

Working Paper

Land use change in Europe **- Scenarios for a project area in East Germany, Poland and the Czech Republic**

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Abstract

This study identifies plausible scenarios for land use changes for a project area (fig. 1) located at the coexistent borders of Poland, the Czech Republic and East Germany. The time frame is 1992 to 2050 with an intermediate step in 2020. The basis for the scenarios is an analysis of the driving forces for land use change in the context of the study area. The main emphasis here is on the EU's Common Agricultural Policy and trends in agriculture and forestry in the three countries of the project area. In addition former land use change, spread of urban areas, the state of mining areas, recreation and nature conservation and policies related to land use planning are of importance and therefore analyzed for each country.

The direction of land use change between 1960 and present was a decrease in agricultural land and an increase in forest and 'other' area, which mainly consists of urban area and area for infrastructure. Recent changes in the Common Agricultural Policy aim at reducing overproduction and cut spending in general. The prevailing tendency is to liberalize the agricultural sector to shift from product tied payments to direct payments to farmers for social, environmental or cultural duties. Since the political changes in 1989 the three countries of the project area have undergone significant economic and structural changes. East Germany as part of Unified Germany and part of the EU has experienced the most drastic restructuring of the agricultural sector with the main feature of major job losses and production decreases, especially in the livestock sector. Similar developments, though not as radical, can be observed in Poland and the Czech Republic.

The first Scenario, "Large Scale Increase of Wooded Area" anticipates the introduction of a free market economy to the agricultural sector. No more subsidies are required for agriculture. Large areas of marginal farmland have to be taken out of production. The price of land decreases. Farmers will either afforest their farmland or sell it to non-agricultural uses like urban development, recreation or nature conservation are options for farmers. A quantification for the project area foresees by 2050 a decrease of agricultural land to half of its size in 1992, a doubling of forest and an increase of 'other' area by 80%.

Scenario 2, "Alternative Agricultural Products", assumes a shift from food production to non-food products, mainly biofuel and incentives for an extensification of agricultural production. Subsidies, that are still required for the agricultural sector, will be kept. The overall policy aims at keeping the land open, avoiding uncontrolled spreading of urban development and providing prospect for development and employment in rural areas.

The main characteristic of Scenario 3, "Europe as Food Exporter", is an increase in the demand for agricultural products, which by approximately 2010 triggers a increase in the world market price for food products. Reasons for this are population and wealth increase, especially in China and south east Asia, combined with environmental constraints like water or fertile land scarcity and erosion. As a result agricultural production in Europe becomes prosperous in the frame of a free market environment. No further subsidies are required for the sector. Until 2010 the development is similar to Scenario 2. Scenario 2 and 3 show only modest changes in land use patterns, but the agricultural production structure differs. Scenario 2 focuses on a mixture of food and non-food products, while in Scenario 3 all available farmland is used for food production after 2010.

1. Introduction

1.1 Background and Study Area

Land use change has been identified as one of the major driving forces for global change. Understanding the past and future impacts of changes in land use and land cover is central to the study of environmental change and its human driving forces and impacts. In order to assess the social, economic and environmental consequences of land use change comprehensive information on future land use patterns is required.

This report is part of the IIASA study on "Regional Material Balance Approaches to Long Term Environmental Planning". The aim of the project is to study the flow of four heavy metals (Cadmium, Zinc, Lead, Arsenic) with focus on soils. The combination of load, soil characteristics, land use and management including plant types grown and agrochemical applications determines the future fate of stored heavy metals. They may further accumulate in the soil or they may be remobilized. In the latter case plant uptake of heavy metals can occur as well as transport to deeper parts of the soil horizon and finally to the groundwater. In both cases they may consequently enter the food chain. Of particular importance here are long term cumulative effects. The crucial soil characteristics with respect to heavy metal accumulation or mobilization are the pH value, the organic matter content and the relative amounts of clay and sand. Land use is a major determinant for the first two characteristics. Land use and land management have also an impact on the load of heavy metals since certain agrochemical inputs (phosphate fertilizers, sewage sludge, manure) contain heavy metals as impurities. Future land use/cover (including land management), together with future emission and atmospheric deposition scenarios are the basic variables determining further accumulation or release of heavy metals in soils and related risks to human beings.

