is proper, they lay for the duration of the whole year until next September. During their egg laying performance 180-250 eggs can be acquired. It depends on the level of breeding of the hens used. The chicken incorporated in the stock in January start to lie in June, but unfortunately start to shed feathers and stop laying. Chickens that are stocked up late during the hot summer drink more and accept less feed; they fall behind in growth and start lying later.
Besides the natural keeping of chicken, these can be stocked in tending facilities with air-conditioning. Optimum temperature and humidity varies according to age. With small numbers of chicken an electric bulb heating is sufficient; larger numbers require infrared lamps and ceramic radiators

of floor brooders. It is a good idea to have the electric devices adjustable.

Rearing of chicken requires space so as to have 6–8 pullets of lighter breeds or 4–6 pullets of heavier breeds per 1 m2 of floor area in the end of the breeding. Windows should be facing south and they should cover from 1/6 to 1/8 of the area of floor space.

Chickens are fed from various types of feeding devices. Gutters and founts shall be placed in the area in time of stocking. Feed has to be available to chicken any time that they start to feel hungry. It is important to situate the feeder so that the chicks could easily find it. As the chicks grow, they should be given bigger feeders. It is important for the chickens and later pullets to have enough space at the feeders. The first day the chicks can be presented millet, rough semolina, partial rice, barley, ground wheat or even ground bread. Starting of the second day the ready feeding mixes are more suitable. These are produced for chicken breeding. K1 is used until the age of 6 weeks; K2 from 7th to 10th and in the time of sexual maturity KZK mix is used. In the first two weeks the powder mix or ground granules shall be served; later granulated mix is served.

If range is available, it can be used up from the 6th week after birth, depending on outside temperature. Range keeping can also be applied. Pullets are placed in light portable cages. Hens have to be separated from the roosters, as roosters are more aggressive and stronger. As soon as they can be made out, they need to be separated to a separated breed.

The right choice of breed or hybrid breed needs to be made on the basis of space capacity. Lighter laying types of hens are more agile, and require larger range. But these are able to collect a significant portion of feed on the pasture. They can easily fly over 2 meters high fences, especially if the space of the range is limited. Smaller spaces are more suitable for calmer semi-heavy breeds, which do not fly so much. However, they consume more feed. Range breeding in the vicinity of forest, where there are many predators, is not suitable for white types of fowl, who are well visible and often fall prey to predators.

The second limitation is the possibilities of feeding the fowl. Provided the conditions are favorable for breeders to acquire cheap cereals, from their own harvest or via cheap market prices, these can be considered when choosing basic feed, which would be supplemented by human kitchen leftovers or cheap commercially available food industry tailings. Feeding of feed mixes is more convenient though. These are produced in specialized editions for layers and are more costly. Yearly consumption of feeding mixes per a hen accounts to about 45–50 kg and 9–10 kg is needed for a pullet. Semi heavy breeds have a little higher consumption.

Intense breeding for egg production is recommended with efficiently bred hybrids, which require feeding of the mixes. In breeds where one's own cereal production is fed, or other occasional feeds, full-blooded breeds with lower efficiency potential are suggested, because these can be saturated by the farm feeds.

The third criterion for choice of breed is the purpose of keeping fowl. Most small-scale breeders keep the chicken for eggs, while culled hens and roosters cover meat production. They can naturally focus on broiler keeping too. The fattening section does not have to be ensured by self-breeding, but chicks can be acquired commercially from specialized hatcheries of broiler chicken.

In small scale farming conditions, these are kept in a fowl house or a range. They spend a greater part of the day in the fowl house. Thus respective microclimate has to be produced for them. The temperature must not drop below zero degrees; the suggested temperature range is 5–23 °C. Higher or lower temperatures mean higher consumption of feed, meant for cooling or heating the body and it results in lower laying. Humidity shall be within the range of 60–75 %. Light regime is crucial for egg making. Regular 12 hour changing rhythm of light and darkness is suggested. That is a significant factor mainly in intense chicken keeping. The size of the fowl house is determined by the number of bred chicken. Three to four hens are calculated per 1 m2 of floor space. Dwarf forms can be housed up to the density of 8 per 1 m2. Interior setup of the fowl house has to be adequate to accommodate the animal's welfare. Laying nests can be individual or common and these are placed near the sidewalls of the fowl house, further from windows. Suggested nest sizes are 30 x 35 x 35 cm. It is a good idea to have a roosting ash place nearby, especially in case adequate range is not available. It is a low box filled with fine sand.

Feed is placed in specialized feeders of various designs. Regular feeding in adequate amounts is assured best by automatic feeders with their own stock. Placing of founts is very important too. Water has to be fresh and harmless. There are founts of various designs, but one is always necessary, especially when hens spend the whole day in the fowl house.

Table 31: Example of feed doses of layers

Feed	Dose of feed per chicken per breed (g)			
	Winter period		Summer period	
	Light	Medium	Light	Medium
Mix of cereal pollards	45	50	55	60
Mix of cereal grains	50	55	50	60
Alfalfa meal	10	10	-	-
Boiled potatoes	20	25	-	-
Skim milk	50	50	50	50
Crushed bones	6	7	6	7
Feeding salt	0,3	0,3	0,3	0,3

Such feeding doses can only be used in semi intense breeds, because they cannot meet all the requirements of the highly effective organism which lays eggs for highly bred hybrids. Such breeds are recommended to be fed exclusively by commercially available ready mixes, which are designed for such effective organisms.

Broiler breeding is a branch of chicken breeding that is very promising. A dietetic view of human food clearly shows tendencies to use more dietary meat in food industry. This paves the way for broilers onto human plates. Dietary broiler meat can be produced not only in specialized industrial farming plants with high animal concentration, but on a small scale too. The results of these cannot be compared, but that is not the point. Provided the keeper is capable of preparing conditions for this kind of chicken, and is capable of feeding them, it is possible to organize such a breed.

Grazing

Range grazing provides an ideal environment for young chickens, too. They can use their natural instincts in search for feed and others. Constant movement has a positive impact on the development of respiratory and cardiovascular systems, which are important attributes contributing to future health and affectivity of the hens. Chickens experience an activation of carotene and its transformation into vitamin A occurs upon contact with sun radiation. Grassy ranges provide additional sources of feed, which are represented by vegetation tops of plants that are easily digestible and rich in vitamins and digestive enzymes. Besides, the grassy growths are inhabited by insects, which represent a very rich additional source of protein nutrients for the chickens. Chickens moreover find various minerals while range grazing.

Chicken at the age of approximately 28 days shall be allowed range grazing, provided the temperature does not drop below 18°C. Chicken at first spend shorter periods of time in the range and the time is gradually prolonged. In case the natural sources of shade are not available within the range, shaded areas have to be provided. Such shelters protect chicken from rain, too.

Grassy ranges for chicken or open pasture are more suitable than hard surface ranges. Grass turf has first of all antierosion function and it is capable of holding many times more water than

bare vegetation less land. For chicken pasture various grass growths can be opted. The actual type depends on spatial capacity and time available for tending growth. The most simple and most commonly used is untreated original grass growth. It is tended only by casual mowing, surface arrangement and possible fertilizing. Provided the range is large enough, there is no danger of growth devastation. Only few farmers have such opportunities and in these cases the best solution appears to be smaller extensively used ranges. The farmer may want an enclosure system which allows chicken free pasture or movable fencing enclosures. With enclosure pasture the whole area has to be sectioned into four sections, among which the chicken move depending on the condition of the grass growth. Ten chickens should account for a section of 30 m^2 for a maximum of 5-6 days. The growths shall then regenerate for 15-20 days. The growth shall be kept lower - up to 100 mm. Chicken can only be allowed on well interconnected turf grass growth, at least 4 months after seeding. It can be strewn from March to mid-September. The best mix to be used is a regular commercially available perennial meadow grass mix. Provided the strewing is done in the spring, a cover crop, such as field pea, oats, garden pea or winter rape can be used. It is applied together with grass growth seeds, which are put to a maximum depth of 10 mm below ground. The surface has to be hardened well; it has to be irrigated and mowed regularly at a height of 100 mm. Nitrogen fertilizers are used at a rate of 0.03-0.05 kg of pure nitrogen per 10 sq. m. Further fertilizing is provided for through the chicken droppings.

Common nettle (Urtica dioica)

Besides grasses the chickens like nettles, alfalfa, clovers and some weeds.

Interspecies hybrids of grasses (Festulolium)

Nowadays there are many hybrids of grasses. Interspecies hybrids evolve through crossbreeding of Italian ryegrass and tall fescue, possibly meadow fescue. There are two types of such hybrids -loloid or festucoid. The intent of such crossbreeding is to achieve grasses rich in forage quality after ryegrass and resistance and perenniality of fescue. The loloid (ryegrass) hybrids are hard to tell from ryegrass, but the festucoid (fescue) hybrids resemble closely tall fescue. Due to the botanical closeness of both the species such crossbreeding is taking place even spontaneously. Due to its properties (higher perenniality and ability to compete) the festucoid hybrids gradually replace meadow fescue from the regular grass mixes.

Garlic and onion are also highly attractive for chickens. Grazing of its stalks has a positive impact on the digestive tract of the animals.

TURKEY

Breeding

Turkey is from the breeding point of view a quite modest bird. It does not require any expensive devices or stables. All it needs is a simple shelter for nesting. It is demanding though for range. It requires spacious, preferably grassy range. It is also very demanding at the time of breeding, both for feed and for stabling. This proves a disadvantage and is the reason why turkey breeding is not very common. Despite this fact turkey breeding has many advantages. Fattened turkey provides very much quality, taste and diversified meat. It is especially popular in the United States, where it is eaten for Thanksgiving and for Christmas dinners. However the consumption of turkey meat is increasing in other countries too mainly because the meat is rich in proteins and does not contain much fat.

Domestic turkey out at grass

Turkeys originate in Central America and they were brought to Europe at the time when America was discovered. Today's breeding is organized in two systems. The first of these is an intense breeding system which produces high numbers of animals intended for meat production. They are equipped with the specialized technologies for turkey breeding. Lesser numbers of turkeys are better bred in less intense and extensive breeding systems. These breeds can exploit the advantage of a turkey as an intensely grazing bird, which saves significant costs in feeding. It shows that turkeys can replace up to 60 % of its feed need by pasture, which is enriched by small animals.

Standard bronze turkey, is a heavy turkey. Its colouring was adopted from its wild ancestors. An adult turkey grows to a weight of 5–9 kg and the turkey cock to 9-15 kg.

The Virginia turkey, sometimes called a Dutch turkey, is of medium stature. The feather coloring is white all over the body. Adult turkey grows to weigh 6 kg and turkey cock around 9 kg.

In intense breeding operations Broad breasted white and its hybrids, which can reach up to 20 kg in weight, is kept. Intensely fattened turkey weighs at the age of 20 weeks 12 kg and the turkey cock weighs at the age of 24 weeks around 22 kg. Such birds reach the market in halves, quarters or portioned out to individual breasts or thighs. The heaviest ones are rid of bones and are processed in the meat industry.

Turkeys are very intense chucklers. This has been long used for breeding of other galliceous and other poultry under the turkeys. The results of hatching of turkey chicks depend on the biological value of the hatching eggs. Intensely bred turkeys are hatched in incubators. The hatching period is 28 days. The principle of hatching is the same as with the chicken. At setting compartments in the incubator, the temperature is held at 37.5-38 °C and humidity at 50–60 %. In the hatching compartment of the incubator the temperature is lowered, but humidity increases up to 90%. The turning of eggs is of extreme importance.

Chuckling makes good conditions for natural hatching under a turkey hen. This does not apply to Broad breasted white, which is absolutely unsuitable for natural hatching. Thirteen to nineteen eggs, depending on body size, are laid under a turkey. In case there are more nests, it is suggested to separate them so that the turkey wouldn't be able to see one another. At this time they are very aggressive and they could disturb one another, or cause fighting, which could result in damage oto eggs and/or of hatched chicks. The feeding bowls have to be placed so that the turkeys have to leave the nest, which is necessary for their emptying and thus keeping the nest clean.

The period after hatching is the most complicated period in a turkey's breeding. It takes 8 weeks. Chicken turkeys are more vulnerable and they are more demanding than regular chicken.

Natural breeding does not bring any complications. Turkeys make excellent mothers and raise their young well. She leads them up to the age of 8-10 weeks. Starting on the 2nd week, if the weather is good, the chicken turkeys can be let into a range. They need to be protected from cold and wet conditions. Chicken turkeys do not have immunity and they can suffer from diarrhea.

With artificial breeding the conditions have to be watched very closely. That includes the temperature, humidity and quality of feed. After hatching chicks turkeys require a temperature of 36–38°C; at lower temperatures they are drowsy and do not learn quickly how to intake feed and water. This causes starvation, exhaustion and death. They lack instinct for digging and the natural search of food. Intense lighting for feeders is recommended, because it enhances ability of the chicks to learn to intake feed. The feeding mix for turkey chicken must contain 28 % of protein (chicken mixes only contain 22–24 %).

During the first 8 weeks heating is essential for turkey chicks. The heated area has to be sufficient for all chick turkeys. Maximum density is 10–12 chicks per 1 m^2 of floor space. In the next period density lessens to a half.

Adult turkeys are capable of standing cold conditions. If a breeder does not expect lying soon, fowl houses don't have to be insulated. One to two animals are allowed per 1 m^2 of floor space. Laying nests are 60 x 60 x 60 cm, for 4 turkeys in breeds without supervision. Breed flock is usually set up in autumn. It consists of one turkey cock for 8–10 turkeys. Adult turkeys have throughout the year a period of not laying eggs from July through the end of year and a laying period, with natural light regime, from April through the end of June. Most eggs should be used for hatching.

An adult turkey consumes daily 250–320 g of feeding mix. With a range breeding system the feed is partially covered by pasture. At the laying period the turkeys require feeding doses consisting of 17–19 % A substances and 11.3–12.5 MJ methabolisable energy ME. There are commercially available industrial feeding mixes for turkeys with adequate nutrition contents. Granulated mixes are suitable.

Table 32: Feeding dose for turkeys with optional range pasture

Feed	Laying period (g)	Idle period (g)
Mix of cereal pollards	110	90
Mix of grains	100	75
Boiled potatoes	25	80
Lucerne meal	40	20
Dried skim milk	20	-
Crushed bones	8	3,7
Feeding salt	1	0,3
Egg shells	4	2
Fresh skim milk	-	150

The technique of turkey feeding is similar to that of fowls. The feed can be moistened. Whole grain is served in the evening. In the summer feeding and watering is possible in the range. After lying the turkeys of 3 years of age are culled, fattened and slaughtered.

Grazing

When turkeys are provided with a sufficiently large grazing area, they are capable of extracting as much as 60 % of their feeding requirements from it. Breeding individuals are bred with grazing methods. The turkey chickens can be allowed range grazing from the age of 8 weeks. They can do with a simple shelter on the pasture, which is used as protection against the sun and rain, and spend nights under it. Adult turkeys can be bred in pasture until late autumn. In this case it is sufficient to feed the turkey with additional feed once a day, usually in the evening. They are fed by cereals or by moist meal of cereal pollard and boiled potatoes.

The turkey possesses a deeply rooted instinct to search and destroy insect pests and thus can be used as a biological protection for garden and vegetable cultures. The presence of a farmer is required in time of allowance to vegetable growths for insect pest collecting. Turkeys cannot be used for insect collection during the ripe-

Soyabean (Glycine soja)

ning period for strawberries, tomatoes, grapes and currant. When used for insect collection the turkeys require sufficient water supply and shade for rest.

Turkeys are not demanding any special requirements for grazing. They accept all forms of green mass and prefer, for example, lettuce, dandelion leaves, or yarrow. A suitable pasture is described, for example, in the chapter on grazing of wild turkeys, or for example, growths of soybeans. Soya beans grow predominantly in warmer areas as they have a relatively long vegetation period of 13-14 weeks. It requires fertile soils. Eighty kg per hectare shall be strewn.

GOOSE

Breeding

The importance of goose breeding lies in the production of meat and feathers with a use of range pasture of various quality. Geese are capable of making use of otherwise useless areas and goose meat is very valuable. It has been served on holiday tables for many generations. Breeding is very traditional in the Czech Republic. The production of quality and delicate goose liver and lard is not negligible either. In the past the reproduction problems used to be a very limiting factor in goose breeding. Today the problem lies in marketing. The production of goose meat only represents 10–14 % of the production 10 years ago. From the dietetic point of view goose meat is high in

"Grazing keeping" of goose

fat and thus it cannot be suggested as healthy and desirable for daily consumption. Since the number of geese decreased rapidly, breeding is just semi-intense in the conditions of the Czech Republic today.

With goslings the aim does not lie in maximum growth, but in proper body development and immune organism. The prerequisite is good health condition. Gosling breeding is limited by the time frame between hatching and reaching sexual maturity, i.e. age 30–32 weeks. Environmental requirements have to be paid close attention with breeding, because they influence development of the organism. Goslings need special attention in the first three weeks after hatching.

Goslings need a dry and warm environment. In the beginning, the temperature has to be 30-33°C. This initial temperature is gradually decreased by 2°C a week so that on day 21 it will be 18–20°C. The temperature in other parts of the hall can be up to 6 degrees lower. At the age of three weeks the goslings can be let into a range.

Humidity should be 60–65 %, and ventilation should ensure airflow at a rate of 5 m^3 of air per one kilogram of life weight in the summer. On the first 4 days the light is left on for the goslings for up to 23-24 hours a day. The lighting time is gradually shortened.

One of the most important factors, which influence the quality of breed, is feed and feeding technique. The goslings grow rapidly after hatching and thus they are very demanding for feed. Up to the age of 4 weeks they should be fed with feeding mix containing 20 % of n-substances with 12 MJ ME (methabolisable energy). These values gradually decrease. The mix should be granulated. Goslings have to be provided with sufficient amount of water. Eight goslings can be placed per 1 m2 of floor space.

The preparation period for laying begins about a month before expected sexual maturity. Breeding flock shall consist of ganders and geese in the rate of 1:3–4. The breeding period of geese is, compared to other poultry, different in length and the proceedings. Geese are used for breeding for 4-5 years, because laying eggs increases after the 4th–5th laying cycle. To assure even egg production and regular rejuvenation of flock, 33 % geese of 1 year of age, 27 % of two years of age, 24 % of three years of age and 16 % of four years of age is suggested. In a geese breeding cycle the periods of lying, idling and preparation for laying alter.

Gosling developments take 29-32 days. Hatching temperature has to be around 39 °C, measured on the surface of eggs. Eggs are turned three to four times a daily. Eggs are transluminated on the 10th and 20th day of hatching. At the time of first translumination un-impregnated eggs are removed from the incubator. These can be told by clear untransformed yolk. (The impregnated

eggs show a dark spot on the yolk and the system of blood vessels is developing). Eggs, where development of the fetus has stopped must be immediately removed from the incubator.

One breeding goose requires at least 250 m^2 of pasture. This size is just a rough estimate and the actual size of the pasture has to be determined on the spot depending on the quality. Goslings are better bred on larger pastures that do not need to be continually covered in vegetation.

It is a fact that natural breeding leads to better economic and breeding success. A goose is a pasturing animal with periodic rutting and a tendency to monogamy. The look and productive efficiency closely relates to the living environment of goose. When the environment changes, some properties of the animals change as well, such as feather quality. Geese need pasture and water. Pasture is not just a mere method of saving on grain feed; it is required to keep a high quality of feathers, which is an inseparable part of the effective production. Another condition of good quality feathers is water. It also stimulates impregnating of eggs and their ability to hatch.

The fattening of goslings is made possible in two ways, intensive and custom. The first uses high growth potential of goslings, when the first slaughtering maturity is reached at the weight of 4 kg. Goslings reach maturity at the age of 8 weeks provided consumption of feed is 4 kg per 1 kg of increase. Goslings are well muscled and the whole body is covered by a layer of 2-4 cm of fat. The feathers have to be matured too. Custom fattening is a semi intense system of fattening, when in the first phase the goslings are fattened in halls and in the second phase on ranges. Custom fattening brings slaughtering maturity later, after the exchange of feathers at the age of 14–16 weeks. Similarly as with breeding, fattened goslings are also demanding in the first four weeks after hatching. In the second phase the main source of feed is pasture (0.5–0.6 kg per bird a day) with a minimum addition of grains (200 g per bird a day). In 3–4 weeks after the last plucking the goslings are transferred for another fattening, when their life weight increases by 25-30 %. They are fattened by a moist mix of ground maize, wet oats and wheat pollard. The life weight of fattened custom geese is 5.5–6 kg. The total consumption of feeding mixes is 25 kg. Custom goose is better muscled in comparison to broiler goose, especially in the breast area. It does have more fat though.

Grazing

Grazing breeding of geese is from the economic point of view very attractive. Geese can transform 50 kg of forage to up to 1 kg of increment in the live weight, which exceeds even the grazing efficiency of cattle or sheep. The prerequisite of a success is an intensive pasture in the very young growth of height 50-70 mm. On natural growths the geese prefer grazing of cocksfoot, meadow fescue, meadow timothy, clovers and some herbs. In cultivated growths the perennial ryegrass or Kentucky bluegrass are suitable. Less suitable are species like matgrass, red fescue, creeping bentgrass, sweet vernalgrass, tall buttercup, sedge, hairgrass etc. The daily forage consumption per one goose is approx. 2 kg with relatively many unfinished spots (up to 50 %). Therefore it is possible to place as many as 100 to 150 geese per one hectare. They begin grazing as early as 3 am and graze with breaks as late as until 8pm. It is recommended to divide to pasture to 8 enclosures (low fencing is sufficient 0.6-0.8 m). It is necessary to safeguard the whole pasture with higher fencing against wild predators (such as foxes etc.). Due to the fact that geese require juicy forage, the fencing has to be alternated quite often (see above). The whole pasture cycle takes approx. 20-22 days. The weight increments are negligible when grazing older forage. A necessary pasture facility for geese is a simple light shelter. Another technical utility is a fount or a small pond nearby in which river sand or gravel shall be placed in order to improve digestion. Provided the pasture is good, the geese weight shall increase daily on average by 390 g, at a consumption of approx. 2.5 kg of green forage.

Particularly fitting component of goose grassland herb species mixture is Meadow fescue.

Meadow fescue is a quality universal traditionally used grass. When sterile it looks like Italian ryegrass (shiny back of leaves, light green color). It stands grazing and it is suitable for use on temporary or permanent meadows. It is neither soil nor climate demanding and it grows in mountain

Meadow fescue (Festuca pratensis)

areas. Its disadvantage is a limited perenniality (4–6 years) and lower ability to compete at higher intensity of fertilizing. It is therefore now replaced in mixes by interspecies hybrids. Unlike ryegrass it possesses a strong winter character and drops seeds only before the first mowing. Due to limited requirements for fertilizing it can be considered a suitable grass for eco-farming. It is plentiful on alpine meadows and pastures, as it can stand well harsh climatic conditions and less fertile soils.

DUCK

Breeding

Duck breeding focuses mainly on meat production. The side product of the production is a plumage acquired during the slaughtering. In Asia eggs are also an important trade product.

Two types of ducks are used for meat production, Beijing and Musk. Both types of ducks are bred on an equal level in Europe, but the musk ducks seem to start being slightly more desirable.

Both the duck types are different species and they differ in the state of domestication, life weight, growth intensity, musculature, meat quality, body fat content, laying and the incubation period of eggs.

The *Beijing duck* was bred in China through the crossbreeding of local ducks. The origin begins from the wild Mallard duck. In the scope of this breed two new types evolved, the American black duck and the English duck. The English type is similar in body structure to the original kind; the American black duck evolved through breeding with the Elber duck and it is the most common in the Czech Republic.

The Beijing duck is a breed of rapid growth, good feathering and good reproduction features, and it is tolerable and adaptable. It reaches a high laying rate of 220–230 eggs. Egg weight ranges between 70–100 g. Fattened ducklings weigh at the age of 7 weeks over 3 kg. Adult ducks weigh around 3.5 kg, drakes 4 kg. They sexually mature at the age of 26–28 weeks.

The Beijing type of duck breeding is focused on acquiring of a duck with high slaughter efficiency, higher partition of breast muscles and low in fat.

Musk duck evolved of Muscovy duck, originating in South America. It has never been totally domesticated. It has lesser growing abilities than Beijing duck, less fat ratio, and special taste qualities of meat; it is modest, tolerant and is capable of using less valuable feeds. Drake weigh 4–5 kg; duck 2.5–3 kg. They sexually mature at the age of 28 weeks. They lay 190–200 eggs. Ducklings are fed depending on the sex, drakes up to 10–12 weeks and a weight of 4.5 kg, and ducks up to 9–12 weeks and a weight of 2.5 kg.

For ducklings breeding body requirements in individual development phases have to be respected. Breeding is differentiated in two periods. The first period covers warm breeding and lasts 2–4

Keeping of Beijing duck is undemanding

weeks. Second period, so called "cold breeding" begins at the beginning of laying, i.e. with sexual maturity in 26–28th week of age. It is less demanding for the environment and it can proceed under light shelters on the pasture. Healthy and well-developed young are selected for breeding.
Temperature requirements are lesser than with chickens. Under the heat source the temperature in the first week should be 28–25°C and it gradually decreases by 3°C. The humidity should range at 60–70 %. In summer 3 m^3 of air and in winter 0.5 m^3 of air has to be replaced per a kilo of life weight per hour.
Diet significantly influences the course of breeding. We suggest up to 3 weeks 22 % N-substances, between 4–7 week 18.5 % nitrogen substances and from 9th to 20th week 15 % nitrogen substances. From 2nd week ducklings consume granulated feeding mixes. Ducklings require a sufficient amount of water.
Duck are not highly demanding, but these rules have to be followed for their breeding: Respect the biological requirements of ducks as a water bird (but they need to have dry stabling throughout the year in winter even in colder environments). For breeding of ducks on water the quality of water has to be monitored. Ducks have to be allowed approach to water and banks of stream or ponds have to be paved at least by flat stones. Otherwise ducks can damage unpaved bank. Carp-duck farming allows for breeding of fish and ducks together.
When dry breeding the ducks have to have some space in a coop or range, where feeding stations or founts will be placed, which will be paved, otherwise in the time of rain it will get too muddy.

Grazing

Each water range and each water area with still or flowing water may serve as a source of feed for ducks provided that such water is biologically active and it is not chemically polluted. Besides, the water area cannot be subject to restrictions for such use. Vegetation period is the period of an intensive growth of plants and evolutionary stages of insects, plankton and small animals representing a substantial source of proteins for ducks. Ducks can use the water areas from the age of three weeks. In the case of water ranges it is possible to exclude or reduce the content of the extruded soy meal from the feeding mix. Nettles, dandelions, young alfalfa or duckweed are attractive for ducklings. Suitable grazing grasses are the same as for geese.

Particularly fitting component of duck grassland herb species mixture is cocksfoot.
Cocksfoot is an early grass. Its advantage is persistence and ability to withstand even very high

Cocksfoot (Dactylis glomerata.)

doses of fertilizer. At higher levels of nutrition it becomes aggressive and pushes the other species out of the growth. It withstands drier climates and it is suitable especially for haymaking (its forage contains relatively little sugar). It can be used for pastures provided it is not placed in complicated mixtures but it will be sowed only in the mix with white clover. If it is added to the grazing mixes at low content there comes a situation that in the ideal grazing maturity of cocksfoot the other grasses are yet not covered and when they are covered, the animals omit cocksfoot as overage.

OSTRICH

Breeding

Ostriches became domesticated in the 80's of the 19th century in South Africa. Ostrich farms have spread all over the planet since. Today's domesticated ostrich is bred for meat, skin and feathers. It plays an important part in the farming industries of

Ostrich (Struthio camelus sp.)

South Africa, Namibia, Zimbabwe and Israel, and demand is growing in the U.S.A., Australia and Europe. All technologies in ostrich breeding are based on welfare requirements and are based on a free-range system. Several kinds of ostriches are used for farm breeding: greater rhea, emu and ostrich.
African ostriches are the largest living birds and they cannot fly. Their legs are very strong and they are ended with two fingers, each of which consists of three parts. Fingernails are large and dangerous. They can run up to 60 km/h^{-1} and kicking impact can be 200 kg per 6.54 cm^2. Their sight is very well developed and it can register movement 3.5 km away. At the same time they can recognize objects immediately in front of their beaks. Their eyes are protected against sand and dust by third eyelids. Flexibility of the neck and strategic turning of the head allow for a very wide range of sight. These facts have to be remembered by the farmer when walking among the animals. There is a rising interest in breeding of Australian emus. These are not quite as big as ostriches, but they can be as very well used.
Breed flock is set up in the ration of one adult and one young male ostrich per two female ostriches. Some breeders claim that ostriches can be kept in large groups. If they are allowed sufficiently vast space, they can survive very easily. Ostriches are territorial. Female ostriches pass across territories and they can mate with different males. Ostriches are competitive and this fact can sometimes lead to trouble. Ostriches are naturally rather aggressive and thus they protect territories of their own flock against alien flocks of their own kind. The survival rate of wild ostriches oscillates around 15 %; modern farm breeds sustain a survival rate of up to 80 %.
Hatched ostrich chicks must be kept in a dry environment, because the chick's feathers, unlike the feathers of the adults, are not water resistant. Chicks have to walk a lot, because their legs need to develop muscles. Lack of movement can lead to respiratory disorders. Ostrich chicken should run daily at least 5 km. From the age of 6 months the chickens are strong enough to sustain on their own.
Fencing of the main pasture range must be made of special fence or electrical fencing, similar to one used for cattle can be used. For a flock of ostriches, a minimum area of range needed is 0.65 ha.
The laying cycle of female ostriches in the conditions of the middle Europe is fairly short and an ostrich lays 18–20 eggs. A female can undergo up to three lying cycles a year. An ostrich eggs weighs around 1 500 g, and the eggshell is about 4 mm thick.

Table 33: Area requirements for ostrich breeding

Age category	Stable building	Range (3)
From 1st to 21st day	120 m^2 per bird	Not necessary
From 22nd to 90th day	In winter from 15.10. until 14.5. – 2.40 m^2 per bird In summer from 15.5 until 14. 10. – 1.20 m^2 per bird	At least 10 m^2 per bird necessary with total minimum area of 50m^2
From 4th month until slaughtering of transfer to parent category	Outside under a shelter (1) 1.50 m^2 per bird with minimum total area of 15 m^2	250 m^2 per bird, minimum of 1000 m^2 of total area, but maximum of 40 birds per ha
Parents from the age of 2 up 1 male with females	Outside under a shelter (1) (2) 8 m^2 per bird	500 m^2 per bird

(1) Outside shelter has to be enclosed from three sides; minimum height is 250 cm, entrance width 20 cm per bird at minimum from 150 cm

(2) There has to be space for separation of individual animals within the shelter

(3) Minimum height of the fences: ostrich chicken 160 cm, adult ostriches 200 cm

The hatching of chicks is done in hatching incubators. The average time between setting the eggs in the incubator and hatching is 40 days.
In the first phase of life, ostriches are fed with mixes of a high nutrients concentration with the addition of greed forage, best fresh alfalfa. The mixes consist of maize, wheat pollard, oats, soya bean peels and brewery yeast. Suggested concentration of nitrogen substances, which decreases with age, is 240–150g.kg^{-1}. Energetic concentration of the feeding mix should be 8.3 MJ.kg^{-1}. The feeding dose has to be high in fibres. Depending on age, 60-180 g.kg^{-1} of feed mix should be fed. In order to meet requirements for ostriches, mixes are enriched with vitamins and minerals.
In case of range pasture, grazing growth is an important part of the feeding dose. On top ostriches are fed by cut Lucerne hay and feeding mix. Feeding doses of chicken ostriches must not be too rich in nitrogen substances in order to prevent fast growth of long bones with insufficient ossification resulting in deformation of bones.
The fattening of ostriches until slaughtering maturity takes 14-16 months and this lasts up to an average weight of 135 kg. The best and the most economically effective are the breast muscles, which account for 36 kg of the whole weight. Ostrich meat is dark, similar to beef. The texture is between turkey and pork. It is not fat and contains only a minimum of cholesterol.
A slaughtered body consists of 62.5 % of lean meat, 9.2 % of fat and 26.9 % of bones. There are 10 bigger muscles on a slaughtered body of an ostrich, which are suitable for steaks. These muscles represent 41.3 % of weight of the slaughtered body and 23.6 % of life weight.
An adult female ostrich produces annually from 1.8 up to 2.5 kg of fine quality feathers used in fashion industry. Feathers of ostriches are used only after reaching approximately 16 months of age, when the first feathering period is closing. Feathers are cut or plucked. Ostrich skin is used for production of fine leather products. One bird produces from 1.2 to 2 m^2 of leather.

Grazing

The clovers should not prevail in the pastures for ostriches and the other valuable cultivated plants should be sufficiently present. An example of suitable grazing mix is (1 kg of seed/1 ha): alfalfa 16 kg, meadow fescue 4 kg, tall oatgrass 2 kg, *Lolium perene* 3 kg, italian oatgrass 1 kg, red clover 3 kg, white clover 2 kg, ligrus 1 kg. Good fertilizing and intensity of pasture determine the quality of growth. In the continental conditions it is suitable to introduce the irrigation system. The additional fertilizing by nitrogen is mostly not necessary however at the establishing of growth it is possible to fertilize with 30-40 kg/ha. The ostriches graze the alfalfa in a special manner – they frill the leaves along the stalk that recovers over the clover and grass level. It increases the competitiveness of the alfalfa in the growth.

Particularly fitting component of ostrich, grassland herb species mixture is red clover. Red clover is our most significant clover for clover growths in the corn-growing and potato-growing area. In the perennial growths there can be found a wild variety ssp. spontaneum that while more perennial it is smaller than cultivated varieties of red clover. The older cultivars were cultivated for a period of one and half year on the arable land, whilst today when new cultivars are cultivated the prolonged perenniality of 2–4 years of use is preferred. In practice the diploid and tetraploid cultivars are grown. The tetraploid cultivars provide the higher yield of green fodder, higher content of sugars and moisture in the forage and they are suitable especially for green fodder or for the ensilaging.
Since the perenniality of red clover in the perennial grass growths is not sufficient there is a need

Red clover (Trifolium pratense)

to keep these species by repeated resowings in the grass growths. In such manner the substantially higher production of high quality forage is ensured and the demands for nitrogen fertilizing are limited. In the first year after the sowing its growth is aggressive insofar that it can repress the other components and after its disappearance in the next two years there are bare areas in the growth. Therefore its proportion in the newly established perennial growths should not be higher than 10 % (2 kg.ha^{-1}).
Tall oatgrass (Arrhenatherum elatius)
Oatgrass is a high grass suitable for mowing (it does not stand grazing). It is plentiful in dryer and warmer areas with a limited number of mows. In unmowed growths it often, due to dropped seeds, succeeds over other plants. Klimeš (1988) suggests tall oatgrass for use in grass/clover mixes for arable land, where it provides high yields and eliminates quackgrass. With higher mowing frequency it is not very perennial in the grass growths. Delayed harvest provides well-accepted forage.
There are certain troubles with its strewing too. Even though an awn less variation exists (Median), it needs to be strewn during dry sunny weather, in order to ensure a proper passage of seeds through seeding machinery (it is possible to increase the proportion in the mix – over 25 %).

GUINEA FOWL

Breeding

Guinea fowl meat belongs to the most wanted specialties in the broad offer of poultry meat. Both meat and eggs of guinea fowls are used for its great taste and dietetic qualities.
Domestic guinea fowls are medium-sized birds with robust legs. The most common is the pearl guinea fowl of purplish-grey colour all over the body except for the neck, which is decorated by blue pearls. There are other breeds too of white, light grey, yellow and brownish colors. Other color mutations are mainly decorative breeds. An adult bird weighs 1.5–2 kg and guinea hen a little more at 2-2.5 kg. They lay 120–150 eggs of 40–45 g.
Nowadays guinea fowls are bred by three basic types of techniques:

Guinea fowl (Numida meleagris)

- breeding of chicks on deep bedding and following cage breeding.
- cage breeding
- breeding on deep bedding

In the first weeks of age round enclosures are recommended for guinea fowls. These prevent them from being crushed to death, and it allows better use of heat source. It also allows for a better approach to water and feed. Three hundred chicks can be placed in one circular enclosure with a diameter of 2 m at the beginning. In the first days the founts and feeders are placed near electric brood-hen. Gutter feeders should be designed for 8 cm per bird and they should be covered by wire netting so as to save feed. During the first few days hat founts are used; later automatic founts are used.
After the removal of the circular enclosures, all edges (corners) of the breeding area shall be protected by a tape, which prevents possible crushing to death among the chicks. Guinea hens and guinea roosters are bred separately in dark spaces and there are possibilities of various light programs. Using light 14-16 hours before the beginning of lying speeds up the process. Photo-stimulation of the roosters is chosen so that the peak of ejaculation was synchronized with the cycle of lying. In order to prevent a stressful situation at the time of manipulation, lessening of light intensity is suggested starting from the first day of stocking.
Deep bedding breeding is only suitable for small flocks. Guinea fowls consume seeds, herbs, worms, earthworms, slimes, slugs and insects in the outlets. With respect to their high movement

activity the saving of feed compared to other enclosed breeding systems is only 10%. Guinea fowls like to root in ashes and sandy areas.
Hatching is similar to one of chicken and the period takes 25-27 days. Incubation in setting compartments takes 23-24 days at a temperature of 37.4-37.7 °C and humidity of 55-60 %; hatching itself takes 4-5 days at the temperature of 37 °C and humidity of 98 %. Hatching eggs should not be older than 4-5 days; otherwise the result of hatching is worse. Hatching rate of guinea-fowl eggs in the hatchery is 77-78 %. This comes from the number of impregnated eggs during insemination, which is 86-90 %.
Guinea fowls provide a fair setup of the slaughter body. Slaughter effectivity is 77%, of which breast muscles account for 25%, skin only 10% and bones only 12% of the body value. The difference between sexes is negligible at guinea fowls of meat breeds. Life weight of a day old chick is about 27-30 g. Guinea-broilers are bred on deep bedding in windowless halls with concrete floors. The fattening broilers density is 15 birds per sq m. Bedding is either straw or fine sawdust. During the initial phase of the fattening each section is stocked with 1500 chicks. There are three electric brood-hens in each section. In the first three days feeding, watering and tending has to be done with special care. Life weight of guinea fowls at the end of a fattening period is 1.5 -1.7 kg. Throughout the fattening period a total of 4.5 kg of feed is consumed, which equals 2.9-3.0 kg of feed per 1 kg of life weight.
Due to the fact that guinea fowls are extremely fast runners and flyers, they are extremely difficult to catch. The best catching time is in the evening.
Nutrition needed by guinea fowls is very similar to those needed by other poultry. The feeding mixes used must meet two basic functions. They supply animals with sufficient amount of nutrients and supply it in such a composition and ratio that the health of the animals would not be threatened, while simultaneously creating conditions of maximum efficiency. Guinea fowls are at the time of keeping fed by commercially available mixes for pheasant chicks BŽ 1 and BŽ 2 (specific Czech feeding mixture for pheasant), or mixes for chicken. In small scale breeding grain pollard, grated cottage cheese, cut green forage and crushed bones are used.
In time of breeding, feeding mixes for chicken are used and in time of laying the mixes for layers are used. For fattening of guinea fowls feed mixes for chicken broilers and turkeys can be used. During the first stage of fattening, up to the 4th week of age, mixes for turkey fattening are more convenient, because these are richer in nutrients. As with the rest of poultry species, special attention has to be paid to ensure sufficient minerals and vitamins are in the feed.

Grazing

The guinea fowl are well kept in unlimited open range. Then they are able to find all their feed. They only require additional grains in the evening. The grassy ranges for guinea fowls have to be relatively large, as they do not dig like chicken for feed, they only collect or graze their feed. They focus on insect collection. Besides they collect all seeds of cultural plants and weeds. Of fruits red tomatoes, currant, strawberries, and grapes attract them. In order to ensure a specific taste of the fowl meat it is suggested to add juniper fruits and branches or other coniferous for their feed.
Particularly fitting component of guinea fowl grassland herb species mixture is millet. Millet *(Panicum miliaceum)* – shall be seeded into unweeded soil, best after rooted crops or after Cruciferae. It should not follow after maize, as some pests attack it. It stands well through droughts, but long rains harm it. Young millet cannot stand frosts and thus it is to be strewn as late as May (minimum coming temperature is 10°C). Fifteen kg are strewn per one hectare. Millet provides both cover and pasture and seeds for small animals.

Common millet (Panicum miliaceum)

III.IV Agro-tourism and biodiversity admiration

In 1998, tourism was one of the five leading export sectors in two thirds of the world's 49 least developed countries. But the tourism business is risky and outsiders usually get most of the benefits. Still, serious attempts to promote „pro-poor" wildlife tourism through community enterprises, serious partnerships between companies and communities, and efforts to upgrade the skills of local workers have just begun. No one knows if they will succeed. With regards to tourism in Africa, the DFID (Brown, 2003) study finds that community based wildlife management projects have yielded mixed results in eastern and southern Africa. Some households and districts got more money and jobs, but at a high cost to donors. To get beyond that stage requires quick and simple mechanisms for establishing resource rights, clearer and more equitable benefit sharing arrangements, and building up local business skills.

According to the Quebec Declaration on Ecotourism (Anonymus 2002), ecotourism:

- Contributes actively to the conservation of natural and cultural heritage
- Includes local and indigenous communities in its planning, development and operation, contributing to their well-being
- Interprets the natural and cultural heritage of the destination to the visitor
- Lends itself better to independent travellers, as well as to organized tours for small size groups

Increasing numbers of travel agencies label their travels as **"ecotourism"** due to the fact they bring their clients into natural areas with a PROTECTED status. However, ecotourism in its proper sense is a travelling activity oriented to educating travelling clients to the facts of nature-human relations together with attempts to understand history and cultural realities of the respected country. Movement for such oriented tourists is regardful of nature and local inhabitants, whereas their visits mean also a meaningful economic profit in such a degree that the native population understands that nature protection signifies profit rather than encumbrance (FAO 1998). By no means should ecotourism lead to damage of natural phenomenons. There are many types of ecotourists, such as foreigners and nationals, young adventurers and elderly people, who need a high level of comfort. They basically want to enjoy a pleasant, instructive experience and are willing to pay for it according to their means. They want good guides, environmental ‚sensitivity' by all the actors, security, good publications, maps and well-marked roads and fair pricing for the services rendered. They are willing to cope with unfavourable climatic factors but not with false promises about what they will see in their tours. Besides admiring nature and its biodiversity, they are often interested in local people and cultures and want an opportunity to establish contact (Budowski in Valentine 2005).

In a simpler way e.g. in accordance with ECEAT findings (European Centre of Eco Agro Tourism – established in 1992, covering now more than 23 countries) – tourism targeted onto nature admiration and rural landscape can mean that tourists come and stay on eco farms, eat home grown products and learn about the country they visit through eco farmers. This means that the farms get paid for extra that they usually don't get paid for at all. They sell lifestyle and in that way it answers a bit the question of how to educate consumers. During the holidays they are

more open for new impressions than on working days. In more specific modes – tourism can mean sports-oriented activities (i.e. skiing, biking) or biodiversity admiration, including bird watching, hunting or fishing.

Biodiversity and agriculture

Given that the World Bank and the Global Environment Facility spent $7.4 billion USD on conservation and biodiversity projects over the last ten years, DFID states that most poverty reduction strategies fail to recognize that many rural people rely on bushmeat and that declining wildlife populations makes their lives more difficult. On the other hand, it is frequently forgotten by green NGO´s that wild animals in the landscape considered as dedicated to man-husbandry – not only in Africa – can cause problems when they eat farmer's crops or livestock, spread disease, or attack people. Conservationists should think more about the bushmeat issues from the villagers' perspectives, and not just in terms of conservation if their intention to protect some precious habitat shall be successful.

The rural environment is foremost a living environment. The complex ecology of flora, and fauna have adapted to and been influenced by farming activities. In Europe this symbiotic relationship has evolved over, not only centuries, but thousands of years. The result is that many species are dependent for their life cycle on the continuation of farming practices. For example, once common birds such as the Chough *(Pyrrhocorax pyrrhocorax),* now confined to a few breeding areas in Europe, rely on traditional grazed pastures. Another example is the globally threatened steppic bird, the Great Bustard *(Otis tarda),* which thrives on extensive mosaics of cereals fallow and pasture in Spain and Portugal (COM/99/0022-final/51999DC0022).

The term biodiversity, in its widest sense, embraces not only wild biodiversity but also so called agri-biodiversity. Agri-biodiversity includes diversity of genes, populations of species and landscape, directly or indirectly associated with agriculture. Agri-biodiversity is, to a large extent, determined by the intensity of agricultural land use. As already stated several times, in the Czech Republic, approximately half of the area is suitable for intensive agricultural use, while the other half represents less favorable areas. Areas with extensive levels of agricultural production are considered important for conservation of biodiversity and many areas are already protected by the legal instruments of nature conservation.

The system of large- and small-sized Specially Protected Areas (SPAs) includes:

- 4 National Parks
- 24 Protected Landscape Areas,
- 2 042 small-sized Specially Protected Areas.

Table 34: Particularly protected areas (PPA's) in the Czech Republic

PPA category	Number	Area (ha)	Share of CR territory (%)
Large PPA's			
National parks (NP)	4	119 020	1.51
Protected landscape areas (PLA)	24	1 034 465	13.12
Total	28	1 153 485	14.63
Small PPA's			
National natural reserve (NNR)	110	27 873	0.35
National natural monument (NNM)	101	2 691	0.03
Natural reserve (NR)	710	33 839	0.43
Natural monument (NM)	1 121	26 616	0.34
Total	2 042	91 019	1.15
PPA's in total	2 070	1 244 504	15.78

Source: Agency for Nature Conservation and Landscape Protection of the CR, 2002

EU environment policy ensures that especially valuable habitats are identified and designated under the habitats and wild birds Directives (Directive 79/409/EEC/1979). These require Member States to assure the necessary conservation measures, which often require the continuation of farming. The ensuing network of sites is known as Natura 2000. Farm-dependent biodiversity is not confined to the Natura 2000 sites. Over 70 % of threatened vascular plant species in Sweden depend on the open farmed landscapes. Throughout Europe, the centuries-old practice of haymaking has produced diverse field flora adapted to a rapid growing season and seeding before mowing takes place. Both the decline of haymaking and earlier haymaking have inevitably led to a corresponding decline in the population of field herbs.

The threats to farm-dependent biodiversity fall essentially into two categories: intensification and under-use (i.e. abandonment). While the links between intensification and biodiversity are the subject of much continuing research, the main agents of change include:

- increased fertilization (organic or inorganic), land improvement; land drainage and irrigation,
- increased specialization such as monoculture and the decline of mixed farming. This process may be promoted through reallotment [rememberment] schemes and rationalization of field patterns;
- loss of field margins and non-farmed habitat areas such as wet areas, farm woodlands, hedgerows,
- indiscriminate use of pesticides,
- replacement of traditional practices, such as haymaking replaced by silage production and temporary fallow by continuous cereals,
- increased mechanization leading to soil compaction.

The combination of some of the above practices is believed, for example, to have contributed to the decline in numbers of farmland birds. However, it should be noted that there are cases where farm land was taken out of agriculture for nature conservation without subsequently achieving the protection objectives. As a consequence, well-adjusted farm practices had to be reintroduced in order to create suitable conditions for birds. Agri-environment measures are developing techniques for the maintenance and improvement of bird population.