In order to formulate policy options, the IIASA study requires scenarios for land use and land cover change in the project area (see fig. 1). It includes the northern part of the Czech Republic (Bohemia and Moravia), southwestern Poland (Upper and Lower Silesia), and most of the former G.D.R. (Sachsen, Sachsen-Anhalt, Brandenburg, Thüringen). In total it covers an area of about 180,000 km². Parts of this area are highly industrialized and densely populated. Extensive atmospheric impact of pollutants from coal burning and other industrial activities resulted in chemical deterioration of soils. Heavy metals have accumulated in the soils over the last centuries. In spite of this pollution the project area is important for agricultural production, with half of its land use devoted to agriculture.

There are many initiatives, which try to harmonize data collection and integration on land use versus land cover. According to Turner et al (1993), *land cover* refers to the actual appearance of land. It can be classified according to numerous criteria, depending on the scientific purposes for which the classification is being developed. Examples of some broad categories of land cover include forest, cropland, grassland, wetland, water, and settlements. *Land use* refers to the purposes for which humans exploit the land cover. Common land uses include agriculture, forestry, mineral extraction, and recreation. Forest for example is a land cover dominated by woody species, which may be exploited for uses as varied as recreation, timber production, or wildlife conservation. Changes in human land use are frequent causes of land-cover conversion and modification. Statistics and literature related to land cover and land use change often do not distinguish between the two terms.

Fig. 1 Project Area of the IIASA study "Regional Material Balance Approaches to Long Term Environmental Planning"



1.2 Aims and Objectives

This paper aims to identify plausible scenarios of future changes in land use and land cover for the period 1995 to 2050 in the project area. Subsequently we shall examine the following objectives:

- to develop a methodological framework for identifying scenarios for land use change
- to identify current land use patterns in the project area
- to analyze historical land use change in the project area from 1950 to present
- to identify factors influencing land use change
- to identify the sensitivity of these factors for the project area
- to analyze these factors for the three countries of the project area (East Germany, Poland and the Czech Republic) and compare the results
- to identify external factors influencing land use change in the project area
- to identify and argue likely directions of land use and land cover change in the European context
- to develop three plausible scenarios of land use/cover change for the project area for the period 1995 - 2050
- to quantify the scenarios for the project area

1.3 Methodology

The transformation of land results from a complex set of interactions. In order to obtain comprehensive information on future land use for a particular region the driving forces for land use change and their sensitivity have to be identified. In the European context the most important driving forces include:

- Agriculture, in particular agricultural policy
- Forestry
- Environmental conditions
- Social context including the history of a region
- Policies related to land use planning

Figure 2 presents a summary of factors influencing future land use. An analysis of these factors provides basic information for the development of scenarios for future land use for a particular region. Depending on the study area, some factors shall not only be identified for the present time, but also their change over the past years may be of interest. For example, for the transforming countries of Eastern and Central Europe the change of agricultural production structure since the transformation is of particular interest. The same applies for the European Union (EU) countries since the implementation of the 1992 reform of the Common Agricultural Policy (CAP). Depending on the study region the importance of the driving forces varies. In the European context agricultural policy including forestry has been and still is the most important driving force for land use change. In addition the expansion of urban area and land used for infrastructure is a growing importance.

The countries of the project area dealt within this study are part of those Central European countries that are currently undergoing major economic and social transitions. The current economic and political framework of each of these countries is very different. Former East Germany is now part of unified Germany and therefore EU laws are to be applied to all sectors. Like all Central and Eastern European countries Poland and the Czech Republic have had two main aims since the political changes in 1989: to create a market economy, and in the long term to join the EU. It is justified to assume that many of the rapid changes currently taking place in former East Germany will in the long term also occur in Poland and the Czech Republic. This is in particular true for the agricultural sector. Here joining the EU means adhering to the CAP.

The methodology applied to develop scenarios for land use change in the project area first undertakes an analysis of the factors influencing land use change (as described in figure 2) for the three countries of the project area, namely Poland, East Germany and the Czech Republic (Chapter 3,4 and 5). The analysis emphasizes agricultural policy and forestry because of its importance for land use change in the European context. Since the project area is strongly involved in the developments of the European Union, the most important driving force for land use change in the EU, the CAP, is included in the analysis (Chapter 2). Chapter 6 compares land use changes since 1960, and driving forces for land use change of the three countries.