In most Member States, agri-environment measures have been implemented under Regulation (EEC) No 2078/92 to preserve biodiversity, for example, reducing or ceasing the use of fertilizer and pesticides on the maintenance of rotational practices. Examples include the introduction of organic farming, integrated crop management, set aside of field margins and specific measures, tested through LIFE nature products, aimed at particular habitats. Measures are also in place to manage farm woodlands, wetlands and hedgerows to benefit flora and fauna.

Concerning under-use of agricultural land, abandonment can have disastrous consequences for the natural environment. In mountain regions and other less-favored areas such as drylands and northern zones, the cessation of agriculture quickly leads to the growth of scrub and then forest with a loss of the higher levels of biodiversity associated with the farmed environment. However, the continued existence of farming may not be sufficient to conserve biodiversity in the absence of appropriate practices. Thus, where managed grazing has been replaced by uncontrolled large-scale ranching systems, the semi-natural environment may deteriorate. CAP support can play a pre-eminent role in maintaining threatened agricultural systems, notably through LFA measures, particularly in marginal areas where agricultural activity would otherwise cease. In addition agri-environment measures form a key part of efforts to preserve farm-dependent biodiversity in these areas. They are therefore a major ongoing and practical element of the Community's approach to the protection of biodiversity.

Taking into account the present acreage of agriculturally managed land in EU and the ten-percent-fallow obligation, theoretically, there is an area of 6 million hectares of abandoned green land that could serve for alternative uses. Green fallows, together with "Agenda 2000", in which the agri-environmental programs create a second pillar

of EU agricultural policy, offer an extraordinary opportunity for partial reconstruction or creation of new valuable animal habitats. Examples from France, Great Britain, Germany, Austria, Spain, Sweden and other European countries prove that, in terms of maintaining the biotopes. A cooperation of nature conservation, agricultural and game management organizations is possible.

Agri-tourism as known in the European Union has developed in the CR only after 1989. At present more than 200 family farms are involved in classical agri-tourism. Further development of businesses in this sphere will require financial support from the state and public budgets (support to businesses through soft loans, grants and subsidies), removal of legislative barriers and support to improve the quality of provided services (Anonymous, 2004).

Environmental impacts of the Czech agriculture

During the preceding 50 years, Czech agriculture underwent fundamental changes that shaped its character as well as its effects on the surrounding nature and countryside. The collectivization of the 1950s is deemed to be a landmark in recent history, which led to a decline of ecologically stabilizing elements in the countryside. In addition to their stabilizing function, they were distinguished by a high biodiversity (balks, small woodlands, wet alluvial meadows, etc.). Another important stage was the conversion of traditional farming to industrialized mass production in the 1970s. Plots were consolidated into large land blocks that often did not respect the topography. These measures still cause considerably distorted discharge conditions and the related risks of floods and droughts. The adverse effects of the consolidation of plots had been also manifested by substantial water pollution and soil degradation. In many cases, parcels were ploughed up that are vulnerable for various reasons.

Those steps gradually started up the process of loosing the natural soil fertility, the considerable decrease of water retention capacity, the reduction of biodiversity and the population sizes for indigenous species. A rapid decline in the number of partridges from 6 million birds in 1935 down to slightly over 50 000 in 2000 is a characteristic example.

Table 35: Changes in the numbers of partridges, hares, and pheasants

Year	Partridges	Hares	Pheasants
1969	927 409	982 748	1 015 725
1970	855 470	989 546	1 012 454
1980	164 807	707 775	639 490
1985	82 973	608 801	450 701
1990	60 727	484 594	346 060
1995	85 143	414 206	258 746
2000	52 134	375 966	263 730

Source: Statistics of the Czech Gamekeepers' Association 2002

Rural tourism in the CR

Tourism is an important factor for economic development in the Czech Republic. Its share in GDP grew from 1.3 % in 1989 to 10–12 % in 1998. The total revenue from foreign tourism reached 3 085 million EURO in 1999. Tourist industry employs 9 % of the total number of employees. According to recent estimates, accommodation capacities in the sector of rural tourism amount to approximately 31 000 beds, mostly in private houses or individual lodging, accounting for 9 % of the total accommodation capacities in the Czech Republic. Approximately 200 family farms are involved in standard farm tourism. It is well known that the development of tourism brings a significant number of job opportunities and allows employment for unskilled labor, albeit to a limited extent. It is estimated that about 80 % of the Czech Republic's territory has potential for further development of tourism (MoA, 2004b). Development of the rural tourism and in particular of agro-tourism belongs according to HRDP among important tools for economic activation of rustic regions. It stimulates new entrepreneurial activities and it supports creation of new jobs and consequent stabilization of rural inhabitants. In particular, the preservation and improvement of landscape quality permits the meeting of needs of people who wish to have an authentic experience of the countryside, close to nature and away from crowded areas; landscape is therefore an essential component of the tourist potential of rural areas.

Another important component of agro-eco-tourism is hunting tourism. Positive changes have been made in recent years in central and eastern European countries concerning the liberalization of hunting. It is believed that, if managed professionally and scientifically, the hunting tourism resulting from that liberalization may prove to be a factor in the development of rural and mountain regions. It may also make a significant contribution to rural tourism, ecotourism, job creation and the preservation of local traditions.

The next chapter deals in detail with specific kinds of agro-eco-tourism. The interesting and challenging topic of traditional Czech game management approaches were always reflected very positively by the public. It is more associated with nature and animal protection than with hunting, but is misunderstood by many NGO´s with green motive in their heraldry but with very poor scientific background in ecosystem interactions on the level of landscape biotic complexity (Jeník, 1995).

III.V. Game management as an alternative of considerate biodiversity and landscape maintenance instrument

III.V.I Historical magnitude of game management

Hunting is widely practiced in all European countries and forged by a long tradition. However, individual hunting traditions differ greatly in Europe from country to country, ranging from game management and hunting as a source of food to hunting as a sport or a social event. For some time, there has been a shift in the behavior of hunters towards practices that are more respectful of nature, game and habitats, which also contributes to the preservation of rural lifestyles, particularly where farming and forestry are concerned. Some 120 000 full-time jobs are said to be generated by hunting in Europe (EU 2005).

In many European countries (mostly in the EU "older countries") game management has been classified as a sport. However, that attitude does not take advantage of the whole branch's potential. The game management, considered as an economic activity in a cultural landscape and as a recoverable natural resource, can be as profitable as agricultural production or even more (apart from sport activities of specific groups of people). Moreover, it minimizes the negative impact of man on cultural landscape ecosystems. The game keeping itself has been connected with a broad spectrum of other branches: production of hunting arms and ammunition, production of hunting optical appliances, production of hunting off-road vehicles, production of special hunting outfits and jewels as well as taxidermal activity, forestry and hunting literature, food industry, production of hunting equipment, the whole branch of hunting cynology (dog feed, special dog training), sale of special seed for grazing areas, association and education activity – lectures, training, film production, hunting exhibitions and museums etc. In regions, the game management directly contributes as an agro-tourist service (accommodation, guides etc.).

Contemporary care for free living animals, including game, has a rich history. At the beginning of mankind's evolution and first trials to manage surrounding nature, it was hunt only. Hunting, and later game keeping, has been therefore an important part of human history. It has more or less influenced surrounding ecosystems – other animal and vegetation species. Even nowadays, there are still people on our planet who are directly dependent on the hunt and their relationship to nature is sometimes instructive for developed civilizations as well. Evolution and advancement of the European human population has been monitored for approximately hundred thousands years. For only six or seven thousand years, people have earned their living from agriculture. During the whole preceding period, they had been practising hunting and collection livelihood. Especially during the last century, the game management has become a systematic human activity oriented upon yield and regulation of some parts of cultural landscape eco-systems. The latter and every year, a more important function of game management must orient this activity toward the target state of the landscape or its parts. The alternative – antropogenous landscape with fully developed auto-regulative mechanisms – does not come into question neither for the present nor for the long future period.

For instance, game management activities in pheasanteries and game preserves represent the most intensive form of the economic activity, as far as the game keeping and influence on forest management are concerned. In preserves, the regulated exploitation of forest vegetation due to wood production has enabled to save some precious growths despite their age, and at the same time the whole phyto- and zoocenoses.

At present, the newly established nature conservation authorities and some non-governmental organizations with similar orientation declare support to the mentioned, ecologically important landscape elements. However, their attempt to conserve the present state, which has mostly been developing for centuries, ends sometimes, due to ignorance of the problem, in non-adequate proposals of eco-system management changes that are mostly based on pure hypotheses and theoretical applications of common regularities.

To the European hunting community, it is a well known fact that numbers of the small game decline. All other free-living animals, whose existence is bound to a cultural, intensively utilised agricultural land, are in an almost similar situation. All factors causing this situation has not been discovered so far. But it is certain that the increasing areas of agricultural hunting grounds, intensity of their maintenance, quantity of applied fertilizers, chemical plant prevention and also the air pollutants play an important role. Increasing pressure of predators and decrease of game food supply resulting in reduced fulfilment of their vital requirements constitute a separate factor in the course of a historically short time.

It is evident that small game decline is more or less irreversible. Each farmer's objective is to minimize maintenance costs. This is only possible if he uses the latest technologies on large areas with all means of mechanization. Under the present market, in order to be economical with cost and yield proportions, an agricultural enterprise needs to dispose of at least 200 ha of land. Due to operational and economic reasons, land areas are larger and more coherent, the sequence of agricultural plants is unvarying, and the fields stay bare due to immediate plough after the harvest, without any vegetation, i.e. there is a minimal chance for the game to hide and graze.

During attempts to prepare an appropriate ecological background – so necessary for small game – attention has been paid to the chance to gain support, especially by means of agricultural, environmental-friendly programs. At first sight, the possibility to use the abandoned land for improvement of living conditions of the game and other free-living animals raises hopes. However, the concrete situation in EU makes one a little disappointed. Taking into account the present acreage of agriculturally managed land in EU and the 10%-fallow obligation, theoretically, there is an area of 6 million hectares of abandoned green land that could serve as habitats for the game and other free-living animals. But only 50 000 ha of this considerable area is managed with respect to biological diversity (EU 2005). About 75 % of abandoned land is managed as one-year fallow. In order to protect the soil from weeds, and because of future cultivation, the majority of fallow land is mowed and mulched in May or June. This fact makes the one-year fallow a fatal trap for game's nests and offspring. In order to create good living conditions for small game, and at the same time with respect to further agricultural utilization, these areas have to be cultivated and appropriate seed mixtures should be applied. Autumn seems to be more suitable so as to avoid weed-infestation.

In EU, the situation of 2-5 years' fallows, which are on about 25 % of abandoned land, is much better. It is also profitable to sow a suitable mixture, but it is also possible to leave the area to natural development. A certain rate of weed-infestation must be taken into account. The necessity of spring mowing and mulching doesn't seem that urgent and the chance of animals' survival is higher. The best maintenance period is early spring or early autumn. If land is managed this way, the farmer is entitled to compensation for the following: land taken out from agricultural production, increased cost resulting from the creation of living conditions for free living animals, and support to increasing biodiversity in terms of agri-environmental programs.

III.V.II Game management as a sound tool of biodiversity management in the cultural landscape of the CR

The tedious but simple hunting endeavour assuring staple food for tribes and kings of Slavonic and even precedent Kelt ancestors has been changed into game management in order to sustain stock of the available animal herds/flocks surrounding the settlement. Contemporary game management is considered to be a collection of in-nature activities concerning free-living animals and club activity. It is aimed at sustenance and development of game management traditions and customs, which form an integral part of the Czech national cultural heritage.

Game keeping is currently dealt with by the Game Keeping Act (No. 449/2001 Coll.). At the moment 5549 hunting grounds are recognized, which represents a total hunting area of 6.7 million hectares. Of this there are 107 game preserves with a total area of 41.7 thousand hectares and 48 independent pheasanteries with a total area of 31.5 thousand hectares. The average area of a hunting ground is 1212 hectares. But almost half the recognized hunting grounds in the Czech Republic have an area from 500 to 1000 hectares.

However, the most important fact is, that game management or hunting (in European context) is a leisure activity for more than 130,000 inhabitants and CGMA itself has got more than 120,000 members, which means that this in-group is the second largest special interest NGO of the country (after the Czech Fishing Association with more than 300,000 members). These members do observe, count, feed and hunt animals. Chase is performed in accordance with the game management plan of the given hunting ground and decree no.245/2002 Coll. on game species and stock allowed to be maintained.
In recent years there has been an upward tendency in the number of all species of hoofed game. This is despite the fact that the numbers of certain species are being reduced by hunting. But reduction through hunting is not sufficient to give rise to such a drop in numbers as to reduce the damage caused by game. It is evident that it is not sufficient to rely only on a game census, and that other criteria must be considered when making decisions on the breeding and hunting plan. The numbers of the main species of indigenous small game, which dropped over the past decades as a result of deteriorating conditions in field hunting grounds, have stabilized over the past three years.

In the Czech Republic hunting of selected species is traditionally combined with their protection and protection of their habitats. Hunting is not a mere controlled exploitation of game populations, as it often happens in North or South European countries. Czechs use the title "hunter" very rarely, but the professional title "gamekeeper"- at present probably "wildlife manager" – has been used for centuries. It obviously corresponds to a specific term for people who are professionally or voluntarily involved in game and environment protection. That is why in the CR, exploitation of species suitable for hunt is not understood as a sport discipline, but as a qualified professional activity. The intensive breeding of pheasants in peasantries and the traditional keeping of hoofed game in game preserves have obviously enabled to maintain the precious biocoenoses which are taken as important stabilization landscape centers – in the landscape that was devastated by the intensive large area agriculture management in the 2nd half of the 20th century. In comparison with the post-war period, the area of the permanent landscape greenery decreased by 20-40 % due to its cultivation and transformation into arable land. Four thousand km of shrub/tree-line vegetation (alleys and waterside vegetation) was liquidated. More than 3600 ha of dispersed woody greenery disappeared. The area of wooded greenery around rural settlements decreased by 2,000 ha. Forty-nine thousand km of bulk covered by bush in the area of 240,000 ha and 158,000 km of field paths were liquidated.
Of course, the landscape changes also occurred in other and longer periods. In 1883, the Czech territory covered 5,501 million ha, and in 1996 it was 5,278 million ha. The number of inhabitants per 1 km2 doubled. Long ago, it was 66 inhabitants, and in 1996 it was 119 inhabitants. On the contrary, the extent of agricultural land decreased from 2,248 million ha (0,811 million ha of pastures) to 0,618 million ha (0,618 million ha of pastures). The woods covered 1,33 million ha in 1833, 1,769 million ha in 1996. The above numbers prove that the relatively high percentage of agricultural land in 1883 in relation to the number of inhabitants results from the different farming techniques. Provided the three-field system was applied, i.e. one third was left fallow. It means that only c. 2 million ha were used for alimentation of inhabitants. This roughly corresponds with the present extent of the agricultural land fund and with the present number of inhabitants. Further, it is evident that the decrease in agricultural acreage in 1996, c. 300,000 ha, has been compensated by the corresponding increase of woody land. It is important that the number of inhabitants has doubled. Also, the structure of habitation has changed markedly. It is possible to deduce from the period materials that more than a half of the population lived outside town agglomerations.

Recently in the present Czech Republic, there were quite different numbers and a bit different species of game. Also the philosophy of keeping of the important hunting game was different. In the middle of the last century, the "game keeping" mostly meant to keep hoofed game in closed preserves. More than four fifths of all hunted animals (red and fallow deer, wild boar) were hunted in preserves. Data stated in the Table 36 show more about the situation, variations in game management conception, and the total annual hunts.

Table 36: Number of hunted animals of selected game species per year

	Year 1894	Year 1994	Difference (in multiples)
Red deer	3566	16332	4
Fallow deer	2303	6384	2
Mouflon deer	0	6914	N/A
Roe deer	25428	105190	4
Wild boar	996	37750	38
Hare	830071	166605	0,2
Partridge	787520	23	0,00003
Pheasant	103167	429917	4

Source: Gesch, D.Land u.Forst, 1896 and CSO, 1996 – revised

With reference to the brief recapitulation of the history of game preserves above, one can summarize that such man-made enclosures have served for many centuries as important places for animal breeding. It also has indispensable importance as the landscape forming factor. This "secondary product" of game-keeping management (i.e. the protection of ecosystems in the game preserves) creates valuable values for the cultural landscape. As a matter of fact, many former game preserves are nowadays denoted by the organs of nature protection as regional and supra-regional ecological centers of landscape stability.
Unfortunately, the game-keeping that established and protected the game preserves for many decades, even centuries, is under media influenced community consciousness suddenly driven out as a malefactor and new-fangled "ecological managers" apply for their protection and management. So what is the perspective of game preserves and gamekeeping activity? The conclusion can be that the perspective is good. However, there will

SUBSIDY OPTIONS FOR GAME MANAGEMENT IN THE CR

The subsidy focused on game management activities is legally designated by the § of the Game management Act, through the State Budget Act No. 675/2004. Czech government supports management of wildlife in the cultural landscape via the following specific subsidy options:

- Support of endangered game species
  - Releasing purchased or bred individuals of endangered game species (Capercaillie, Black grouse, Grey partridge) into localities of their natural habitat
  - Purchase and installation of artificial ie man-made burrows
- Rearing in game-preserves – rare game species and sub-species (European wild goat, White-coloured red deer)
- Creation of feeding fields for the cloven hoofed game, including seeding, their maintenance and renewal in subsequent years.
- Assistance of birds of prey in plant protection
  - Farm crops protection against rodents
  - Production and installation of nesting boxes, production and arranging of stands for the birds of prey on farmland
- Medicinals as an ingredient of the feedstuff for treatment and prevention of parasitical diseases of the cloven-hoofed game
- Breeding and training of national hound races and of birds of prey
  - Successfully passed field-trial in the same year when contribution request was submitted; only for race of Czech pointer and Czech Terrier
  - Successful breeding of the bird of prey originating from the artificial breed (Goshawk, Peregrine falcon, Saker falcon, Golden eagle)

The state supports community associations, in accordance with its subsidiary policy towards non-state and non-profit organizations, in execution of their beneficial communal activities, in their voluntary education of children & youth and in the development of a platform for extracurricular activities of children & youth.
Apart from financial contributions, the state supports club game management indirectly as well. The game-keeper clubs, which have a place of residence in the area of the hunting ground, have a priority in the game-tenant selection procedure.

be the necessity to modernize slightly the view of the importance of game preserves. It is very dangerous to insist on the older concept of game preserves as single purpose establishments aimed at the hunting leisure activity and at the production of top hunting trophies. In the modern concept and with regards to the correct disputation with sometimes hysterical argumentation "nature first, man second" of extreme NGO´s, the game preserves should be presented as entities of extensive ecological agriculture which pay full attention to habitats, maintaining complexity of the cultural landscape on the one hand and which produce trophies and bush-meat i.e. biofood, including development of agrotourism on the other one. Consequently, environmentally friendly game preserves can be a source of livestock biofoods, if as well bred domestic animals in open space together with wild ones. It can be a prospective echo to new demands and at the same time, serve as a kind of significant life-quality perfection (welfare) for domestic animals. The additional livestock husbandry in game preserves or vice-versa of game animals on agro-farms, increases also economic efficiency of the companies oriented in such a business.

III.V.III Profit of the trophy hunting and venison as traditional viands

Historians suggest that venison has been consumed as a food longer than other meats, including beef, chicken and pork, that are more popular today. While venison and other wild game have roamed the lands for millennia, the practice of domesticating venison for food seems to have begun in ancient times, during the Stone Age. While the ancient Greeks seemed to be the first civilization that printed a guide to hunting, the ancient Romans lauded the pleasures of hunting and consuming wild game. Today, venison is enjoyed by many cultures who still rely upon hunting to gather their food. In addition, for a variety of reasons including maintaining the natural population of the animals, farm raised venison is becoming more popular. New Zealand and the United States are for many years the leading countries specializing in the domestication of venison (already Krostitz, 1979).

A DFID (Brown, 2003) study concluded that some 150 million people still rely heavily on wildlife for meat or cash and that wildlife tourism might become an interesting option for marginal remote areas. Given that the World Bank and the Global Environment Facility spent $7.4 billion USD on conservation and biodiversity projects over the last ten years, the poor could also benefit from having more of such funds going to meet their needs. DFID states that most poverty reduction strategies fail to recognize that many rural people rely on bushmeat and that declining wildlife populations makes their lives more difficult. (On the other hand, wild animals also cause problems when they eat villagers' crops or livestock, spread disease, or attack people.) Solving the bushmeat problem in countries with weak institutions is not easy. So far efforts to find other sources of protein to substitute for wild animals haven't had much success. Conservationists need to think more about the bushmeat issue from

the villagers' perspectives, and not just in terms of conservation. Working with logging companies, traditional forest dwellers, small farmers, and commercial hunters each require separate approaches. In any case it is a hard nut to crack.

Average prices in the Czech Republic are further stated as an example of direct income from game hunt (venison price is not included here). Charges for animals with a very good trophy (bronze to golden medal) range widely, but in average: fallow-deer EUR 1100-2700 and more, red deer EUR 1950-9700 and more, mouflon EUR 1100-3300 and more, wild boar EUR 900-2000 and more, roe deer EUR 790-1900 and more. Supplementary detail, depicted in the following table, summarizes CIC points and average charge per trophies in the Czech Republic.

Table 37: Overview and simplified prices of trophies in CR.

Item	Unit	Price (Euro)
Red deer – 150, 180, 220 points	CIC points	1500, 4300, 16000
Roe deer – 80, 100, 120 points	CIC points	250, 700, 1900
Wild boar – 80, 100, 120 points	CIC points	1000, 2000, 3500
Pheasant – hunted/shooted	piece	35
Hare – hunted	piece	45

Charges for a guide, interpreter, accommodation, meals, off-road vehicle usage etc. are paid separately. Thus, the Czech deer, wild boar or pheasant earns twice the amount of foreign exchange over for a long time. The foreign hunter who pays a high fee for a hunting vacation is allowed to bring home the antlers as a trophy. In the meantime, the meat is often exported, most likely to the EU countries. And of course, rates for sale of live animals are higher than rates for hunting itself. For example, the price of a live hare is about EUR 100. Therefore, bearing in mind the surplus profit from one hectare of wheat which is about 150 EUR, on can immediately see promising profitability in natural hare reproduction per ha. That is, if besides cereal cultivation biodiversity supporting measures are also employed for particular improvement of feeding opportunities, or in broader sense, for considered landscape advancement towards game resting haunts.

According to an expert evaluation by CGMA and FGMRI, hunting activity in the Czech Republic has brought in years 1980-1990 an average of 7300 foreign visitors per year and asset returns of 9,6 mil USD paid on trophies and other hunting commission fees (most of hunters were from Germany). In the period after the political changes, 1991-2004, the figures dropped down a bit, mainly due to incomplete data from private hunting ground owners, still reaching 5100 foreign visitors per year i.e. asset returns of 6,7 mil USD (personal communication CGMA, FGMRI).

Expert estimates by the director of Czech corporation called *Interlov* – a former traditional state firm managing trophy/venison sales which is trading currently some 70% of venison in the country – suggests that the total annual average of venison consumption from open hunting grounds (besides intensive farms) is reaching 6000 tons of all game kinds annually. It is more than before 1989 due to the openness of the market to European enquiry. A bigger part of the venison production ends up in restaurants and hotels and a smaller portion in commercial chains. Around 1/3 of the venison production is consumed by hunters themselves and therefore is not realized through the market. It might be of interest to see summarized average prices of venison in the Czech Republic in the table below.

Table 38: Overview and simplified prices of venison in CR.