After having collected as accurate information as possible on the factors influencing land use change, likely directions of future land use change in the European context are identified. These trends in land use change present a broad overview. The extent and importance of each trend depends on political decisions (in particular in agriculture and energy policy) that will be decided in the coming years. Built upon this knowledge three plausible scenarios will finally be developed and argued including a quantification of each scenario for the project area (Chapter 7).

Figure 2. Factors influencing land use change

| |
|--|
| <p>1. Former land use structure and change</p> |
| <p>2. General economic environment Population GDP share (agriculture, forestry, industry, other) Share in employment (agriculture, forestry, industry, other)</p> |
| <p>3. Agriculture Percentage of GDP and of employment in agriculture Production structure Size of farms Policies (subsidies, taxes, agricultural pricing policies, special short term measures,...) Land ownership and tenure</p> |
| <p>4. Forestry Ownership structure Forestry use (timber production, recreational, protected areas) Policies (Incentives for afforestation, nature protection,.....)</p> |
| <p>5. Environmental conditions Climate, topography, soil characteristics Environmental pollution (acidification or other pollution load)</p> |
| <p>6. Social context Demographic factors (population density, migration,...) Markets for agricultural and forestry products Tradition of land use Attitudes and values (towards the landscape, cultural heritage and nature conservation)</p> |
| <p>7. Policies related to land use planning Development plans Legal frameworks (land use planning, land use policy)</p> |

2. The Common Agricultural Policy (CAP)

2.1 History

The post-war period of agricultural development in Europe is mainly characterized by steadily increasing yields (productivity per unit area), improved varieties, a better understanding of crop physiology, enlargement of farm size, an increasing use of chemical fertilizers and pesticides and also by replacement of labor with machinery and capital. The present situation of agricultural productivity in the EU can be characterized by:

- overproduction in relation to markets (currently in the EC there is a yearly increase of food production between 2 and 3%, whilst consumption rises only by 0.5%)
- considerable differences in productivity over the continent, for example in the EEC 50% of the total wheat production is produced on about 25% of the total wheat acreage (Strijker and de Veer, 1986)
- costly agricultural support programs
- declining rural communities
- a growing number of negative environmental impacts

On the one hand the state aims to cut the high subsidies paid to the agricultural sector (partly due to its own interests, partly due to pressure from liberalization tendencies on the world market). On the other hand the farmers are facing more and more difficult economic and consequently social circumstances. Further there are growing costs for treatment of negative environmental impacts resulting from agricultural activities; in particular drinking water treatment, flooding due to erosion and increased water runoff. These problems are mainly tied to the intensity of production. Extensive discussions on several levels were addressing these issues during the past years resulting in a change of the legal frameworks related to agriculture.

The legal framework in the EU reflecting these changes towards agricultural production is the Common Agricultural Policy (CAP). Most developed countries support agriculture in order to alleviate the social strains brought about by economic change. More than half the support is paid for directly by consumers via the "hidden tax" of protectionism (import barriers keep prices above free trade prices, thereby, transferring income from consumers to producers) (OECD, 1992). The rest is paid for by the European Agriculture Guidance and Guarantee Fund. This Fund accounted for 53% of the 1992 EU budget. The basic CAP instrument has been market price support, which encourages production but penalizes consumers, and has resulted in EC self-sufficiency or surpluses in most farm products since the 1980s. Taxpayers have faced increasing budgetary costs of export and other disposal subsidies, intervention storage, direct payments to farmers and administration.

2.2 The 1992 CAP reform

The most recent reform of the CAP, the MacSharry reform, named after the Commissioner for Agriculture who initiated it, was agreed upon in 1992. It has been the most substantial change in its history. The package was essential in paving the way for a GATT settlement on agriculture. The price support mechanism for production has been significantly reduced in favor of direct aids for producers that are independent of levels of production. In particular the support price for cereals is reduced substantially. Three accompanying measures were undertaken concerning farming and land utilization, namely the introduction of:

- environmental conservation measures,
- afforestation aid and
- an early retirement scheme for farmers aged over 55.