Item	Unit	Price (EUR)
Red deer – venison	1 kg	11
Roe-deer – venison	1 kg	15
Wild boar – venison	1 kg	9
Pheasant – venison	piece	10
Hare – venison	piece	15

According to the records of the Czech MoA, average consumption of venison was 400 g/ inhabitant. Biggest venison consumers are in Germany where the average reaches 700 g/ head, although the figure includes only meat purchased through the trade network.
Marketing advertisements could likely stimulate venison trade, although one should keep in mind that if domestic production is successfully promoted in major consuming countries, a rapid expansion of production for export by New Zealand and other countries might in the longer run result in lower prices for venison, at least in real terms (Krostitz, 1979). This would bring venison within the reach of a wider group of consumers, but the profitability of this new industry would eventually be reduced.
Repeatedly, the concept of the viable alternative to ecosystem management via traditionally practiced intensive game keeping, has prepared a good basis for the modern utilization of game populations as a recoverable natural source. Game keeping combined with other forms of extensive agriculture (grazing) can become a very attractive form of ecological use and production of bio-nourishment. Professor S. Prien (Germany) said at the conference in Prague (2000):
"I cannot understand why the EU commissions have not supported and emphasized our outstanding alternative to surplus milk and beef production - the production of venison that is favorable for animals, environment and for the consumer. Why are we so nonflexible when such a new, perspective and important agricultural product is available? Is the lobbying for traditional commodities – despite over production – stronger than the will to accept the new ones?"

III.V.IV Free-ranging of wildlife in the open

Due to changes in the agricultural management system and excessive cultivation after World War II, a lot of grasslands in the Czech landscape have disappeared and the ecological stability has been disturbed. After 1989, the function of agriculture in the landscape started to be understood differently. At present, agriculture doesn't only produce but also plays an important role in maintaining of cultural landscape. Overproduction of foodstuff and low prices, accession to EU, reduction of cattle etc, caused many fields to remain uncultivated. The state subsidies program ("Abandoning of arable land") should motivate farmers to manage the areas so as to prevent them from dissemination of weed mono cultures and subsequent soil degradation. The aim is to maintain land's fertility and to stop erosion, with the lowest costs. As for game keeping, diverse weed- infestation is not considered negative. Some weed plants, sometimes considered dangerous (goosefoot, knotweed etc.), are important because of high seeds' production. These seeds play an important role in providing food for some birds (sparrow, bunting etc.) including those belonging to the game (partridge). Especially in the winter season, these seeds can become decisive for the birds' survival. Of course, they can be substituted with other plants, more acceptable for agricultural production. The above mentioned subsidy program supports cultivation of plants that are not processed in the food industry or used as forage, e.g. technical plants for bio-mass production or maintained grass cover.
On the basis of agricultural research, different ways of grassland maintenance and suitable structures of cultivated species have been recommended. Some of them can be rarely utilized by the game, but their efficiency can be increased by additional plants that do not occur in the ecosystem. In addition, it is possible to prepare special mixtures suitable for the game, respectively for individual game species.
An experiment performed by the Czech University of Agriculture (Department of grass and fodder plants) arranged the cultivation of grass species, clover plants and their mixtures in four different ways over the vegetation period, including mulching when the chopped matter remains on the plot. Neither nutrients nor pesticides have been used and the following methods have been applied: 3x mowing, 2x mulching or 1x mowing and 1x mulching at the end of the vegetation period. Harvest terms are shown in the following table no. 39 :
Attention was paid to yields, weed infestation, herbage cover before winter, microbiological soil activity, mulch decomposition, soil characteristics, and by Italian rye-grass. Also considered were the number of seeds fallen into the cover, their germinating capacity and other characteristics.
Results prove that the areas grassed spontaneously are infested with weed in the first years. Dangerous perennial weed often appear (thistle). Therefore it is useful to decide for 5-6 years of grassing. Oat grass suitable for different ways of mowing and preventing weed infestation is a recommended variety. Its disadvantage is a big amount of harvested hay – up to 9 t.ha-1. The fuel consumption makes the harvest too expensive. However, the biomass can be used as a renewable energy resource.
Lucerne and bird's foot trefoil are applied preferably from a group of clover plants. A common disadvantage of clover plants is their low cover capacity in winter. On the other hand, their positive fertilizing influence on soil quality is indisputable. For the game, with respect to the production of seeds, clover plants are more suitable than grass. Clover plants' variability also better meets the needs of some hoofed game species (e.g. roe deer) and brown hare. Foundation and treatment of the herbage on arable land can be financed from the subsidies fund mentioned above. Czech Governmental Regulation No. 86/2001 instructs how to obtain financial support and compensations for land abandoning and for the sale of oil rape grown on abandoned land which is subject to administrative order No. 454/2001. This order is available at the Ministry of Agriculture (Agricultural agencies), competent authorities etc.
From the game-keeping point of view, a yearlong grass cover of the land is advantageous not only for the hoofed game, but also for the small game, as it offers not only grazing but also a hiding place.

Table 39: Yields of selected forage and type of treatment (t/ha^{-1}) in the 1st year of establishment

	3x mow			Total	2x mulch		Total	1x mulch	1x mow
Term of harvest	**20.5.**	**25.7.**	**10.10.**		**20.6.**	**10.10.**		**10.10.**	**10.10.**
Oat grass	6,7	0,6	1,6	8,9	6,7	2,9	9,5	6,0	7,1
Cock's foot.	2,2	0,3	0,6	3,1	2,2	1,3	3,5	3,9	4,2
Bird's foot trefoil	4,3	3,2	1,7	9,1	4,3	2,2	6,5	3,1	3,1
Lucerne	5,7	4,0	2,8	12,5	5,7	2,7	8,4	4,6	3,7
Italian rye-grass	9	7	1,7	17,7	12,8	1,5	14,3	8,5	8,5

From the agricultural perspective, the harvest obtained by mulching twice during the vegetation is the most advantageous one, for the time being. Sustenance from the mowed matter remains in the soil and gets back into animals' food chain. This increases the number of animals on the respective plot. Later harvest can enrich the food of grass seeds, especially those of clever plants. Grass seeds are not that important. However, they can serve as nutrition – together with the mulch – to other animals, especially insects, who later serve as nutrition to pheasant and partridge offspring.
It might seem that the interests of game-keeping and agriculture compete – as it is given by the nature of both activities. Nevertheless, the Czech agro-envi program "Abandoning or arable land" partially harmonizes interests of both parties. It offers possibilities for improvement of ecological conditions in the landscape.

Planting of the temporary game refuges on arable land

Temporary game refuge is not a new concept; it has been discussed and recommended in tra-

ditional publications (eg. Černý, Kostron, Mikula, Kokes, Jirkovsky, Mottl, etc.).
The temporary game refuges are agricultural and fodder plants (annual or perennial) that can be – unlike woody plants – sowed and planted on arable land and other suitable areas. Compared to permanent game refuges, they grow quickly and the sowing is easy. Their shape and size should grant good hiding possibilities for the game. The plants serve not only as a shelter but also as a graze (some of them attract the game very much).
The most appropriate plants for particular habitats are as follows: anise *(Pimpinella anisum),* broad bean *(Faba vulgaris),* feterite *(Sorghum),* mullein *(Verbascum thapsiforme),* fennel *(Foeniculum vulgare),* cumin *(Carum carvi),* white meliot *(Melilotus albus),* kale *(Brassica oleracea var.acephala),* maize *(Zea mays),* pigweed *(Amaranthus sp.),* lovage *(Levisticum officinális),* lupine *(Lupinus alba et lutea),* marigold *(Calendula officinalis),* buckwheat *(Fagopyrum esculentum),* millet *(Panicum miliaceum),* fodder mallow *(Malva verticillata),* sunflower *(Helianthus covnus),* thancy phacelia *(Phacekua tanacetifolia),* topinambour *(Helianthus tuberosus),* fenugreek *(Trigonella foenum-graecum)* etc.
Some plants used in the past are not recommended nowadays, due to their bad diet qualities (i.e. winter rape "00") or proclivity to run wild i.e. giant knotweed that becomes a dangerous weed over the whole CR.

III.V.V Intensive cloven-hoofed animals rearing in game preserves

The breeding of game in game preserves has a long time tradition in the Czech land. Jan Evangelista Chadt Sevetínský quoted in 1908 that the sovereigns and the aristocracy established early on the game preserves *(hortus ferarum),* i.e. in "fenced forests" where the game was bred and hunted. In 1278, the record of royal game preserve in immediate proximity of Prague is mentioned, namely in the area of today's Stromovka park (the biggest park area of the capital city); the game preserve ranged as far as to the Strahov and Petřín hills. King Jan ceded the village Ovenec – after approval by the Congress – to the provost of St. Vitus church in Prague in 1320, however he had bespoken the game preserve expressly for himself (*hortus ferarum,* Kul. porn. 328, History of Prague, L 347). Further there are mentioned various kinds of wild animals bred in the game preserves, namely red deer, fallow deer, boar, as also rabbit and various exotic beasts as camel, buffalo and Asian sheep. Author Balbín then enumerates in the 1600´s Bohemia about 27 game preserves. Author Černý (l884) quotes as follows: "according to newest statistics there are in Bohemia 86 game preserves with total area over 50 000 ha". Author Wolf (1976) then quotes that game preserves in Bohemia, Moravia and Silesia oscillated between 254-353 from 1875-1895 A.D. In the year 1900 there were 146 game preserves with a total area 120 257 ha, and in 1910 there were 178 game preserves with total area 104 684 ha. The average area of game preserves was then approximately 600-800 ha. The same author further quotes: "till 1990 most game preserves were managed by the State forest company and within the 1990´s some game preserves were established also through the agricultural organizations and private subjects". In accordance with the gamekeeper statistics in the years 1996-97 the total area of game preserves in the Czech Republic was 32 221 ha, being situated on 2 504 ha of agricultural lands, 28 711 ha of forest lands, 319 ha of water surfaces and 687 ha of other lands. The average game preserve area was 418 ha.

Game preserve establishment – according to Cerny (1884) – a game preserve is a permanently and totally occupied part of the forest of a larger or smaller area at a favourable location intended for breeding the numerous amount of game serving mainly for interesting hunting. If local conditions make it possible one game preserve can include even more species of game such as red deer, fallow deer, roe deer, wild boar and hares. Most frequently, however, game preserves are intended for one game species only, viz. either red deer, fallow deer or wild boar and in addition to the game, roe deer and hare can occur in smaller numbers. Although it is more interesting and amusing from the aspect of hunting if more species of game occur in the common preserve it is recommended rather to guard only one of the species only. If the size of the preserve is adequate it is possible to recommend for common breeding red deer and fallow deer with lower numbers of roe deer and hares. Wild boar is less suitable for common breeding.

As mentioned already above, public awareness caused a right shift towards multifunctional perception of game preserve and away from the previous "monotheic" conception of a game preserve as a special-purpose facility for hunting and the production of top trophies only. At present, the establishment of game preserves is regulated by Law No. 449/2001 Coll. on game management as amended by later directives. A game preserve is defined in § 2 letter (j) as the form of a hunting ground with conditions for intensive game management, with its periphery permanently and perfectly fenced or otherwise arranged in such a way the game cannot leave the preserve. A basic condition for game preserve establishment is that the preserve has to be formed by continuous hunting grounds. The minimum area of the preserve amounts to 50 ha. Types of game preserves – the preserves are divided according to the number of land owners participating in the preserve formation, viz. two types: personal and community game preserves. Personal game preserves are created by hunting grounds of one owner only. Com-

munity game preserves are created by hunting grounds of more owners which are connected to each other reaching a minimum area. Their owners will create a hunting community for the purpose of game preserve approval.

From the viewpoint of climate, the most suitable locations in which to establish a game preserve are those in a region with a warm to slightly cool climate, with a maximum altitude of 500-600 m. The duration of a vegetation period (mean daily temperature over 10°C) should be more than 130 days, with the mean annual temperature over 7°C. The mean January temperatures should not exceed –5°C, the maximum snow cover should not exceed 40 cm, and snow cover should last no longer than 90 days.

As for game species kept in game preserves, warmer regions are suitable particularly for fallow deer. Colder localities are suitable for red deer and wild boar, and mouflons are sensitive to the snow cover height. Undulating terrain is more suitable for the preserve establishment than a plain. It is important that the game preserve has a permanent source of clean water throughout the year. It is ideal if a permanent stream runs through the preserve, ideally served by a good spring area.

One of the conditions of successful game preserve management is the suitable species composition of forest stands. The species and age composition of the forest, as well as the proportion of pastureland, are important factors in the determination of a spring stock of game within the game preserve. Broadleaves should dominate over conifers in the stands. The main tree genus in a game preserve should be the oak - any of the species besides red oak *(Quercus rubra)* whose acorns are less palatable for game than acorns of other oak species. Browsing plots of softwoods, especially of willows *(e.g. Salix triandra)* and their planting into enclosures is also very important since the supplemental diet of animals on young shoots complete the nutritive balance. Nutrition of game in a game preserve is dependent on the stand species composition. Oak creates the important component of food for game not only due to the relatively frequent crop of acorns but also oak leaves are browsed by game. In winter, it consumes newly fallen leaves. Ideal species composition of oak in a forest stand should be at least 50 %. Another important and typical species in game preserves is horse chestnut the fruits of which are sought particularly by fellow deer, red deer and mouflons while wild boar almost does not consume them. From the viewpoint of fruits, beech is of minor importance. The crop of beech nuts is by far lower and seed years of beech are less frequent and irregular. Leaves of beech, hornbeam, ash and also linden are browsed by game consuming newly fallen leaves. Fruit trees appear to be a suitable diversification, namely apple trees and mountain ash, either as wild trees or cultivars. Age structure and stand density are also important. Stands in the fruit-bearing age should predominate, i.e. over 60 years in oak and beech. Horse chestnut begins to produce fruits far earlier, such as from 10 years of age. Low stocking affects good and regular crop of fruits. In oak stands, it should mean only 30-40 % of their tabular full stocking. It is necessary to release crowns of oak trees in time for maximum fructification. Properly established, maintained and tended old oak stands should resemble a park. Regeneration of oak stands in the period of flowering our game preserve management was carried out using small-area artificial regeneration (5-10 are) by means of planting oak saplings to a minimum height of 150 cm and usually 4 x 4 m spacing.

Grazing plots of a game preserve consist of pastures, meadows and feeding grounds, or also stands, which serve for browsing. These plots are of fundamental importance for the determination of basic game stocks in a game preserve. The carrying capacity of a game preserve is markedly influenced by well cultivated pastures because they provide food for game from early spring to the first snow cover. However, one has to pay attention to the water regime of the ground. Waterlogged meadows and pastures have to be drained both from hygienic (small snails are often intermediate hosts of liver flukes) and production aspects. At waterlogged localities, acid grasses and sedges are predominant. The game does not eat them and consequently hay from the plots are of inferior quality. Every meadow and pasture should be mown annually according to the conditions of the vegetation and the weather. It is necessary, however, to limit mowing to selected parts of the pastureland at a time, ideally into three parts which are mowed at intervals of two weeks, in such a way that the larger part of pastures is always available for grazing. As for the composition of meadows and pastures, we do need to take soil quality into account. Plant species which tolerate grazing and trampling are preferable. As for clover cultures, Swedish clover and white clover are suitable in particular, on moist soils. It is five-fingered and on humic sandy soils, we can add alfalfa *(Medicago sativa)* or snail cover *(Medicago lupulina)* etc. As for grasses, the following species should be included: red fescue, meadow fescue, meadow grass, timothy grass and ryegrass. Quality hay for winter game feeding can be provided from meadows and grasslands outside a game preserve.

A precondition for the establishment of the grassland is a sufficiently insolated site which is preferably not waterlogged. There is a principle that feeding grounds should balance defects in game nutrition originating in certain periods of the year. Rotation of crops and distribution of crops for the game food plots should be chosen in such a way that the game can be naturally lured by the crops to the plots. Sometimes, it is suitable to sow various grass mixtures on one plot or on adjacent plots in such a way that sites are attractive for the major part of a year, i.e. pasture offers on neighbouring plots relate to each other. Cole crops (fodder kale), forest rye or millet liked also by pheasants rank among the most favorite pasture of cloven-hoofed game. Buckwheat is a suitable pasture in the period of growth depression of other forage crops (end of summer), lupin, fenugreek, soya, mallow etc. being also attractive. Of course, the use of various types of grass mixtures according to the behavior of game and environmental conditions appears to be most suitable. Grass mixtures for game food plots include various species of fast-growing variously maturing and variously tall herbs. Quality preparation of soil is, therefore, most important. Seed has to be evenly sown to a certain depth using standard mechanization or manually. Sometimes, it is necessary to roll the plots.

Game food plots are to be mostly fenced being often sown twice a year. In spring, e.g use mixtures of oat, peas and sunflower which are available for game in the period of oat milk ripeness. After grazing down, forage crops such as fodder kale, fodder rape or legumes are sown and are available for game in the winter period. For autumn, winter and spring grazing, more complex forage mixtures are suitable such as: fodder kale, white clover, oat, buckwheat, radish, rape, sunflower and forest rye. To ensure a forage base for a game preserve we grow cereals (mainly oat) and fodder beet outside of the game preserve or we ensure the forage through the purchase of bulk feed.

Game feeding in game preserves – area and type of pasture management together with stand arrangement – has to be in relation with determined target game stocks and an endeavour to fulfil the food requirements as much as possible. In ideal cases, game feeding in game preserves of the highest site quality should be needless (with the exception of drought periods or bad conditions of plantations on grazing plots) in the period May – September. In game preserves of lower natural carrying capacity, it is suitable to balance a deficit through the limited amount of briquetted components with the higher content of rough dietary fibre (over 50 %), such as 0.5-1.0 kg per day per animal (see below).

In the conception of game feeding in the period at the beginning and at the end of the vegetation season and out of it in the 9th through the 4th month (at higher altitudes also the 5th month), it is necessary to abandon the traditional cumulation of the care of game to winter months. The main attention must be paid to feeding in the period October – December when game forms reserves of fat for winter and male game has also to balance a weight deficit from the period of rut. Carbohydrate food, rather than protein food, is suitable for the period of January – April. In mouflons characterized by lower energy requirements than anther game,

a difference in the quality of autumn and winter feeding is not so marked. All changes in feeding have to be gradual considering the fact that the functional transformation of the organism of ruminants including the adaptation of microorganisms in proventriculi takes two or three weeks. It is necessary to reassess the importance of feeds with the higher content of fats (oil plants, maize) due to the considerable risk of debasement. Legumes can be used for feeding

Salt is necessary food supplement

in smaller quantities only. Various types of silage and haylage are the permanent component of game feeding. Special attention is to be paid to the spring intermediate period when beet, kohlrabi, turnip, carrot etc. are part of feed rations. Haylages in plastic bags are a new type of attractive forage approaching the natural winter food of game in the open. As an example, tried quality silage for cloven-hoofed game can serve a silage f the following composition: 25 % green maize, 13 % fodder carrot, 12 % apple pomace, 10 % brewer's draff, 10 % oat, 8 % meadow hay, 4 % fresh clover, 3 % mineral additives.

Granulated feed brings a possibility to control the content of particular components. Rough fibre which is an important component for the digestion of ruminants can be added into briquettes in the form of slash of broadleaves max. 0.7 cm thick, chopped oat or wheat straw, alfalfa, hay, dried browse etc. Oat or other grain feed and necessary mineral admixtures and medicaments serving for worming are other components. Suitable granulated feed prepared according to well-tried prescriptions is on the market.

Game has to be supplied with rock salt licks all-year-round and admixtures for the formation of antlers added seasonally. Orientation feed rations: All feed (roughage, pulpy feeding and salt licks) should be served *ad libitum* with the exception of grain feed. For orientation purposes, the need of feed is to be calculated per one animal of red deer circa 1.5-2.0 kg of hay per day from October – April. In case of fallow deer, it is about 1 kg and in case of mouflon 0.5-1.0 kg.

As for grain feed, red deer has an average yearly consumption per animal and day of about 0.6 kg, fallow deer 0.4 kg, mouflon 0.4 kg, roe deer 0.3 kg, and wild boar 1.2 kg in the winter period (December – March). In case of pulpy feeding, in red deer we can calculate on average 1.0 kg per animal and day for the period October – April, in fallow deer 0.7 kg, in mouflon 0.6 kg and in wild boar 0.5 kg (October – April).

Game preserve facilities (prepared according to Standardization directives of Lesprojekt 1986) – game preserve fences rank among necessary game preserve facilities. The fences should not disturb the landscape character. Present roads, rides or newly felled corridors up to 4–5 m in width are used for their construction. For particular game species, it is

Game preserve fences can have various construction appearance

necessary to observe the height of fences: red dear – 2.2 m, fallow deer, mouflon – 1.8 m, wild boar – 1.6 m. Gates, escape-control grids etc. are parts of the game preserve fence. The facilities prevent game from leaving the game preserve where a permanent fence cannot be constructed. The escape-control grid is constructed mainly in roads of the 3rd class going through the game preserve area (when the game preserve plan could not avoid the roads). Parameters of the grid: Sufficient width of the grid is at least 4 m.

Feeding equipment and stores – Various types of facilities for game feeding and storing various kinds of feed are an important game management facilities. Ways of serving feed are different in particular game preserves in relation to the localization of storage areas inside or outside the game preserve. In smaller game preserves, traditional methods of feeding are used, i.e. combination of larger feed racks of roughage with a feed stack and the system of feeders or silage tables. It is a time-consuming method supposing a relationship between living areas of game breeders/feeders and the game preserve. In larger game preserves, game feeding is carried out using large-capacity feed racks with feed stacks, often for bulk feed and grain feed and cellars for storing fleshy feed.

The feeding facilities in game preserves have to be placed in accessible sunny places (natural sanitation/decontamination by solar radiation is used destroying as many as 50 % developmental stages of parasites). A feed rack is placed in a place with natural or reinforced ground where it is possible to remove droppings and leftovers of feed (also in winter) and no waterlogging or retention of precipitation occur.

Other parts of a game preserve consist of feed racks, feed racks for young game, feeding devices for grain feed, feeding devices for fleshy feed, silage pits, silage tables and salt licks, hunting facilities, catching devices, water supplying devices, drinking places, wallows, and quarantine enclosures.

Winter stocks of game are the basis of controlled reproduction of game in a game preserve. Notice No. 491/2002 referring to Law No. 449 determines maximum game stocks for game preserves in such a way that 0.5 red deer unit can be per 1 ha of a game preserve. Determination of game stocks is dependent on the carrying capacity of a game preserve and on its area. It is necessary to ensure not only pasture but also a resting place for game. The area and quality of grazing plots of a game preserve are decisive factors for the nutrition of game. We can calculate that 1 ha of quality pasture or meadow can provide pasture for 4 red deer for the whole growing season or for 8 fallow deer or sika deer or for 11 mouflons. Under conditions of rich undergrowth, it is possible to add per every 1 ha of predominantly broadleaved stand aged over fifty years 0.1–0.2 red deer or 0.2–0.4 fallow deer, sika deer or mouflon. The area of a rest zone, i.e. of a forest stand should be for one animal at least 1.0 ha for red deer, 0.4 ha for sika deer and 0.2 ha for fallow deer or mouflons. Year-round fenced areas of forest or field plantations are not included into the exploitable game preserve area.

In game preserve management, the sex ratio is set 1: 1 to 1.4: 1 in favor of males. In establishing the game stock, the sex ratio can be temporarily in favor of females, such as max. 1 : 4.

Selective cull – One of the tools of cloven-hoofed game management is selective cull. It is a management measure aimed at the selection of winter stocks of game. The selection is of negative character because game is removed that is unsuitable for further breeding. The selective cull cannot be understood as the elimination of below-average male individuals only as often as implemented. It is necessary to consider that female game participate actively in reproduction before male game. This is usually in the second year of life. If the selective cull is to be really the selection of game stock, then it must affect also female game as soon as possible. For the proper assessment of the breeding value of game it is necessary to know the given population in great details, its physical development and the health conditions of game. Evidently diseased and injured animals and game of very low weight will be always the subject of selective cull. Obviously diseased animals are those which are considerably emaciated, with dull and erect coat, late mewing or suffering from diarrhoea which is expressed by the polluted target and hind part of legs.

EXAMPLE OF FALLOW-DEER GAME PRESERVE ECONOMY

Economic vitality of the preserve was verified under Czech Republic conditions in an example of a newly introduced management in the area of approximately 60 ha at the altitude of 490 to 510 m and with an average temperature of 7 °C. The costs were divided into the investments and current year expenses. The investments included money necessary for building the game preserve including purchase of deer. Current year expenses included animal branding, forage, veterinary interventions, repairs, wages, taxes, insurance, depreciations, and the like.

The numbers of animals during the first years after starting the game preserve were as follows (without the growth): the first year 30 pcs , second – 44 pcs, third – 45 pcs, fourth – 49 pcs, fifth – 52 pcs.

Operating yields consisted of revenue from sales of the fair game, trophy (head) hunting, sales for selected individuals, and venison sales.

The economy of the game preserve management was evaluated on the basis of the following economic relations enabling the analysis of relationship and dependence between inputs and outputs of the breeder management. Profitability is the main category in the market economy. It is important for comparing results from the management and agricultural production as well as for comparing results in the time series. That's why the profitability was expressed as a relative value related to different factors. Profit was compared with the factors influencing its creation. They were the following indicators: profitability rate showing the amount of profit per 100 Czech crowns (CZK) of total costs. Reciprocal value of the profitability rate is the indicator of economic effectiveness – the volume of profitability. This value expresses profit per one ha of agricultural land. Another indicator is production yield showing the proportion of profit to total income. The cost rate shows the percentage the costs participate in the income. Productivity of labor is expressed in the indicator showing the ratio of the total amount of production to the total labor.

In the third year after starting the game preserve (all indicators tended to increase), the profitability rate was 31.80 %, economic effectiveness 131.80 %, profitability volume (in CZK/ha) was 5,830 CZK (in 1995), production costs 75.87 %, productivity of labor (in CZK/h) was 305.50 CZK.

At first sight it is obvious that the activities were profitable even in the first years. When comparing economic results in the time series, we can see that the profit volume increases with the growth of the breeding. While in 1995 there was profit 15.5 CZK per 100 CZK of total costs, in 1995 the profit was as high as 31.80 CZK, i.e., almost double. Participation of profit in total income was only 14.17 % in the first year of operation while two years later it was 24.13 %.

It is interesting to compare this activity with results of agricultural management related to the land as well as game preserve management. The following table shows comparison of structure of costs in agricultural holdings divided into three groups according to the area managed. The most significant holdings for the comparison are those with the area of 10 to 50 ha whose area is close to that of the model game preserve.

The most significant difference in cost items between the game preserve management and agricultural holdings is in running overheads and the other expenses which are more than three times lower in case of the game preserve management. On the other hand, there is higher proportion of material costs as well as labor expenses there. The labor expenses of the agricultural management, however, do not include work of the game preserve owner. Anyway, it is not very important for the final comparison of the profit as profit from the game preserve management is conspicuously higher as compared with agricultural activities as it will be shown below.

The profit of the game preserve management can be compared with profit of agricultural holdings depending on the area managed and the LFA region. The statistical survey in the Czech Republic showed in 1994 (it covered 9.4 % of holdings) that 56 % of them achieved some profit. The game preserve management in the hill-country (potato cropping area) showed better profit than that achieved even in better production areas. These results are favorable even in comparison with holdings with the area of 10 to 50 ha. The difference was 3,693 CZK. The positive aspect was that profit was achieved even in the first three years. The yield rate of the game preserve in the third year was 24.13 % while in agricultural holdings with similar area it was just 3.22 % and in those working in the same region even only 0.66 %.

Productivity of labor was increasing during the first three years and the trend remained the same even later.

Wildlife for the landscape harmony

RED DEER

Breeding

The selective cull of red deer has to be started from the stage of calves. Criteria/limits for cull individuals cannot be set generally. It is necessary to determine them for a given game preserve and game population individually as well as gradually to making them stricter. Generally, a principle is in force that in female calves it is necessary to carry out more intensive elimination and it would be best to discard nearly the whole worse half of young hinds. As for young stags, only one quarter of their stock is removed at that stage. The measure can be substantiated as follows: for the game stock reproduction it suffices yearly to replenish the stock by young hinds, viz. about 15-20 % of the stock of hinds which means about 50% from the young hind increment.

Red deer (Cervus elaphus)

Hinds in the second year of their life are quite easily differentiated from other hinds because they are more slight than adult hinds. Visually, they appear to be on taller legs having an almost conical head, cylindrical body and a thin neck. Quality hinds usually become pregnant in October. As a criterion for cull, we take the physical and health condition of a young hind according to the change of color and comparison with a hind.

Hinds successfully participate in the reproduction of game stock up to ten or twelve years of age and as long as a hind leads a calf it remains suitable for breeding regardless of its age. Thus, the breeding value of a hind is assessed mainly according to the quality of its offspring. A young hind in the third year of its life sometimes has a weaker calf, however, it is its first offspring. Such a young hind can be quite reliably identified by an experienced gamekeeper and if the hind is healthy and developed he keeps it in the game stock.

Age is distinguished by age class which is recognizable by the antlers of a stag. The first antlers of red deer are usually simple spikes and these stags are called spikers. The physical condition of a spiker and length and diameter of spikes reveal its biological quality. Cull spikers are always those with the shortest and thinnest antlers and of weaker physical development. More accurate criteria (particularly the length of antlers) are set separately for every game preserve being gradually tightened as time passes. From the total number of spikers in the summer game stock before hunting the proportion of culled spikers should amount to about 30 %.

Stags in the second antlers: Stags with the sufficient length of antlers, well developed long brow tines and strong tray tines are considered to be promising stags. As for the segmentation of antlers, well established stags in the second antlers should be eight-pointers or ten-pointers.

Stags in the third antlers: Well established stags with the third antlers should have a strong long tray tine and a crown developed above it, i.e. three or more tines should be developed above the tray tine. The extent of antlers measured as the inner distance of beams at right angle to the longitudinal axis of a skull should be more than 80 % of the beam length. A length over 65 cm is regarded as a good length of beams of the third antlers.

The second age class, stags in the fourth to the seventh antlers: Stags of the second age class are denoted as maturing. They are already of robust body. The fourth and fifth antlers of breeding stags should have a crown with good tines and good extent of antlers. As for the length of antlers, a length of 75 cm is considered to be good. Requirements for the quality of the sixth and seventh antlers are similar as in stags of the fifth antlers, quantitative criteria are, however, more strict; the number of tines in a crown, their length, the length and weight of antlers. The length of antlers should exceed 90 cm and the length

of at least half of tines in the crown should exceed 15 cm. According to the standard methods of planning, about 10 % from the total plan of hunting are considered to be culled.
The third age class, stags in the eighth and other antlers: After a proper cull, stags in the third age class should correspond to breeding purposes from all aspects. They should differ only by quantitative characteristics, i.e. by the length and weight of antlers, length and number of tines in the crown and by their weight. The number of the stags should be sufficient, such as about 30 % of all stags of the game stock and they should be efficiently used in reproduction. As for the cull of stags of the third age class, it is about 30% from the total plan of red deer hunting. Hunting of stags of the third age class should be carried out at the end of rut or even after it.

Grazing

The environmental capacity in the game preserves and farms of Cervinae is increased by the introduction of individual plants, such as fodder cabbage. They prolong the grazing period by providing green mass for the majority of the winter.
It is seeded in the beginning of April in rows of 50-60 cm wide, and depths of 1-2 cm. The seeding amount of fodder cabbage is 2- 4 kg. This plant consumes many nutrients and grows very well with dung fertilizer. Nitrogen is then added in amounts of 200-400 kg per 1 ha. The green mass production of fodder cabbage amounts to 100-140 tons per ha and the mass can withstand frosts extremely well (up to –15 °C). Also, frosted and thawed cabbage are well accepted by the deer and it causes no dietical disorders.


Fodder (Brassica oleracea)

Out of annual mixes the deer are attracted for example by one consisting of leguminous plants namely field bean (15 %), field pea (35%), lupin (5 %), rape (10 %), vetch (15 %), soya bean (5 %) and chick pea (15 %). This annual leguminous mix produces great volume of green mass which is what attracts the deer. It provides quality protein nutrition which is suitable also for other kinds of ungulate game together with leporine game. Due to high and thick growth this mix provides not only grazing opportunities, but also hiding space for game up to the size of roe deer. The seeds of the legumes are eaten by pheasants, pigeons and other species.
This type of leguminous mix is not demanding for area, and it only requires medium to deep processing of soil and fertilizing by 2 kg of P^{2O5}, 4 kg of K^{2O} and 3 kg CaO per 100 kg of seeds (fertilizers on the basis of Thomas's meal). For the seeding of these kinds of mixes it is reasonable to apply cultures of nodule bacteria (such as Radicin) which significantly support the development of undergrowth and contribute to the root system and nitrogen for the soil. Grazed leguminous mix also works under the soil as a valuable fertilizer after ploughing. It does not only serve as summer and autumn grazeland, but at the same time it enriches the earth for the following season.
The above described leguminous mix is seeded in May by 200 kg/ha.
For grazing areas of more significant size, perennial grazing growths are, especially due to economic reasons, more suitable. Red deer and even, for example, roe game, is more attracted by a mix of timothy (4 %), red clover (4 %), white clover (2 %), fodder cabbage (1,5 %), red fescue (4 %), meadow fescue (2 %), fodder pea (4 %), cocksfoot (1,5 %), oats (30 %), winter rape (2 %), buckwheat (6 %), lupin (4 %), malow (3,5 %), scorpion weed (1 %), bird's foot trefoil (2 %), yellow trefoil (3,5 %), sainfoin (1,5 %), forest rye (20 %) and caraway (2 %).
Such a perennial mix consists of several grazing plants, which are suitable practically for all locations, even though it benefits more from richer soils. Thus fertilizing is recommended at 200-300kg/ 1 ha using a complex fertilizer. The mixed crop provides three years of interesting pasture and a further two years it is rich in clovers. In the seeding year oats and buckweed provide producing cover; clover and grasses develop slowly and forest rye athropises and stays near the ground. In winter annual plants diminish due to frosts and grazing and forest rye rises the next spring and provides a suitable cover. In the second year the grasses and clovers develop as undergrowth; forest rye is gradually grayed during the spring and into the summer (July) ripe period. In the third year part of the forest rye grows (about a third of the previous year). Clovers and grasses spread out and together with flowers they develop into growth that can be, depending on the winterizing condition, mowed. Following two to three years the areas of mixed crop can be used as meadows with a high content of clovers. Due to the fact that game does not graze equally on all areas, meadows need to be mowed once a year in order for them to rejuvenate and provide pasture which is attractive to the game. It seems useful to seed mixed crop on smaller bordering areas year by year so that different phases are available for the game every year. Testing in Central Bohemia (the Brdy Range) showed that the second year is very suitable for relatively higher fiber content in comparison with standard legume/oats mixes. Individual nutritious characteristics are from the physiology of the game point of view more favorably balanced - they are closer to the natural diet of a red deer and it helps prevent damage to forest growth, such as peeling. Mixed crop is seeded at 100 kg per ha in the second half of April.

FALLOW DEER

Breeding

Fallow deer fawns are calved in mid-June and their physical development is already at its most intensive by the end of November. The fawns suck their mothers' milk until the end of January (some of the fawns even until February). Thus, the weight increase in fawns is highest from the second half of August to the end of November and roughly between mid-December till April of the next year growth nearly stops. From the viewpoint of the development of each fawn, the first stage is the most important, i.e. from birth to the beginning of winter. Considering the physical development of fallow deer fawns and that fawns increase their weight roughly by 4-6 kg during September and October, it is suitable to carry out the culling of the fawns as late as after rut, i.e. from mid-November to February of the next year. Assessing the fawns is rather easy. From the second half of November, a quality fallow deer fawn is only a little smaller than its mother fallow deer, male fawns being usually stronger than fallow deer female fawns.


Fallow deer (Dama dama)

Through cull we ought to remove almost 40% of fawns per year.
The selection of fallow deer male fawns is only half as intense as against fallow deer female fawns and so we hunt roughly one quarter of their annual increase. This less intensive measure is substantiated mainly by a fact that assessing fallow deer in the second and third years of its life is by far easier than in female game.
Thus, the total cull of fallow deer fawns should be 37 % of their stock, i.e. roughly 40 % as mentioned above.
If we carry out the selection of fallow deer female fawns as planned we considerably facilitate work in the selective cull of tegs, i.e. last year's female fallow deer fawns or female game in the second calendar year of life. From the total number of cull of adult female game, ¼ are tegs.
Through the cull of fallow deer female fawns and tegs the main part of the selection of female game stock should be carried out. The selective cull of fallow does is then limited to diseased animals, fallow does leading repeatedly weak fawns and overmature fallow does.
In terms of bucks, the cull is carried out in this order of importance; fallow bucks of the first age

class - in the second and third antlers - fallow bucks in the first antlers fallow bucks in the second year of their life – spikers. Pedicles begin to form to fallow deer male fawns at an age of 6–7 months.
The subject of the selective cull of spikers consists above all in weak spikers of below-average physical condition. The height of antlers appears to be an unreliable criterion for breeding purposes; dimensions in their basal part are much more important because they correspond not only to the pedicle diameter but also weight.
Fallow bucks of the second age class – in the second to the sixth year of life. Fallow bucks of the second age class usually already have bucks with palmated antlers. The third antlers have a palm with spellers formed above a tray tine. The traits for breeding purposes are: beam length over 52 cm, palm length over 26 cm, palm width 11 cm, beam girth over 8.5 cm. A five-year-old and six-year-old fallow deer present antler quality and form which do not change markedly during next three to five years. The breeding value traits are: beam length 58-62 cm, palm length 32-34 cm, palm width 14-16 cm, brow tines 16-18 cm, lower girth of beams 9.5-10 cm, upper girth of beams 10-11 cm, trophy net weight: 2.5–2.8 kg, trophy value 152-165 CIC (the first numbers relate to five-year-old and the second to six-year-old fallow bucks). Typical defects include: cloven palms, palms ended by a crayfish claw, shovel-type palms, missing brow tine or tray tine and asymmetrical antlers.
Fallow deers of the third age class represent the results of breeding efforts. The shape of antlers remains in principle the same for several years from about the five years of age and only their parameters increase. Antlers of fallow buck backers rather rapidly lose their point value and the decrease increases with the deterioration of living conditions.

Grazing

Besides fodder cabbage and some other plants monoculture for fallow game contains attractive forest rye, which can be seeded in mixes. Due to its unpretentiousness for climate and soil it can be seeded within spruce monocultures. It is a primitive plant which has been recently recultivated. It used to be seeded on cleared forest areas in the past. Grown green forest rye used to provide quality pasture which attracted sheep or game between spring and autumn. Caraway used to be introduced into such growths and it used to be harvested the following year after the rye harvest. Area for forest rye is fertilized very rarely and only phosphorus is used as fertilizer. Nitrogenous fertilizers increase the risk of procumbence. In acid soils the reaction has to be modified. 100 kg per ha is seeded on St. John´s day (second half of June). Green stubble fields are grazed by game throughout the whole winter until late spring and provide excellent pasture with outstanding nourishment values. In the second year the forest rye can be, providing the quality of growth is good, harvested for grains and as such can be used in feedstuff or as seeds.

Forest rye (Secale cereale)

As annual crop mix attractive not only for fallow game, but for red deer and mouflon game consists of a combination of seeds of field bean (5 %), field pea (5 %), clovers (6,5 %), cabbage (2 %), corn (5 %), oats (38 %), buckwheat (15 %), rape (11,5 %), sun flower (3,5 %), soya beans (5 %) and scorpion weed (3 %).
A high covering of this annual mixed crop is assured by a range of cultivated plants with excellent nutrition and high attraction for game. Oats provide well digestible farina, grease and proteins with balanced relation with nutrients in rapes and clovers. Due to diversity in plants the mixed crop is attractive for insects too, which is the basic prerequisite for survival of pheasant and ptarmigan chicken, to whom it provides a good hiding refuge. The mix is seeded in May and July at a rate of 100kg per 1 ha to a depth of 2-4 cm. As fertilizer, pure nitrogen shall be used in concentrations of 80 kg per 1 ha.
Of perennial pasturing mixes fallow game shall be provided with more or less standard grazing mixes, such as mixed crop of timothy (25 %), red clover (15 %), swedish or white clover (5 %), ryegrass (15 %), meadow fescue (15 %), Kentucky bluegrass (5 %), alfalfa (15 %), oats (5 %). Such mix represents united undergrowth suitable namely for meadows established on arable land. The grass composition adds to clovers and covers areas, where these get loosened. Grass/clover is especially attractive for ungulate game, which it provides with high nitrogen free educt masses. Besides quality grazing the meadows seeded with perennial grass/clover provide hay with a single annual mowing. The advantage of the grass/clovers is their tolerance to harsh conditions and resistance to grazing and treading. Between April and the first half of August, 40 kg per 1 ha are seeded. It is advisable to add 200-300 kg of complete fertilizer per 1 ha.

MOUFLON

Breeding

Mouflon management is very traditional and has been for a long time, both in game preserves and in hunting districts. The quality of trophies of our mouflons represents a world top.
The reproduction capacity of mouflons is underestimated in forest management planning. The usually considered coefficient of expected production (KOP) 0.9 is in reality often higher than 1.0 being rather 1.1–1.2 KOP. Therefore, it is necessary to check it separately in every game preserve. With respect to these high reproduction potentials, a suitable sex ratio for game preserves is 1.2:1 or even better 1.4:1 in favor of male game. The aim of selective culling is to create a game stock from the very best individual animals. A main criterion for assessing the breeding value of game is its physical development, its health conditions, the development of horns, and the color of the coat (white saddles of mouflons are of secondary importance). The health condition of game is indicated by the time and rate of mewing. Healthy game begins to change color sooner and quickly.

Mouflon (Ovis musimon)

Mouflon young are lambed from the second half of March to the end of May. In the period of hunting, lambs vary in age. The physical growth of mouflon lambs is rather quick. At the end of their first year, the earliest mouflon lambs reach almost the size of their mothers. The sex of a mouflon lamb can be easily identified from the age of two months when the horns of lambs are already evident. The subject of cull will be at first female mouflon lambs because in males, from the second half of December it is possible to use developing horns as the criterion for selective cull. Considering high reproduction potential and thus numerous increases, we ought to hunt the worse halves of male and female mouflon lambs.
Diseased animals will be always the subject of cull. The main criterion of a breeding potential of mouflon ewes is the quality of their offsprings. Assessment of the mouflon ewe age is carried out according to the head shape, size, color and form of a nasal spot. The head shape (front view) in a young mouflon ewe is rather triangular, and in an old ewe almost egg-shaped. Nasal spots are at first small increasing with age. They elongate up to a forehead and in old animals, the whole head becomes gray. If a mouflon ewe leads a strong mouflon lamb, especially a robust mouflon lamb, then the ewe is of breeding value regardless of its age.
The development of mouflon trophies is much more common than in other cloven-hoofed game. In case of a proper selective cull during the first two years we can hunt only what we left out of the cull. The most important selective cull is carried out in the second year because a two-year-old mouflon already well indicates the further development of trophies. It can be found rather easily

according to its body shape, coloring the face part and the form of trophies. In mouflon horns, we assess their length, girth, extent and winding. The mouflon horn length of a two-year-old mouflon should reach at least 50 cm in December because the length of horns for the first two years represents nearly half of the final attainable length of a trophy. The spread of a trophy is generally given as early as at the end of the second year and should be about 50 cm. In addition to the length and spread of mouflon horns, their diameter measured as a girth (at the base of horns it should reach about 23 cm) is also very important.

Mouflons in the third year of age: A three-year-old mouflon already indicates the further development of trophies in all parameters. The mouflon can be found according to the coloring of its face part. A white nasal spot increases and elongates its upper edge being sharp lacking a grayish transition. A fleece is formed on the mouflon neck and its body becomes robust in the thorax. The main bend of mouflon horns is already created and they definitively show their spread. Mouflons with the length of horns over 75 cm, horn girth at its base 25 cm and span over 55 cm are considered promising.

Mouflons of the second age class, four to six-year-olds: These rams should be left in rest and their cull should be carried out for health reasons only such as injury or illness. In the case an excessive number of well established mouflons, it is possible to carry out hunting through catching for commercial purposes. Six-year-old mouflons can be also used for charge hunts.

Seven-year-old and older mouflons: This age category represents the third age class and results of breeding efforts.

In game preserves, mouflon rams reach maximum trophies sooner than in open hunting districts. From the economic point of view, it is not suitable to reserve mouflons needlessly and so we begin to hunt them already from around seven years of age. In the eighth year, the cull of strong mouflons should be finished.

Health care of game: The health condition of all cloven-hoofed game is, together with nutrition, one of the limiting factors showing a direct relation to the economics of game management. It does not only refer to the creation of trophies, but also to the production of quality and steadily required venison. Only healthy and genetically stable populations of game with appropriate nutrition living in a suitable environment have a chance not only to maintain quality trophies but also the subsequent economic evaluation.

Unlike populations of cloven-hoofed game living in the open, for game living in game preserves and in other "special-purpose" breeding centers, it is necessary to take into consideration the gradually occurring increased fatigue of the natural environment and its related health risks.

Problems of parasitic diseases in the whole spectrum of cloven-hoofed game can be regarded as one of the most important in game preserve management. It refers particularly to hoose (verminous bronchitis) which is induced both by species specific and nonspecific "small" or "large" lungworms. In wild boars, it refers to metastrongylosis, i.e. an illness caused by biohelminths. (Intermediate hosts are necessary for the parasite development.) In this particular case, it refers to earthworms of the genus Eisenia, Octolasium, Lumbricus or also Allolobophora. In our game preserves, the infestation affects 90-100 % of the population.

Treatment or preventive worming measures should be preceded by coprological examinations (examination of droppings) in order to learn the species spectrum of inner parasites and their intensity of occurrence. In breeding where problems of parasitic diseases are studied, repeated examinations of droppings are carried out even after 14 and 28 days after the preparation application.

At present, a number of antiparasitic preparations of various effectivenesses are available on the market. At present, preparations based on raphoxanid *(Rafendazol premix)* or ivermectin *(Cermix a.u.v.)* appear to be most suitable. It refers to preparations of the broad scale of effectiveness for lungworms and gastric- intestinal parasites. The first mentioned preparation is also effective for liver fluke, the second for warble fly and botfly. The preparations are mixed in a 1 : 9 ratio usually with oat groats being served for 2 days. For practice it is, however, more suitable to use a double interval for applications and in case of worming wild boar by *Cermix a.u.v.* to increase the basic ration. For individual treatment of all cloven-hoofed game (catching, immobilization etc) it is recommended to use a simple subcutaneous application of *Ivomec* or *Ivomec Super* (partially effective for fluke worms).

Grazing

Growths of lupin are among monocultures that attract mouflon game. Yellow and white lupines appear to prove tastier for the game. These are also more suitable from the nourishment point of view in comparison with the less valuable wild blue lupin. The disadvantages of the so-called sweet lupines are that they demand a warmer climate and better soils. Besides the fact that lupin is very suitable for ungulate game, it is suitable for small game too and it can later be used as green fertilizer.

Lupin is grown later than cereals and it can be seeded several years in a row on the same patch. Pre-seeding fertilizing is not necessary. It is seeded at the end of March and in the beginning of April and it has to be taken in account that lupin rises relatively slowly. Seeds are placed 3-4 cm into the soil. Suggested width of rows of 30 cm. Blue lupin is seeded at 150 kg per 1 ha and white lupin is seeded at 200 kg per 1 ha. It is advisable to mix lupin and oats using 70 kg of oats and 70 kg of lupin.

Lupin (Lupinus sp.)

Another plant suitable as a monoculture for ungulate game is buckwheat. It also provides a good refuge for small game. Seeds (achenes) and fresh green mass are very attractive for pheasants. It grows successfully on poor sandy, boggy or acid soils. Due to the fact that it is seeded later in the year, the temperature is not a limiting prerequisite to such an extent. It can be seeded as pasture in late summer, when it still has enough time to grow enough green mass, which prolongs grazing opportunity for game until autumn – until the frosts.

Green mass of buckwheat is very attractive to game until the point of maturation - it should be grazed before it develops seeds. The seed nutrition value is almost as high as one of cereals. Buckwheat possesses very valuable dietetic effects. It contains a cure called Glykosid Rutin.

Soil for seeding of buckwheat shall be prepared in the same manner as for cereals. It is seeded in rows 10-15cm apart at 80-100kg per 1 ha. If necessary, it shall be fertilized after seeding by 60 kg of N per 1 ha. Before seeding, 60 kg of P^{2O5} and 80 kg of K^{2O} per ha can be applied. It shall be seeded in the second half of July. Unlike lupines, buckwheat grows rapidly in the first stages and it is able to level out an area by closing up the space. It mixes well with charlock at 10 kg of charlock and 30-40 kg of buckwheat per one hectare.

Of annual crop mixes that are suitable for farming of mouflon, Landsberg mix is one that stands out. It is a mix proven by generations of farmers and chasseurs. It is seeded as a winter crop and it can stand late seeding, i.e. end of September. Still it is more suitable to seed it before the end of August. Green mass production depends greatly on fertilizing. A well-fertilized mix provides pasture in autumn. Due to the fact that Landsberg mix is not so early raising as, for example legume/cereal mixes, it provides fresh pasture even in periods when other plants lignify. Beside pasture, the mix can be used for making hay in two mowings per season. *Landsberg mix* typically grows up quickly even though after pasture or mowing vetch or rye-grass dominates. Both plants form interconnected growth with fair production. The mix consists of hybrid raygrass (28 %), Italian ryegrass (28 %), winter vetch (30 %) and incarnate clover (14 %). In August or in mid September 70 kg per hectare shall be seeded. Use 200-300 kg of complete fertilizer.

Of perennial mixes suitable for mouflon pasture, a crop mix developed by J. Rauwolf, a German specialist for game, should be mentioned. The mix consists of a balanced combination of annual and perennial crops. Annual plants provide pasture mainly in winter and in autumn. Part of these plants produces seeds and provides some pasture even the following winter and autumn. Perennial plants, namely clovers, grasses and herbs must not be oppressed by fast growing summer plants in the early stages of growth. Due to precise planning for seeding, the patch provides three years of quality pasture. This helps lessen the initial cost impact of cultivation and the seeding of a patch.

The mix can be described as a three-year mix of crop with a high content of papilionaceous and herbs. Other important parts are rapes, malow and fodder crops.

In the seeding year, a patch should not be mowed in order to let annual plants disappear. Spring cereals in the mix also cannot stand mowing. Fertilizing in the seeding year shall be limited too in order to prevent the growth from being too quick. In the second year the mixed crop should not be mowed too early in order to provide hiding space for game. Early mowing would also prevent seeding, which would lead to the disappearance of forest rye the next year. Still forest rye in the mixed crop is represented only sporadically in the third year. Lupines start the second year. They grow slowly in the first year and they blossom very late. Starting the third year, the growth changes in appearance and it becomes a meadow with dominant clovers. Quality of soil improves and after ploughing, the patch is ready for the next seeding of annual mixes.

The seeding of the mixed crop contains 10 % of clovers, perennial reygrass 4,5 %, fodder cabbage 2 %, lupin 2 %, oats 20 %, buckwheat 7 %, spring wheat 20 %, rape 2 %, malow 2 %, bird's fool trefoil 3 %, alfalfa 3,5%, sainfoin 6 %, winter vetch 2 %, forest rye 16 % and 2 % of herbs. From May through the end of July, 90 kg of mix is seeded per hectare. To fertilize, use 200-300 kg of complete fertilizer.

WILD BOAR

Breeding

At present, natural populations of wild boar are very large and it appears that the situation will last a number of years in spite of the efforts made by game managers and veterinary surgeons to reduce numbers. The present density of wild boar represents considerable zoohygienic risks and damage to agricultural crops which already exceed tolerable limits. Trophy quality is, however, very high and numbers do not suffice to cover the demand for quality trophies as well as

Wild boar (Sus crofa)

for venison. This fact can be compensated for by breeding the game in enclosures. Wild boars are tolerant to diverse environments but they prefer to habitate forested regions in lowlands or upland mixed oak/beech forests. Soils of higher textural classes and regions with higher precipitation are ideal for this type of game. In practice, a limit for breeding the game is the height of snow cover which is, however, only exceptionally limiting.

In establishing a game preserve, the area of which has to be at least 100 ha (as in other enclosures for cloven-hoofed game), we have to take into account the distressing effects of the wild boar upon the environment and therefore observe the lower limit of game density. Generally, the minimum required area for wild boar is 2.5 ha per animal, optimally 3.0 ha. It means that in a one-hundred-hectare game preserve, it is possible to keep a maximum of 40 wild boars (spring game stock).

To establish a game preserve with suitable breeding facilities for wild boars, it is advisable to use a fence in this combination: masonry column × wood. It is a very frequent type of game preserve fence in older enclosures. The masonry consists mainly of stone columns of about 130 x 100 cm, with side grooves on the left side and large-diameter half-round logs or boards inserted into them. There is a stony socle between the columns. Another variant consists of panels assembled from half-round logs and vertically attached on two horizontal beams which fit into pockets on the left side of the columns. The advantages of this type of fencing consist in its solidity, durability, cheap reconstruction, and minimum maintenance. The disadvantages consist in the high costs involved, particularly for material and transfer if local sources are missing. Simple stony or masonry fences form a stony or brick wall, the height of which depends on the kept game species. In the upper part, the wall surface is inclined. The advantages of this type of fencing lie in its durability. It is a functional variant suitable for all species of game requiring minimum maintenance. The main disadvantages are its high costs and the time it takes to construct.

Another facility very suitable in the case of wild boars that live in the open are artificial or natural elevations outside a game preserve reinforced by logs with an excavation inside the enclosure. The height difference of levels between the inner and outer part of the game preserve is 2 m. The advantage of this type of enclosure is that it allows for relatively long-term use. High purchase prise is a disadvantage and so this facility is not commonly used. It is also difficult to keep predators out.

In game preserves for wild boars, feeding places are reinforced by a concrete base where it is possible to serve feed on the ground and often to remove faeces (the transfer of metastrongylosis – verminous bronchitis is thus reduced).

For young game (piglets) it is necessary to construct pens for feed troughs to make it easier to control the group administration of food and feeding mixtures containing medicaments. It is not suitable to carry out the feeding from the ground or in troughs on the ground without soil reinforcement.

As for catching devices for wild boar, the catching is always carried out at night; the animals that enter the catching device are locked in automatically by means of movable rods placed 30 cm above the ground or by means of a trigger placed in served food. Construction of the equipment is most robust mainly in its bottom part. A multi-chamber catching device is used in the type of selection that offers hunting possibilities. An offer of the low-quality population of game can be controlled during hunting but this is, however, problematic from the viewpoint of ethics in our game management.

Wallows are special-purpose facilities used by game for cooling, protection from insects etc. in summer months, in the period of rut, and in wild boar serving all year round. The wallows are usually selected by the game itself in a spring area or in waterlogged depressions (permanent) or in road ruts or potholes (accidental). Permanent wallows are "opened" by game preferably in quiet and out-of-the-way places; as for wild boar, it refers to extensive young-growth stands and pole-stage stands. Under longer periods of drought, it is possible to regulate tracks of game by the importation of water into dried-up wallows.

In feeding wild boar, the carrying capacity of a game preserve is important. In the case of wild boar, fruit-bearing stands of oak, beech and horse chestnut are very important. According to the carrying capacity of a game preserve, a wild boar may consume as much as 1.2 kg grain feed/day/animal and 0.5 kg pulp feed. Feeding grounds of topinambour being gradually void of fencing appear to be a magnet for the game.

In order to aid the reproduction of wild boar in game preserves special troughs are employed, which is not the case for other cloven-hoofed game. The development of wild boar game stock is characterized by the high reproduction potential and feeding requirements of wild boar. Therefore it is principle to keep only as many female game as necessary for the reproduction of game stock. The reproduction coefficient of wild sows including female hoggets is 3.5–4 and, thus, the need for female game in the population is far smaller than in other species of cloven-hoofer game. Sex ratio in the game stock is set 3:1 in favor of male game.

Wild boars considerably damage their environment by digging up soil as well as in the creation of wallows and, therefore, some other breeding and organization measures are required, that is the creation of a generation rearing facility, covering an area of 2 to 4 ha. A selected breeding strain of 1:5 to 1:10 sex ratio is placed into a generation enclosure while male game is kept in the remaining part of the game preserve. In case of the necessity for more rearing facilities, these enclosures are arranged side by side in such a way that one catching device may be used for two or more enclosures. In each of the rearing facilities, it is necessary to build wallows, feeding places and sufficient shelter where wild sows can create their beds to farrow young piglets. These generation rearing facilities function for three to four years before, and for hygienic purposes, soil is decontaminated and left to rest for the period of one or two years for revitalization and subsequent use. When young wild boars are about six months old, their catching and sorting out are carried out before they begin to mate. The most promising piglets are used for further breeding and the rest are released to the game preserve for hunting purposes or are used commercially as living game. Under this method of management, the selection of breeding animals of the game stock is more perfect than in the case of the traditional selective cull. This does have its importance in a game preserve and allows promising tusks to be left for trophies. It works particularly well where the game is living in an open game preserve. It is, however, difficult to determine the measure of the selective cull because a correlation between the body condition and the quality of trophies does not always occur. Thus, selective cull depends above all on the experience and detailed knowledge of game. It is known that in the Sedlice game preserve, where the strongest trophies of tuskers occur in our country, bearers are of below average weight up to 100 kg and age 7-10 years.

One of the roles of establishing game preserves of wild boar is to produce trophies of high point value, easier hunting opportunities, production of quality venison and attractive skin. Abroad, there are game preserves and farm breeding where hybrids of wild boars with selected breeds of domestic swine are kept with an aim to produce high-quality meat.

Grazing

Wild boar is omnivorous and will distinguish between the quality and taste of feed. Studies show that they prefer certain kinds of corn to other kinds. Therefore the grazing pressure of wild swine in some preserves and even in open nature can be destructive. However pasture must be offered to this sort of game and it should be made available in a regularly controlled manner. The plant patches have to be secured and need to be accessible only on a temporary basis. The most attractive to the wild boar are the patches on the fringes of forests. Moreover, the wild swine prefers not only areas providing nourishment but also protection.

Usually corn fulfills these requirements. Corn is after all one of the most common agriculture products in Europe. A special plant for wild swine is Jerusalem artichoke, which also attracts deer and other sorts of game. It is related to the sunflower, blossoming in autumn from September to November. The bulbs of the plant are especially good pasture for wild swine because they contain about 20% of dry mass, which consists of 2% of proteins, of which inulin forms the greatest part. This is based on glycid and is similar to starch. The bulbs are yellow, white or red, the red ones being of highest quality. The green mass of Jerusalem artichoke can be silaged or dried.

Jerusalem artichoke is an unassuming plant adaptable to all kinds of soil and climate. It grows well in all agriculture areas, it resists the drought, cold, infections, pests and bulbs can survive even in temperatures over -20°C.

Topinambour (Helianthus tuberosus)

Jerusalem artichoke grows on one spot for 4-8 years. Before seeding it is recommended to fertilize the soil with dung (20-30 t/ha). If no dung is available, green fertilizing can be used in combination with industrial fertilizers. Bulbs of Jerusalem artichoke are laid as potatoes, in rows 60 cm apart with distances of 40 cm to the depth of 6-10 cm. One hectare can contain 1.3 to 2 tons of bulbs. They are laid in the spring, but can also be laid in the autumn. Yield differs from 15-100 tons per 1 hectare.

Turned up bulbs can be left on the field. Game feed on them all during winter until the spring.

Besides monocultures of attractive plants, wild swine should be offered a mix of plants. It has been proven that the feeding of wild swine is best arranged through a system of many small-sized patches with different pasture. *Bayerische Futtersatbau* recommends a system of three kinds of grazing patches. One shall be seeded by a mix of clovers; the other shall be seeded by a mix of oats, peas, beans and sunflower and the third shall be laid by Jerusalem artichoke or potatoes. (250 kg in combination with corn, 3kg regular types, 0.5 kg of sweet corn). Sweet corn increases the attraction of the patch when ripe. It is then grazed and other types of corn can ripen in the meanwhile. Seeding of anis or lovage increases the attraction too. Jerusalem artichoke and clover grazing area is perennial as long as they do not get devastated through extended exposure to wild swine grazing. The seeding of corn and potatoes should be annually renewed.

WILD RABBIT

Breeding

At present, with respect to low stocks of small animal populations, artificial rearing and release of wild rabbits appear to be a new phenomenon of game management activities. Reintroduction of wild rabbits into suitable habitats cannot be understood only as an effort to enlarge hunting offers/opportunities but at the same time as increasing the diversity of impoverished communities and to a certain extent also as weakening the predator pressure to populations of hare, partridge or pheasant.

Prior to the start of a wild rabbit rearing program it is necessary to obtain suitable breeding equipment. For wild rabbit rearing in captivity it is possible to use both "comfortable" hutches designed for hare rearing and ordinary hutches. It is necessary to take into consideration that wild rabbits are very industrious quickly gnawing wooden partitions and even an ordinarily used wire netting; "hexagon" is not an obstacle for them. One piece of equipment recommended by Vent is a very practical and tried alternative. It is virtually a "box" or the configuration of four cells each one of them being 0.75 x 0.75 x 0.7 m. A hatch fitted with netting forms a roof and one doe rabbit or buck is placed into each compartment. It is also necessary to prepare an appropriate area/space for young rabbits. They are mostly placed together in a larger hutch or well-secured enclosure. This equipment has to be, however, placed in a covered building. It is necessary to ensure sufficient light and protection not only from natural predators ranked among game but also from rats and even cats endangering mainly small rabbits.

In rearing facilities of any type, it is always necessary to provide good bedding consisting of straw or hay. Wild rabbits are grateful for the creation of shelters and hiding places either in the form of small boxes or only a plank leaned against the hutch wall. At the shelter entrance, a "threshold" several centimeters in height should be built. A doe could not put out its offsprings when leaving its nest. Devices for serving feed: Granules, hay, water, pulpy feeding and also salt are the same as in rearing domestic rabbits (earthenware sufficiently heavy feeders). Browse

Wild rabbit (Oryctplagus cuniculis)

is served freely. The need to use hutches which can be opened from above is compensated by a good approach to game and easy handling. Catching wild rabbits in standard roofed rabbitries is more complicated. It refers particularly to cases of non-crossed wild rabbits which are kept in pairs being unaccustomed to handling during mating. In these cases, it is sometimes practical to use a special catching transport box with movable walls.

For the transport of wild rabbits, it is necessary to prepare appropriate transport boxes to prevent losses. The crates can be composed of one or more compartments, usually two to four but it is best for each of the rabbits to have its own compartment. If rabbits are conveyed together, it is suitable to place a maximum of three animals into one compartment. If rabbits are transported in common compartments, animals of the same size should be in each of the compartments. Otherwise smaller individuals can be suffocated by larger ones. The effects of a heat shock caused either by crowding or poor ventilation can be very dangerous. If symptoms of a heat shock are found during transport (accelerated breathing, increased temperature, an increase in urine secretion) it is necessary to leave rabbits in a quiet shady place for the period of several hours. It is important for the boxes to be fixed during transport because their movement would increase the stress caused to the animals. The crates have to have good ventilation, however, openings in them should not exceed 1 cm. Height of the crates should not exceed 20 cm so that the rabbits are not able to jump up and wound themselves.

Food requirements of wild rabbits are identical with those of domestic breeds, however, with increased requirements for browsing. Feeding containing granules, hay and pulpy feeding and serving browse proved best. Sufficient amounts of fresh water appear to be a basic condition, the importance of which increases just with a recommended "dry" diet. Alternation of various green fodders in artificial breeding brings certain health risks. On the other hand, rabbits fed in this way are better prepared for adaptation in the open. If rabbits accept the fodder it also provides essential salts.

The actual breeding is started using suitable breeding animals. For intensive rearing of captive rabbits it is always more advantageous to use breeding animals coming from an artificial breeding program than animals that have been obtained through catching. Though these individuals provide a certain guarantee of a "pure species", their slow adaptation for new conditions markedly hampers reproduction and there are also increased veterinary risks. During the purchase of wild rabbits it is necessary to assess the appearance of game to make sure it corresponds to the species description (size, short ears, uniform coloring of all animals in the breed, higher timidity than in domestic rabbits).

When we reach the point of having healthy and genetically corresponding rabbits in appropriate breeding facilities then the stage of actual breeding may begin. With respect to the type and size of hutches the breeding of wild rabbits can be carried out individually, in such a way that a doe is kept separately and a buck is admitted to the female for a limited period, or they can live as a permanent couple. In that case, wild rabbits can be kept only in large facilities such as pens for hares 2 x 2 m in size. The risks in this case are that does are sometimes molested by bucks and small rabbits can easily be killed either due to spreading a nest or biting to death. Generally it is recommended, particularly in small hutches, to use separate rearing. One buck should be available for five females. Whether the doe was successfully impregnated can be found out about 14 days after mating (half of the gestation period) according to her behavior during the buck admittance. If the female is not pregnant then mating is repeated. At the end of the gestation period, about one week prior to a supposed litter (it is necessary to keep appropriate records) we clean the hutch or we move the female to another hutch with fresh litter so the hutch with young rabbits is not disturbed for a longer time. Weaning the young rabbits is carried out at an age of one month to five weeks when young rabbits are transferred to a prepared common facility. After two or three days after weaning, a buck is mated again to the female and the date of successful mating is recorded. Generally, we can consider 15-20 wild rabbits per year from one female. Release of reared rabbits into the wide open space and their intensive rearing in nature are the logical culmination of artificial rearing. Sometimes, this presents a larger problem than the reproduction of game in captivity. Wild rabbits are able to adapt very quickly in the open, at least with regards to food, but not however, with regards to predation stress. At the stocked location, therefore, suitable shelters should be provided, formed by vegetation and artificial refuges (holes, burrows, stacked wood etc.). The location should ideally be south-facing, and its subsoil should allow for the digging out of burrows. Abroad, plastic labyrinths are manufactured for these purposes – colonies which are dug into the ground. They provide shelter for the whole colony of rabbits protecting them from predators making it possible to carry out supervisory catching and a yearly vaccination. A shelter from dismantled transport palettes covered with soil and thorns is a simpler domestic variant. Minimally 25 rabbits are released in each location. It is useful to construct a high seat in the near proximity making it possible to watch over and monitor the game.

The production of wild rabbits using farm breeding can serve to stock hunting grounds with an aim to increase intensive rearing in the open with final hunting, production of venison and luring away predators, revival of the landscape or only the production of quality venison which is scarce on the market.

Grazing

The geographic and dietary tolerances of a European rabbit are fairly wide as proved by the introduction of this species to various continents and various climates (Scotland vs. Australia). Crimson clover thrives best in dry locations and so in dry areas this plant is extremely suitable for grazing. In wetter areas it can be planted in mix with Italian ryegrass. Other suitable perennial fodder crop for the grazing of European rabbit is lupinella *(Onobrichis viciifolia),* which is suitable for dry calcium rich soils. It can be cultivated as a monoculture or among grasses of permanent meadows. It grows naturally on meadows. Winter crops on fields attract European rabbits and among these is winter barley as a green fodder. Winter barley is less demanding on soil than wheat and spring barley. Its advantages are resistibility against droughts and strong offshooting. Winter barley is, in the form of green fodder, used only peripherally. It is mostly used as cover plant for GPS (ensiling pulp) and mainly in the period from beginning to mid seed sodden ripeness, which lasts roughly for one week. Its dry mass is 38-44 %. Winter barley can be base seeded with Italian ryegrass, which can be, according to the location, seeded until the end of September. Both plants (barley and ryegrass) are strong in offshooting and consequent seeding of clover is therefore impossible. Ryegrass growths can be used as intergrowth or can be used for longer periods (1-2 years).

Sainfoin (Onobrichis viciifolia)

As for the mixes, European rabbits are attracted by all mixes high in clovers. Clovers are resistible to intense grazing. The latter attribute is crucial for rabbits, as they tend to live sedentary lives and the grazing pressure, especially near the rabbit colonies, is immense. A good example of such suitable clover mixes is 40 % of red clover, 10 % of crimson clover, 10 % of white clover, 10 % of Fenugreek, 10 % of alfalfa, 10 % sainfoin, 10 % of scorpion weed. The combination of various clovers provides for both the high grazing activity of the game and for high resistance to trodding or unusual location conditions. Clover-covered areas attract game for several years from spring until late autumn. The green mass also allows for a higher volume of digestible proteins than, for example, clover-grasses. The type of mixes described

herein can be seeded from early spring (April) until the second half of August. Seeding is done roughly at rate of 20kg/ha. Using of phosphate or potassium based fertilizers is recommended according to the type of location. The best time of application is in the time of ploughing. (Havránek & Fejfar, 1988)

BROWN HARE

Breeding

In the course of recent decades, hare populations have rapidly decreased throughout Central Europe. The Czech Republic was considered to be a sanctuary for this species and interestingly here the decrease of rabbits was relatively the largest in Central Europe. The rearing of hare in farms shows, therefore, a number of alternatives and uses starting with the controversial reintroduction into the open, ordinary stocking and finally the mere production of venison.

Breeding environment: In the selection of land for a hare farm we have to take into consideration that the plot should be situated in a quiet environment, with good drainage and seepage conditions, near the source of fresh water and with a possibility to prevent penetration from the outside. It is important that a breeder is permanently near the facility. Pens should be situated facing a south-easterly direction because hares like to bask in the sun. On the other hand, hares do not tolerate wind. This should be taken into account in selecting a farm location. A widespread opinion that hares do not need water for their full-value life is unsustainable. In captivity, hares consume about 0.5 litre water per day (under conditions of dry feeding) and this amount markedly increases in the period of lactation. Foreign research has proven that where there is a shortage of water, the existence of hares is extremely threatened. Fresh water habits are also necessary from curative purposes, such as while serving drugs.

Brown hare (Lepus europaeus)

Facilities for hare rearing are usually made of wood although there are also metal alternatives abroad. The floor of their pens (about 2 m^2 for one pair) is made of wire netting or prefabricated sheet metal or plastics. This makes it possible for pellets and urine to drop onto the reinforced surface under the pens. Only a small part of floor is covered with boards for the protection from draught. Pens should be situated at around 70 cm from the ground, and placed on four legs. Detailed evaluation of pens is given by Kucera (1996). Droppings accumulating under pens have to be regularly removed. Feed is placed into cast-iron feeders, e.g. 25 x 14 x 5 cm in size; drinkers are constructed in such a way that they can be filled from the outside as can the racks for hay.

Feed rations for hares must contain the necessary percentages of protein, metabolizable energy, fiber, vitamins and minerals. For these purposes, a special feeding mixture Bz-Z (pelletized mixture for hares) has been developed which has proven to produce good results. However, it is possible to use a different feeding mixture that was originally designed for reproductive rabbits. It provides all the necessary nutrients for hares and the feed ration needs to be complemented only by quality hay. In the period of lactation, it is advisable to serve peeled oat or oat flakes into the feed ration for this feed favorably affects digestion and production of milk in mothers. For mature hares, we allow a feed ration of 120-150 g Bz-Z, and hay is served ad *libium*.

For abrading teeth we provide branches of trees and shrubs. Non-chemically treated branches of fruit trees, willows, oaks, locusts and other species are suitable for these purposes. If hares do not find a suitable substance for this purpose they will start to destroy their cages. The use of green fodder can cause diarrhoea, however, using fleshy feeding, particularly in winter when feedracks freeze can be recommended. As mentioned above, mature hares do show increased requirements for water in the period of lactation and consume more than 2 liters per day. Water has to be of good quality and, therefore, it is necessary to change it frequently.

Under optimum conditions, it is possible to achieve very good results in hare rearing. An average productive female litters 3-4 young hares per year, the average number of young in a litter being 2.2–2.6 (maximally 7). On average 1.2-1.8 young hares are weaned from one litter. Records show that one female produced more than 20 young weaned hares in one year (in the Research Institute of Animal Production in Nitra /Slovakia/, it was 27 young ones per year and 23 of them were reared). On the other hand, it is also necessary to consider the high loss rate of young hares, 20-35 % of all born hares. Intensity of reproduction is also negatively influenced by infertile pairs. Sterility of females can be determined by pairing a female with a male (for about 14 days) that had already young ones with another female. If even after 42 days the female is without young ones, it is possible to suppose that the female is infertile and we record it to be excluded from breeding. If a female becomes pregnant after mating with another male, we exclude the original male from breeding.

Breeding economics: The construction of breeding pens is a relatively demanding initial investment amounting to CZK 10,000 to 15,000. The price of one pair of breeding hares ranges about CZK 4,000 which means that costs for one pair with a pen are about CZK 20,000. To ensure breeding, it is necessary to carry out 2 m fencing of the area. It is also necessary to fence adaptation plots for weaned hares protecting them from predators.

The average consumption of granulated feed per one hare and day is 150 g. In breeding where 30-35 pairs are kept, it is necessary to calculate with the consumption of 50-60 quintals of quality alfalfa hay per year. At present, work is also an important factor in the economics of breeding. Generally, it is possible to calculate with an amount of about CZK 100,000 for wages. Revenues are dependent on realization prices which differ in case of hunting, sale of living hares or sale of venison. However, it is necessary to realize that cage breeding of hares is very demanding and results fluctuate under conditions of various external reasons.

Grazing

Apart from the known clovers and alfalfa, another plant which proves attractive to hares, even in monoculture, is another type of clover called bird's foot trefoil. It is an annual, possibly winter, procumbent plant, which persists in permanent growths through seeding. According to the location, it can grow from 40 to 60 cm in height. It is a melliferous plant and it is often used as a component in multipurpose grass mixes. It is also suitable as an under seed for green fertilizing. The nutrition content in this trefoil is comparable to alfalfa but it provides lower yields. It tolerates all types of soils and it is resistant to short droughts, but it does not tolerate wet soils. From March through August, 15 kg per hectare is seeded. The yield of the trefoil seed is 3-5q per hectare.

Among annual mixes, which help overcome the usually sparse winter period for the hare, is a mix of fodder cabbage, rape, forest rye and buckweed. This annual mix provides for a stabilization of food offer for ungulate and small game during autumn and winter, when food is scarce. Fodder cabbage and rape provide attractive feed and the possible negative dietary impact is leveled by grazing of forest rye. Buckweed also contains various dietary substances. The mix is seeded from July till the end of August. Since the majority of plants in the mix belong to braciacae, it requires fertilizing with nitrogen (up to 100kg of pure nitrogen per hectare).

Snail clover (Medicago lupulina)

Hare seem to prefer quite an intriguing perennial mix, which has been designed based on studies of the hare specialist, Dr. Brull (1973). The mix contains 38 types of plants including various herbs. Grasses-wise these are timothy, fescues, Kentucky bluegrass, crimson clover, white, red, and alsike clover, reverse clover and alfalfa. The named mix further contains fodder cabbage, carrots, parsley, great burnet, caraway, dill and various herbs (plantain, basil, borage, camomile, lovage, majoran, sneezewort, sage, thyme, and others). Introducing this mix to the cultural landscape helps eliminate many of its negative characteristics – large fields, monocultures, and lack of plants stabilizing digestive and other processes in animal bodies. It shows that during hunting season, hare and deer game flock to areas covered by such a mix of plants. It reaches its highest appeal in the second year after seeding. The impact can be still more increased by seeding of this mix on further small grazing areas throughout the landscape. This ensures a natural spatial structure of hare game, eliminating the risk of overpopulation, the transfer of diseases due to high concentration and furthermore the spreading of predators. This mix is very suitable for seeding as belts along the edges of fields. Another simple solution is to mix ryegrass and oats (annual ryegrass 20 kg and oats 40 kg per hectare) with the mix of: perennial ryegrass 8 kg, Kentucky bluegrass 6 kg, red fescue 6 kg, red clover 4 kg, meadow foxtail 3 kg, meadow timothy 3 kg, white clover 2 kg, alsike clover 2 kg, scorpion weed 2 kg, kidney vetch 2 kg, plantain 0.5 kg, agrimony 0.2 kg (Bukovjan & Havránek 1998, Kučera 1981).

RING-NECKED PHEASANT

Breeding

Pheasant came to Bohemia under the rule of Luxembourgers, i.e. in the 14th century (sometimes mentioned already the 11th century). Its breeding obtained worldwide fame and traditionally great interest in pheasants from Bohemia occurred in neighboring countries. It referred to an acclimatized subspecies of *Phasianus colchicus*. These pheasants had no white collar on their necks and feathers on rear back parts were chestnut-brown. In the 20th century, this population was, however, unfortunately crossed by various subspecies of *Phasianus colchicus*. In the course of past decades, a marked decrease occurred of natural populations of pheasant in the open. Relatively high bags are ensured, particularly by artificially reared and released birds. Habitats corresponding to the requirements of pheasants should provide sufficiency of food and shelter. Pheasants occur often in areas of high agricultural soil quality. On the one hand, crops grown there bring food and shelter, however, on the other hand, conditions of intensive agricultural production limit pheasant populations.

Artificial or farm, aviary, intensive or tame breeding of pheasants is most widespread at present. It is based on aviary keeping the breeding flock with the aim of the high production of eggs from one layer and on the artificial rearing of chickens until the time which is suitable for their release into the open. Conditions for intensive or farm breeding are as follows: sufficiency of suitable areas to build up aviaries for egg-laying, wintering aviaries, rearing aviaries, areas for the storage of feed and eggs, incubators, auxiliary rooms etc. Further, permanent manpower is necessary for game treatment and watching. The most suitable areas for large-scale rearing of pheasants are southern and south-eastern gentle slopes with permeable and drying soils protected from wind by trees. Traffic is to be away from pheasant breeding and excessive disturbance of game must not occur. It is suitable to plant hedges round aviaries at a distance of 2-3 m from a wire netting. A breeding flock is placed into an aviary which provides at least 5 m^2 for one bird. The facility has to be properly equipped before stocking. That means that it must be disinfected and sowed by suitable crops (winter crops, clover-grass mixtures). It has to be also protected from predators. Aviaries are to be equipped with shelters, feeding hoppers, drinkers, roosts and places for taking a dust bath. As mentioned above, aviaries for egg-laying are to be available for intensive aviary breeding. These can be either common aviaries or stable basic stock or portable basic stock aviaries. Common aviaries serve for breeding more hens and cocks of pheasants together under sex ratio 1 : 8-10 (e. g. 10 cocks and 100 hens). Minimally 7 m^2 are calculated for one bird. Stable basic stock aviary is about 3 – 10 m in size. The area of such aviaries should be covered with gravel sand to stop pools from forming after rain. It is necessary to ensure shelter and roosts there. Advantages of this method of bird keeping are the fact that we can monitor their reproduction characteristics and health conditions. Disadvantages of this technology are higher requirements for work during operation and higher purchase costs.

From the viewpoint of preserving a quality gene pool, it is suitable to include into a breeding flock non-relative individuals from other farm breedings, and also birds caught in the open. Of course, an ideal solution is to obtain a breeding stock which is not the mixture of variously crossed subspecies but it is a "purebred" *Phasianus* colchicus which is most suitable for breeding under conditions in our country. In reality, a gene pool of the majority of our pheasant breeding occurs in poor conditions. It is affected by crossing various subspecies, technological selection and sometimes also by inbreeding.

Ring-necked pheasant (Phasianus colchicus)

Under conditions in our country, an egg-laying period in farm rearing starts after 20 March and the egg laying should be used about until 15 June. As early as at the beginning of February, feed is to be adapted to the preparation of the hen organism for egg-laying. For this period, a feeding mixture BZN (Czech feeding product for pheasant hens) has been developed. Combinations of vitamins are added into water after a consultation with a veterinary surgeon. Eggs are gathered twice a day and are cleaned from coarse impurities. Nonstandard and damaged eggs are removed and remaining eggs are then placed in a room with a guaranteed temperature of 10-14°C and air humidity of about 60%. Eggs are placed on trays with their air cell upwards (dull end). It is advantageous if the racks with eggs are placed in a tilting device. Eggs are stored about 1 week (or a maximum of 10 days). Before placing into incubators, eggs are disinfected in storage rooms or in hatcheries by formaldehyde vapours (30 ml formaldehyde and 20 g potassium permanganate per 1 m^3). Eggs are gassed for a period of about half an hour at the temperature of 25 °C in such a way that vapor do not condense. We can obtain on average 50-55 eggs per season from one hen pheasant (present hybrid breeding). If we consider a subspecies non affected by artificial rearing, e.g. so-called Czech collarless pheasant, we have to calculate with somewhat lower egg-laying.

The seventh day after placing the eggs into the hatchery we carry out the first inspection of fertilization. By means of a candling device we exclude unfertilized eggs. The heat regime is observed according to instructions for the actual incubator, a temperature of 37.8°C being generally recommended. Air humidity is kept at 50 % and before the actual hatching (after the 21st day of incubation), it is increased to 65 %. Chickens are not removed from the hatchery until they are perfectly dry. If we are going to transport one-day chickens to larger distances it is necessary the chickens not be older than 24 hours. Within the time, chickens can do without drinking and feeding because they consume a vitelline sac. After hatching, it is necessary to calculate 1 m2 of heated area per 20 chickens which is gradually

increased. Coarse shavings not containing moulds are suitable as bedding. For small chickens, it is necessary to ensure an incident temperature of 32-34 °C and a possibility the chickens are able to run out into the area with a lower temperature. It enables the development of a thermoregulation mechanism which is very important affecting also other parameters of metabolism. In rearing houses, it is necessary to place roosts from the very beginning of breeding. Chickens can jump on them already from an age of 10 days. Without the adoption of the roosting habit, the chance of pheasants to survive in open nature is minimal.

Feeding mixture Bz 1 is used for feeding till the age of four weeks. In the period from the 4th to the 10th week, Bz 2 (complex Czech feeding mixtures for pheasant chickens) is used. A transition from Bz 1 to Bz 2 is gradual. From the seventh week, corn is also served. Moreover, from the 14th day we complete feed rations with green fodder (nettle, alfalfa etc.). A passage from the heated rearing house into the aviary is opened for chickens according to weather conditions at an age of about three weeks. The aviary can be at first partitioned and the space used by chickens is so limited. The conclusion of pheasant rearing in relation to a heated rearing house occurs in the 6th to the 8th week. Birds at this age are completely feathered and self-reliant (at an age of 6 weeks, young pheasants weigh at least 250 g, at 7 weeks 300 g and at 8 weeks 360 g). If we keep smaller numbers of pheasants, it is possible to use mixed feed and other standard sources of feed during their initial age.

The actual release of pheasant poults is never carried out by the method of "free flight", i.e. we do not empty the young pheasants from transport boxes in the open but we always use adaptation aviaries for a period of at least one week. A fenced plot connected with the aviary appears to be a very useful measure. Thus, young pheasants are at least partly protected from predators but can freely fly out from there.

The production of young pheasants can be used for sale, stocking a hunting ground, commercial purposes in pheasantries or production of venison.

Breeding pheasant broilers, which is sometimes considered, is not economically substantiated at present because the production of pheasants from hunting in pheasantries is high both in our country and abroad. The price of pheasant venison is negligible against revenues for the realization of one bagged pheasant. In addition, rearing pheasant broilers does not fulfil requirements of the species for welfare.

Sorghum (Sorghum sp.)

The dietary spectrum of pheasant and other gallinaceous birds represents both a vegetal and a sensuous part in accordance with the season. The sensuous feed offerm that is based on insects can be broadened by the seeding of insect-attracting plants. The source of sensuous proteins for pheasants (needed especially by chicks) is mainly represented by *Formicidae, Rhaphidophoridae* or *Curculionidae* and others. Besides this, the pheasants also collect butterfly caterpillars and beetle maggots.

Grazing

The plants used on areas for the intense raising of pheasants are mainly Indian millet and its hybrids. This cotiledonous plant of *Gramineae* family originates from areas with warmer climates. It thrives on medium weight and sandy soils, where it can resist droughts well. Among suitable precrops of Indian millet are root crops and maize, clovers or leguminous plants. It is seeded in May and in the beginning of June. Forty kg of seeds per hectare are strewn 2-3 cm below surface. It is fertilized by super phosphate. Another suitable crop attractive for feathered game is the broomcorn millet. The nutrition value of the broomcorn caryopsis is equal to peeled oats. Unpeeled caryopsis is higher in pulp and vitamins B1 and B2. For semi tame and tame breeds, the broomcorn is suitable during the period of transition from pheasant feeding mix to fractional grain. Broomcorn is resistible to drought but it demands light and warmth. For sprouting it requires a soil temperature of 8-10°C. The soil has to be fertile. The vegetation period is very short and it requires minimum water for sprouting. In seeding sequence, the broomcorn comes after clovers, *Brassicaceae* and root-crops. Thus rather lighter soils are required for broomcorn. It is strewn at the turn of April and May at the rate of 20-30 kg per hectare.

A good example of annual mix suitable for pheasant game is field bean (3 %), field pea (8 %), cabbage (1 %), maize (20 %), lupin (6 %), buckweed (18 %), broomcorn (20 %), mallow (6 %), and sunflower (8 %). Such a mix provides green pasture (cabbage in winter), energetically rich seeds, and cover, as well as being suitable for insects. It is suitable for belt seeding or for smaller fields. It could be mixed with spring cereals. Fifty kg per hectare and 50 kg of additional cereals per hectare is seeded. The seeding period is from May through the end of June. Fertilizing with 500 kg of complete fertilizer per hectare is recommended (Slamecka & Havranek 2001).

GREY PARTRIDGE

Breeding

Since the 60s of the last century, a marked drop in the number of partridges has occurred caused by changes in the anthropogenic landscape. Moreover, care of the species and its environment decreased at present. Therefore, it is necessary to look for ways which could at least partly eliminate devastation to the environment and at the same time benefit the implementation of local rescue programs. In artificial breeding and also in the open, we can sporadically encounter Alectoris spp, the nearest relatives of partridge. In Europe, there is chukar partridge coming from Bulgaria, rock partridge from the region of the Alps, former Yugoslavia or Greece and also red-legged partridge which occurs, e.g. in France. From the viewpoint of hunting, red-legged partridge is very evaluated.

Grey partritge (Perdix perdix)

The first stage of the artificial rearing of partridges consists in wintering a breeding flock which is prepared for egg-laying. Game treatment is technologically identical with keeping of partridges in pens during winter which was carried out in past with partridges caught in hunting grounds at the beginning of winter. Partridges tolerate this method of conservation very well and their feeding is relatively simple. The main principle is that partridges must not be placed in such a space where there is a possibility of longer flights. The flight of partridges is very quick and frequent losses occur due to impacts of partridges on walls or netting. It is suitable to partition the space for keeping the partridges to particular sections covered by a net. Anther possibility is to tie feathers or to cut through wing feathers. For short-term keeping, relatively small plots are sufficient, e.g. 5 x 5 m for 100 birds. In the vicinity of partridge rearing, domestic poultry breeding should not be carried out in order to prevent the transfer of diseases. In the rearing facilities, it is necessary to keep cleanness and frequent exchange of litter. It is ideal if we can move the partridge flock from one section to another. The rearing house floor can be covered with sand. Partridges need places for taking a dust bath. If we keep partridges in aviaries it is necessary to cover walls with reed matting or shields of another material so partridges are not disturbed from outside. It is also suitable to separate particular runs. Based on previous experience, a basic feed can consist of tailings with an admixture of *Setaria moharia,* millet or sorghum, crushed maize etc. At the same time, it is necessary to serve feed rich in water: sliced beet, boiled potatoes, cut carrot etc. If partridges do not accept the feed immediately it is suitable to mix the components into grain. In addition, it is suitable to serve green feed such as leaves of winter crops, grasses and cabbage or germinated grain. Older papers mention that partridges cannot be reared without green feed because of the risk of avitaminosis. It was recommended to serve boiled

meat as a source of proteins. From the viewpoint of current knowledge, however, the use of cereals, special feeding mixtures and green feed appears to be most useful.

Partridges rank among monogamous species. A dark horseshoe-shaped spot on the cock chest is a diagnostic trait for partridge cocks. As a matter of fact this trait is not reliable. Coloring of upper covering feathers is, however, a really clear and reliable trait for sex differentiation. These are graced by transverse stripes in partridge hens; in cocks the stripes are missing.

During winter or in its second half, we separate sexes to special aviaries. Thus, we can prevent fights between cocks and the formation of undesirable permanent pairs in this developmental stage is precluded. After wintering, it is necessary to carry out coupling during February, i.e. putting particular couples into separate aviaries. At first, it is necessary to check if frequent conflicts do not occur. If they occur it is necessary to give a new cock to the hen. Keeping partridges in a collective egg-laying aviary similarly as in pheasants does not correspond to biological requirements of the species.

Handling and treatment of eggs are the same as in pheasant eggs. Partridge eggs can be stored best for a maximum of 10 days. Hatching is carried out in incubators of various types. For example, in a table-type incubator Bios-Mono, the breaking temperature for partridges is 38.5°C. After two or three days, hatched are released from circles which held them under radiators at an incident temperature of 30-32°C.

Also further rearing of partridge pullets is carried out similarly as the rearing of pheasants. It is suitable to use special feeding mixtures supplied for example by Biofarm Chotoun-Jilove Co. Adding green feeding and particularly insect (insect obtained by sweeping, mealworms, crickets etc.) to the feeding mixtures affects very favorably results of rearing. It refers not only to nutritional but also ethological aspects and welfare. In rearing smaller numbers of young partridges it is possible to use traditional mixed feeds (grated carrot, boiled egg, green material, curd, crushed cereals or oat flakes etc.).

For the introduction of partridges in the open it is possible to use various methods according to the type of birds and the purpose of release. Birds kept in pens during winter are released right into the hunting ground. Three-day or older pullets can be released in the open, in an area occupied by a wild couple of partridges which adopt very probably the pullets (necessary inspection). Release of pullets with an adoptive parent (partridge cock, domestic hen of a lighter type) is an alternative.

Such a release is realized through a special aviary where a family flock is adapted to the locality. We can also release partridges at six weeks and older, artificially reared, temporarily placed an a hunting ground, in an adaptation aviary. The method makes it possible to work with higher numbers of pullets being relatively less laborious. Mortality of birds released in this way is, however, higher. According to the method we do not release birds lighter than 250 g. It is an important factor influencing the survival of young partridges.

Ribwort plantain (Plantago lanceolata)

It is not true that artificially reared partridges are not able to roost or that they do not connect with wild populations or that they displace them.

Already many years ago, these theories were disproved by papers of Dr. Bouchner who worked with large numbers of marked partridges. Released partridges remain at the locality of releasing. Based on experiments, 88% partridges did not leave the place of releasing to a larger distance than 1 km.

Partridges can improve natural populations. Their rearing can be used for commercial purposes, such as the production and sale of a breeding stock for exports, hunting, and the production of venison.

Grazing

An analysis of the feed spectrum of the partridge shows that one of the most important aspects of it are plantain seeds. This wild herb, considered a medicinal also for humans, can be planted in pure culture or can be added to mixes or seeded in existing meadow growths. The narrow leaf plantain can be seeded to all sorts of soils. Sunny areas are preferable, but it prospers in shady areas too. It is seeded manually with mixes or using machinery to depths of 4 cm. 40-60 g should be sufficient for 100 m^2. Germinability of well preserved seeds is 3-5 years. In human medicine the plant is used for its positive impact on alimentation. It contains glycoside aucubin, enzymes, invertin, emulsin and up to 2.5 % of lipids etc.

In the areas where partridges thrive, belts of annual mixes of buckweed, peas, maize, millet and lupines shall be seeded, as described in the article on mixes for pheasant game. The mixes should not only provide to partridges green mass and seeds for nutrition but a cover from predators as well. This is especially important when commercial crops are not available in the fields.

In perennial mixes, which serve the purpose on improving the location conditions for the favour of partridges and other species, we look for; timothy (20 %), Italian ryegrass (10 %), fescue (20 %), Kentucky bluegrass (15 %) and clovers (25 %). The remaining volume should be used up by flower seeds such as sneezewort, plantain, caraway, borage and others depending on the location conditions. Such a mixed composition ensures, among other things, a high attraction for insects, especially in the spring period. Insects represent an important part of the partridge chicken's diet. The mix is very diverse and it represents an attractive forage of greens during the vegetation period and in the autumn it provides a wide variety of seeds of plants and herbs, which contribute to the physical preparation of the birds for the winter period. This type of mix provides cover not only in the summer but in winter too. It is strewn from April, should be mowed in the first autumn and then again each following year. Annual flowering plants dominate the growth in the first year. Perennial plants, meeting the conditions of location and surviving the winter best of all, take over the dominance in the following years. The given plant mix has a high requirement for a suitable location. (Havranek & Bukovjan, 1996)

WILD TURKEY

Breeding

Wild turkey is the largest gallinaceous bird. It moves well and quickly overland. It does not like to fly although in case of threat it is able to fly up rather high. However, it does not fly long distances. It roosts on tall trees, mostly broadleaves. During the day, it moves constantly overland. It is a robust bird reaching a weight of 15 kg.

Wild turkey as a typical grazing bird needs for its life open terrain, however, it is possible to keep it in aviaries. It occupies preferably forested habitats where grassy areas overgrown with shrubs and adjacent farmland occur in the vicinity. Throughout the year, it prefers warm and dry areas because it is (particularly in youth) very sensitive to cool and humidity. It thrives best in the patchy landscape with water resources. Wild turkeys need not be additionally fed (naturally in relation to the carrying capacity of their habitat) perhaps with the exception of part of the winter months. They look for food on the soil surface, unearth seed and parts of plants and insect. One turkey can grub an area of 20-30 m per day. According to literature, it is able to hunt animals up to the size of a rat. In summer, green fodder, seed, needles etc. are the most important part of its food. In autumn, acorns and beech nuts, fleshy fruits and grain become the important component of

Wild turkey (Meleagris gallopavo)

its food. Young turkeys consume more food of animal character as compared with mature birds. On the yearly average, the food of animal origin amounts to about 40 % of the total volume. In the winter period, turkeys move to places with the smaller amount of snow and thus more favorable conditions to obtain food. During the first days of live, the food of young turkeys in artificial rearing is the same as that of young pheasants or partridges. However, their requirements for the amount of green pasture gradually increase.

Wild turkeys can be designated as polygamous birds. The age structure of turkey cocks markedly influences the population dynamics of micropopulations. Its favorable development supposes the proportional composition of all age categories and appropriate sex ratio, i.e. 1:3 to 1:5.

The higher number of turkey hens is not already suitable. One-year-old cocks and hens are able to reproduce. Under conditions of our country, lekking begins at the end of February and at the beginning of March. Nesting and hatching fall, unfortunately, to a period when cold and rainy periods still occur. It is the cause of the small prosperity of wild turkey populations in our country. The actual technology of hatching is similar to pheasant eggs. A difference is that eggs of wild turkeys are displaced after 24 days of incubation from an incubator to a post-incubator for a period of the next four days. In the post-incubator, it is necessary to keep the constant temperature and humidity of the environment. Candling the eggs is carried out in the seventh to the fourteenth day of incubation. They are reared identically as pheasant poults. In Litovel city, three- to five-week turkey poults were transferred (according to weather conditions) into boxes with small runs which were shifted each third to fourth day. At night, it was necessary to close the turkey poults and turn up the heating (according to weather). Unlike pheasants, it is possible to keep together turkey poults of various age from three weeks (with a difference of up to 10 days) without the occurrence of e.g. problems of cannibalism. At about ten weeks, turkey hens are transferred through an adaptation aviary and a fenced plot into the open landscape.

Chick-pea (Cicer arietinum)

From economic aspects, wild turkey breeding can be assessed positively. Turkeys provide quality venison which is highly valuated in specialized restaurants. In spring, they are attractive hunting and nice trophies. For the purpose of trophy hunting, it is necessary to keep turkeys to an age of at least 3 years. Turkeys render valuable services to forestry through the collection of insect pests.

Grazing

Wild turkeys are best bred in the warmer and dryer areas of Central Europe. Spring rains and temperature drops can kill turkey chickens, whose thermo regulative systems develop relatively slowly. In such areas a suitable crop providing forage and cover for feathered animals is chick pea. It is a crop cultivated of a wild plant type with dark seeds. It is an annual crop with thin non-procumbent stem covered by glandular hair. The seeds are found in a husk, which may contain one or two seeds. Chickpea is a leguminous plant high in proteins and the seed can be utilized in food industry. The root system of the plant contains nodule bacteria. The plant is resistant to drought and is capable to capture atmospheric nitrogen. It is suitable for reclamation of sandy and podzolic soils and it is used for boosting of yields of following crops on the arable land. Chickpeas are seeded in early spring so that moisture is captured. Between 80 and 120 kg per hectare is seeded. The vegetation period of chick peas varies according to location and it is around 130 days. The best mixes for wild turkey in a game preserve those producing sufficient volume of turkey attractive seeds. These are especially spring grain mixes tolerant to different locations and climates. A good example represents a mix of 80-100 kg of field or garden pea, 60-80 kg of oats, or alternatively 50-60 kg of pea, 30-40 kg of summer vetches 40 kg of oats. In dryer conditions the following mix shall be considered: 80-100 kg of pea, 30 kg of barley, 40 kg of oats or 70 kg of garden vetch, 30 kg of barley, 30 kg of oats. These are well tested plant mixes. Oats, vetch and pea provide for a good yield.. In the warmest areas, which are most suitable for breeding of wild turkeys, a mix of 20 kg of maize and 15 kg of soya beans is also suitable (Kucera 1987).

TETRAONIDAE BIRDS

Breeding

Since the beginning of the 20th century, not only in Bohemia and Moravia but also in larger parts of western and central Europe, the decrease in numbers of tetraonide birds has been noticeable. The continuous natural range of the birds began to divide along its margins and to assume an island-like character. Islands and isles with surviving populations of tetraonides have gradually reduced, concentrating themselves into the north-eastern parts of Central Europe.

Capercaillie (Tetrao urogallus)

For the purpose of breeding the birds which are intended for release into the open, it is necessary to create conditions as far as possible comparable with the open landscape, i.e., to ensure that the maximum area possible in the aviaries is covered with natural vegetation both of herbaceous and woody character.

Conifers are to be planted along wire netting creating the natural impact wall which can retard the flight and impact of disturbed birds. First of all, however, it forms an obstacle which cannot be ignored. As for woody species, it is suitable to plant willows and fruit-bearing shrubs such as currant etc. in an aviary. Open grassy areas in aviaries are to be mowed so as to offer soft young leaves for pasture. Burdock *(Arctium sp.)* forms a suitable shelter and shade but also a natural drinking place with water accumulated in leaf axils. However, artificial drinkers should also be made available. Ferns are an indispensable component of the capercaillie food. With respect to their attractiveness, however, they have to be repeatedly set out as full-grown plants in aviaries. Moreover, it is necessary to prepare places for taking a dust bath and collection of small stones – "gastrolites". For rearing capercaillie in smaller or larger aviaries, it is necessary to take into account the division of the area for a cock and hens. It means that the central aviary with a cock is connected with adjacent aviaries by passages (usually of a diameter of 18-19 cm). These are, however, passable for smaller hens only. Thus, hens can visit the cock, however, they are not disturbed in their aviaries because larger cocks cannot get into them.

Black grouse is reared in basic stocks – 1 cock and 2-3 hens in one aviary. It is advisable to visually separate neighboring aviaries so that the cocks are not able to see each other.

Hazel grouse live in couples which are put together in autumn. After making-up a couple it is necessary to observe the birds as one would do with partridges. If the cock and hen do fight this will usually end in the death of one of partners and, therefore, it is important to notice in time. Also in the period of mating, there is a danger of increased aggressiveness between a cock and hen. As mentioned by some breeders it is suitable to separate breeding couples not only visually but also acoustically. A cock provoked by calling a rival can turn its aggressiveness against the hen. The spectrum of food of tetraonide birds markedly changes during the year being more specific than in other species of gallinaceous birds. The digestive tract of capercaillies adapts to the changes, the double blind gut being of specific importance. For example, in birds of prey it is almost atrophic but also in domestic fowl, the gut is several times shor-

ter than in capercaillies. It is because capercaillies need, above all in winter, to use heavily digestible food with the high content of cellulose. Only then can the blind guts of tetraonide birds become fully functional as against the growing season. It is also known that, e.g., Scots snow fowl kept in captivity and fed by pellets had blind guts 48% shorter and small intestines 28% shorter than birds living in the open landscape. A capability to survive in the open landscape in such handicapped individuals is of course markedly reduced and, therefore, it is not necessary even to comment upon it. A similar situation, though not so striking, has been found in aviary rearing of ducks in Bohemia and could obviously occur in other gallinaceous birds kept in aviaries (pheasant, partridge). The actual nutrition of tetraonide birds in captivity should be as similar as possible to the nutrition of the birds in the open landscape. The recommended composition of nutrition in relation to the season is as follows. January-February: spruce and pine twigs, juniper, hazel, birch, willow, carrot, apples, onion. March-April: spruce and pine twigs, juniper, hazel, birch, willow, aspen, beech carrot, apples, onion. May-June: spruce twigs, larch, aspen, blueberry shrubs, fern. July-August: blueberry and cranberry shrubs, willow, larch, clover, currant, lettuce, chives, watercress, fern etc. September-October: blueberry and cranberry shrubs, aspen, maize, apples, larch, acorns, lettuce, watercress, chives, fern etc. November-December: twigs of spruce, pine, juniper, apples, apples, carrot, hazel. In addition to the foodstuffs mentioned above we serve permanently (particularly in winter) cereals, i.e. oat (oat flakes), maize, wheat, buckwheat and millet.

The consumption of cereals is a highly energy feed from the viewpoint of capercaillie metabolism and, therefore, it is necessary to control their consumption so that the birds do not become too fat. Insects are always a welcome enrichment of a feed ration. It is also possible to feed using mixtures of seed for exotic birds. It has been noticed that in aviary breeding, capercaillie consumes 110 to 160 g needles per day during winter months, whereas in summer virtually none. The consumption of cereals in capercaillie cocks is 40-50 g (by the way, it is a daily norm for much smaller pheasants). It is necessary to note that the winter metabolism of tetraonide birds is very economic and, therefore, the birds find it hard to endure disturbances connected with material requirements during this season. In addition to natural food, it is also possible to serve granules to young birds which are fed by hard-boiled shred egg yolk and ant pupae during the 1st day, the 2nd to the 8th day by mixtures – shred eggs, granules-complete feed, finely cut chives, curd, yarrow, nettle, mealworms, shred carrot, swept insect, the 21st to the 40th day as in the previous period – completed with dandelion and other green fodder supply of insect being also important. At 40 days a gradual conversion to the food of mature birds begins.

In the open landscape, the full egg yield of a capercaillie hen amounts to 7-8 eggs. In captivity, we ought to obtain 10-15 or more eggs from one hen. In the egg yield of a black grouse hen, 7-10 eggs are laid in the open, however, in aviary rearing hens lay as many as 30 eggs. A similar situation can be seen in hazel grouses.

The eggs of tetraonide birds are treated in aviary breeding similarly as they are in domestic fowl or pheasant or partridge, i.e. they are stored at a temperature of 12-13°C and relative humidity of air 75-80 %. Of course, basic hygienic rules have to be observed, viz. disinfection, as well as the turning of the eggs.

For hatching tetraonide birds in an incubator, an air temperature of 37.5 to 36.5°C and an air humidity of 70% are recommended. Naturally, turning the eggs has to be ensured under conditions of open ventilation. These data can, however, differ in particular types of hatcheries. Sometimes, for the purpose of increasing the successfulness of hatching it is recommended to incubate eggs during the first ten critical days under their own mother or a domestic hen and only then to place eggs into a hatchery. This procedure is really only a technological step to increase the effectiveness of hatching. In reality, poults finally hatched in an incubator are impoverished even before hatching due to the fact that they have been without the acoustic contact of their mother. This is important from the viewpoint of the development of an individual. Another time, eggs in the nest of a pheasant hen are substituted by false eggs while the actual eggs are incubated under a domestic hen in a safe room. Thus, a danger of abandoning the eggs or their threat by a marten, stoat or rat is markedly decreased. Before the actual hatching, eggs are returned to the own mother in the aviary so that the development and rearing is as natural as possible. Such a method of rearing should be the aim of every breeder. Well-ensured hatching and rearing poults under their own mother or a domestic hen are the most successful and the cheapest methods of breeding. Reared poults are of higher biological value and have a higher potential of survival in the open landscape.

At present, the breeding of tetraonide birds in central Europe is motivated and permitted particularly on the grounds of support of the preservation programs. A final product is, therefore, increasing the quality of the environment in regions which are suitable for surviving capercaillie or exposition breeding in zooparks. In Scandinavia, farm breeding is used for the production of venison. In Germany, capercaillie breeding is sometimes practiced together with the farm production breeding of other game, e.g. fallow deer. Unfertilized eggs are sold there as souvenirs and these capercaillie breedings increase the visit rate of commercially oriented breeding facilities. If the artificial rearing of tetraonide birds is related to the permitted preservation program, the birds can be sold for a good price. The costs for well-run breeding are relatively low from the viewpoint of feeding. The operation, however, supposes year-long serving twigs, branches and natural feeds which does prove rather demanding from the viewpoint of labor.

Grazing

In the case of tetraonidae, namely capercaillie, the environment and its management cannot be described according to previous schemes. The capercaillie's natural environment is the forest and it needs to be paid very close attention. Generally it needs to be said that due to migrating abilities and the ethnology of capercaillie, a minimum of a suitable location has to be established (area of approx. 3-10 ha), but it is best to manage

Blueberry (Vaccinium myrtillus)

the forest in the ways which would provide the creation of an environment suitable for the sustaining of capercaillies. Such a situation further signalizes that the environment is not only suitable for capercaillies, but for general biodiversity and ecological stability. That depends :

1) on case of planting, strewing or self sowing, coppicing, letting of unsuccessful forestification without improvement, or in case of an improvement in the kind of trees in the state of grown copses. The forest management has to focus on aiming for a final state of the forest growth in order to create species with a differentiated growth biotope suitable for capercaillies.

2) on preclearance growths the actions cannot be generally specified. Higher intensity and well-timed actions can be suggested as long as position of the location and the undergrowth state is taken into account. The basic prerequisite is not to remove unleveled individuals or to start bush growth and to support natural youth growing from a medium age. The complex health conditions of the growth have a direct impact on the intensity of growth interactions (snow damage, game demand etc). With a greater scale of damage to trunks, the interference shall be gentle with stress on supporting tree species. With healthier growths building the longer crowns, spruce trees need to be supported in order to regulate even light regime, thus providing a more intense action.

3) Clearance for improvement of the forest needs to be done exercising greater care, because most of the areas are threatened by wind, snow and possibly even frost. Of renovating processes, only small scale

harvesting under mother growth is possible. Peripheral shielding harvesting, group shielding harvesting or selective harvesting is suitable. On locations with fair exposition renovation next to mother growths can be applied through small scale pot harvest. When the renovated growth gets linear segmented, a possibility of setting up of an ecoton arises. In further phases growth along the lines is gradually lightened up. The removal of individuals has to be willingly directed towards preferred species (pines).

The regular renovation period of the forest has to be prolonged by at least one half. During the first renovating phase lower significantly the common density of the forest and exercise management actions in the forest with maximum focus on sensitivity without damaging herbal and bush forest levels. This is best done with high snow cover.

A suitable capercaillie biotope with a high likelihood of long term sustaining of vital population should meet the following conditions:

1) dominant coniferous with significant portion of feed preferred tree species (pines)
2) Sufficiently opened structure of the forest allowing development of rich herbal level allowing free flight
3) large quantities of berries of Vacciniacae family
4) Sufficient amount of insects and other Crustanacae for the chickens
5) Low fragmentation and majority of plots larger than 50 ha
6) Total area of at least 10,000 ha.

Plan of measures for one capercaillie micro population should incorporate an area of 300-1000 ha. This space theoretically includes 3-4 mating areas for 15-20 cocks and 20-25 hens (Havranek & Bukovjan 1997).

MALLARD

Breeding

The mallard is the most abundant and best-known duck in our country. The high number of mallards found in game preserves today backs up the opinions of professor Komarek who wrote in 1945: The mallard is a bird of the future game management business on our pond waters – its time, however, has not yet come. At that time the mallard was, economically speaking, behind squirrels or foxes, i.e. the price of venison or skin.

In 1933-1936, on average only 25,117 various ducks were bagged which means that at present, we bag roughly ten times more. These figures, however, tell nothing on the increase of the number of mallards in nature during recent years. In reality, their number decreases and increased bags are a result of the increasing number of released mallards. For example in 1976, only 2,224 mallards were released in the CR, however, in 1989 230,402 birds were released.

The fact that the nesting population of mallards is estimated to have halfed between 1988 and 1997 is obviously caused by the intensive fertilization of ponds, lack of safe habitats and rapid increase in the populations of predators.

The farm rearing of mallards became very popular during recent years. It is nearly trouble-free to keep a breeding flock; they maintain a good production of eggs, a low mortality of hatched ducklings, hold possibilities of early release on ponds (at an age of three weeks), maintain faithfulness to a habitat (place of release), and have a mostly low mortality rate till the time of hunting, high bag rate.

For the successful farm rearing of mallards it is necessary to ensure that the aviary has access to water, i.e. a reservoir (preferably through-flow). Before egg-laying, we place nesting boxes in the aviary preferred by the birds particularly if we use nest-eggs at the beginning. Thus, eggs are not polluted and their collection is partly simplified. In addition, the system makes it possible to identify birds with a tendency to brood. Feed is served in various forms of troughs or feeding hoppers.

Mallard (Anas platyrhynchos)

For proper feeding while keeping ducklings in a rearing house (i.e. 14-21 days), they are fed ad libium with an appropriate mixture for mallards (the use of mixtures for domestic ducks is not suitable). A further feeding regime (granules + cereals and other seed) is dependent on the capacity of the environment for released mallards and on the number of released birds. The number should not markedly exceed the environmental capacity, i.e. mallards should not be dependent on artificial food.

For reproduction, the sex ratio in flocks of a mallard (although in the open, mallard is mostly a monogamous bird) is kept 1:4. Egg-laying takes 70-75 days. Collected eggs are disinfected and stored in a cold room (10-15°C) for a maximum of one week. It is necessary to turn the eggs once a day and moisten them using a sprayer. Before putting the eggs into controlled hatcheries, it is suitable to place them into the environment with a temperature of about 20°C for 15–20 hours. Hatching occurs in a pro-hatchery at a temperature of 37.6°C and relative air humidity of 40-60 %, and in post-hatcheries at a temperature of 37.4°C and humidity 75-80 %. In pro-hatcheries, eggs are also moistened once a day by means of fogging, and in post-hatcheries eggs are shifted mostly the 23rd day, and moistened 4 times a day with the exception of the last day (ca the 28th day). We do not forget the inspection (candling the eggs the 8th and the 20th day) and removal of unfertilized eggs with dead embryos. After hatching and drying out, ducklings are transferred to rearing houses where it is necessary to ensure a temperature of 29-30°C and within 14 days decrease it to 20-22°C. Straw, not sawdust, is suitable as bedding. Until the age of 14 days, it is necessary to calculate at least 1m^2 rearing house per 10 ducklings.

As compared with the merits mentioned above, there are also a number of drawbacks related to farm breeding and the subsequent hunting or other uses of reared mallards. On the one hand, it is keeping breeding flocks consisting of individuals, the origin of which is very problematic from genetic aspects. On the other hand, it is affecting the birds by artificial rearing which is repeated in the CR already for many generations.

In releasing artificially reared ducklings to ponds and intensive feeding along banks or on feeding trays, birds do not use the natural way of food intake in the aquatic environment. Therefore, shots to the stomachs of artificially reared mallards are much more rare than in a wild natural population where they occur in 3% of birds. If we take into account that digestion of shots takes about three weeks, then a considerable part of the population can encounter the noxious agent during several years of life. Now, let us consider various schemes of rearing and hunting of mallards. The most widespread way is based on a partly domesticated and genetically, probably not pure, breeding flock with a high production of eggs (40-60 eggs from one mallard). Ducklings are reared using a poultry technology, i.e. in large groups under serving energy-rich feeding mixtures in a loose or granulated form. At the age of three weeks, when they do not need additional heating, ducklings are released to ponds and intensively fed mostly using grain. If possible, they are forced by alternate feeding to fly between two ponds (using an acoustical signal). The weakest point of the method is a more or less decreased possibility and willingness to fly. In relation to the fact, increased contamination occurs of the aquatic environment by shots. The above-mentioned method of the production of mallards is sometimes also connected with releasing such a number of ducklings which exceeds the carrying capacity of the environment, the size of a pond.

Recently, senseless conflicts have occurred between pond owners, nature protection and game managers. In some countries, therefore, maximum permitted numbers of mallards are set for releasing according to the area of a water

body. The use of mallards kept in aviaries during winter appears to be an alternative, close-to-nature and biologically more quality method.

1. Mallards kept in aviaries during winter are released in smaller groups at the end of February or in March to ponds with a suitable shelter for nests.

2. Mallards which regularly lay eggs or succeed to sit in nesting boxes are separated to be able to sit in seclusion. After hatching we release the whole family flock though only to a small pond.

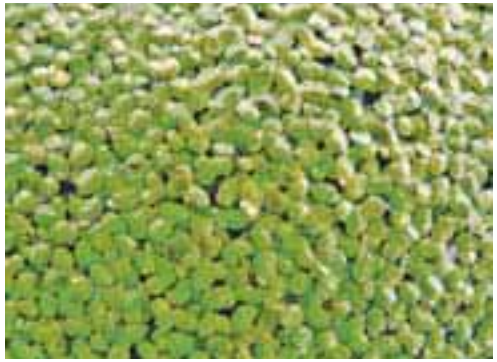
3. In the half of the period of egg-laying, part of the breeding flock is released in the open. Part of the mallards (20-30 %) can still brood.

4. There are historical sources that say eggs of mallards were laid under domestic breeds of ducks and released together. From the viewpoint of a permanent imprinting of the appearance of a parent as a future sexual partner, the method is sometimes questioned. There is increased risk of the origin of interspecific crossing.

For the prosperity of both natural and artificially established populations of mallards, it is useful to construct artificial nesting places – boxes in the open landscape markedly increasing the successfulness of nesting through the elimination of predation pressures. Nesting boxes should be of the following dimensions: ground plan 30 x 40 cm, height 30 cm, entrance hole 15 x 15 cm (situated in the upper part of the front wall).
Before the entrance hole, it is suitable to construct a landing platform about 25 x 30 cm in size which can originate through the extension of the nesting box floor by 25 cm. In the installation of nesting boxes we must not forget to fill them by "bedding" (straw or hay). If its quantity is too small or none, the mallard cannot create a nesting hollow; eggs roll away and cool down. Therefore, we apply a principle to use more bedding. Another method to increase the capacity of the environment for intensive breeding of mallards is to use suitable plants, above all reed.
From the viewpoint of costs for the production of one duckling and the production of ducklings of one mallard, the breeding of mallards can be considered very advantageous. A fact is also favorable that ducklings can be released to ponds at three weeks of age. There they can find a considerable part of their animal food (according to the carrying capacity of the environment) and "cheap cereals" are sufficient for additional feeding. Thus, hunting and venison are the final products of breeding. However, it is necessary to consider the objectives of breeding from the very beginning. For the purpose of hunting and nature protection, it is necessary to keep light and mallards that fly well.

Grazing

The feed offer of wild mallards can be augmented by the planting of various plants, all trees, grasses and other herbs. Near willows and alders can be used, and birches can form a fast growing



Common duckweed (Lemna minor)

background. Alder and birch seeds are eaten by mallards. More distant oaks broaden the feed offer by providing intensely accepted acorns.
Bog plants tend to shoot out slowly and with considerable irregularity and thus these are better multiplied by planting pond collected roots, bulbs or sprouts. Autumn planting may be successful, but the plants must not be exposed where they could be grazed. Wire net planting is highly advisable in this case. Water plants must not be allowed to dry out during manipulation, storing and transport. Submerged rooted plants can be covered by clay or hummus covers, which can be on bulbs and cuttings, gently packed in rugs. These can be planted freely from the boat to depths of 1-2 m. A few plants flourish in depths greater than 3 m.
As far as the significance of individual plant species for mallards is concerned, the opinions of specialists from individual countries differ. Mallards are not fussy and will feed on what is available. The plants given herein represent the main food sources for mallards and the data have been evaluated on the basis of stomach analysis and field observations. Floating plants: *Lemna minor* (gibba, trisulca) – lesser (ivy leaf, star) duckweed. Emergent plants (emerging from water): *Potamogeton natans* – floating leaf pondweed, seeds of this plant are consumed by mallards. The roots are the favorite feed of swans. This plant requires a depth of 0.3-1.5 m. It is tolerant to more acidic waters too. *Hippuris vulgaris* (common mare's-tail) is unfortunately endangered in many locations in Europe. It is sometimes planted in garden ponds. It provides a very valuable feed for ducklings. *Nasturtium officinale* (watercress) used to be planted as commercial vegetables in some countries. It is critically endangered nowadays. It requires clear running waters. Large commercial plantations attract mallards that can cause damage to the crop. Submergent plants (submerged plants): *Potamogeton pectinatus* (Fennel pondweed) is common in fresh and estuarial waters, ponds and rivers. Seeds, fruits, leaves, and stems all provide forage for mallards. In the stomachs of some birds pondweed seeds made up 26% of the content. *Chara sp.* (Muskgrass) is common in still waters. Provided conditions are suitable, i.e. water is alkaline; it grows rapidly and can be planted even during vegetation period. Bank plants: *Rumex hydrolapathum* (water dock) proliferates by seeds and by separation. The height of the plant is 1-2 m. *Sagittaria sagittifolia* (Hawaii arrowhead) provides a very good cover for ducklings. Ducks feed on the bulbs too.

CONCLUSIONS

This book ranges from the past to the future of European cultural landscape. It covers inputs about the context of historical landscape-development in European mankind living space, offering also comments on up-to-date management approaches, and the existing framework of subsidies regulating the behavior of present-day farmers. It also tries to summarize the available nature-friendly alternatives for landscape management, for securing and developing biodiversity in the cultural countryside, especially in areas where conditions for agriculture are less favorable.
We - as farmers – have for centuries been changing natural sites into production-areas, but at the same time leaving some of the land temporarily abandoned (as a fallow) enabling it to restore its potential once again. However the pace of the natural succession of zoocoenoses and phytocoenoses on set-aside or abandoned lands is not fast, and due to many factors, seral stages might get sometimes frozen before the final climax stage is reached, or may oscillate around some intermediate stages for decades.
The effort for a global understanding of such multicriterial problem of mankind desire to manage surrounding resources and actuo/geo-historical landscape dynamic is reflected by the structure of this book. Thus it contains a wide variety of information about various aspects of human activities in the landscape. Since mankind's strategy (policy and regulations) for landscape-management changes very often, some of the chapters will only remain up–to–date for a short time. Nevertheless, the authors hope that the detailed level of some chapters will still be an interesting source of reference even over the course of time. Whilst only a few readers did probably study the whole volume, the authors hope that readers would find relevant details on: animal-husbandry, pasture-management; forestry & game-keeping, and would thus be able to find answers to their eventual quest for a sound and balanced management of our European landscape space.

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ISBN 978-80-902617-6-1