Environmental conservation measures are specified in the agri-environmental regulations. They refer to aid to compensate for loss of income granted to farmers who voluntarily undertake, for a period of at least five years, measures of the following list:

- "substantial reduction in the use of fertilizers and/or plant protection products, or the introduction and continuation of organic farming methods;
- change to more extensive forms of crop and livestock (sheep and cattle) production;
- use of other farming practices beneficial to environmental and natural resource protection and to maintenance of the countryside and landscape;
- upkeep of abandoned land;
- long-term set-aside of agricultural land for environmental reasons;
- land management for public access and leisure activities" (CEC, 1993).

Three years after the implementation of the 1992 reforms, the experience shows that farmers primarily participate in the set-aside programs, which were already initiated in 1988. They include long term set-aside (five years) and one-year set aside. Since the beginning of the long-term set-aside program in 1988, Italy has set aside 8.1% of its agricultural area, Germany 4.2% and France 1.3% (the other EU countries less than 1%). In addition one-year set aside programs were offered.

For example, in 1992 in Germany, the five-year set aside area comprised of 483.000 ha and the one year set-aside area comprised 291.000 ha, together 6.8% of German's agricultural area. The vast majority of this area lies fallow. Only 2% of the area was converted to forests, extensively used grassland or to non-agricultural use (Jungehülsing, 1993). The reason for this is that the latter conversions require long-term decisions. The premium for afforestation or conversion to grassland is paid for five years, but afterwards a reconversion to agricultural land is difficult. The value of farmland is till higher than forest land. In the light of these experiences, criticism towards the concept of set-aside of agricultural land is growing within the EU.

2.3 Recommendations for further reform

Though the 1992 reform has not been fully introduced yet, the EC recently released a report (EC, 1994) recommending wholesale reform of the CAP.

"The fundamental approach is to separate more clearly two aspects of agricultural policy, that of economic efficiency on the one hand, and that of social and environmental measures on the other. With the introduction of direct income support a clearer separation of the responsibility for internal market unity and for competition on the one hand, and the responsibility for more localized social and environmental aims of agricultural policy on the other, is possible. Whereas the responsibility for the former should remain at Community level, the principle of subsidiarity endorsed in the Maastricht Treaty of European Union suggests that the responsibility for the latter should be allocated to Member States." (EEC, 1994, p.xvii)

Chief recommendations for such a reform are:

- Further cut in agricultural support prices near to world market price in all sectors. All remaining import levies and quotas should be transformed into flat-rate tariffs. The objective should be a level of market protection no higher than that enjoyed by other sectors in the EC economy. These price cuts should be phased in over a reasonable time period in order not to dispute overly the production and rural conditions.
- With support prices close to world market price levels the rationale for quantitative restrictions, such as milk quotas and set-aside would have been eliminated, and should therefore be abolished.
- Compensation for price cuts could continue via direct payments, as in the 1992 reforms. Initially, compensatory payments should be financed by the EC budget as at present, but gradually (over 7 to 10 years) this common financing should be phased out. Then support for the farmers shall only be provided by the member states. Their subsidies are restricted to direct payments.
- Member states liable to suffer heavy penalties through loss of EU financial support could be compensated through increased contributions from the regional, social and "cohesion" funds, established to assist poorer EU members."

The report further argues that fulfilling these recommendations would increase the EU's "flexibility towards trading partners and new entrant states", referring to the Central and East European Countries applying for EU membership. Their high agricultural share of contribution to GDP and employment has often been argued as the main obstacle for these countries to join the EU because then the current CAP could not be financed any more.

2.4 CAP versus Structural Funds

Possible CAP developments shall also be discussed in the light of the overall EU spending policies. Two items dominate the spending side of the EU budget - the Structural Funds and the CAP (Table 1). A very important shift in EU spending priorities was set in the 1988 "Delors Package". CAP's share of expenditure was required to fall from about 65% in 1988 to less than 50% in the coming years. (In 1993 53.4% of a total EU budget of 65 billion

ECU was spent for the CAP). The Package doubled the Structural Funds spending. Agreements surrounding the Maastricht Treaty and the Edinburgh summit agreement imply that this share will rise to 34-40% of EU outlays by 1999.

The Structural Funds are large transfers to the poorer member states and regions. The funds are explicitly aimed at encouraging greater economic and social "cohesion". Cohesion is generally taken to mean convergence of per capita income levels. The regions or groups that are the focus of these aims are guided by Objectives 1 to 5b. Table 2 shows recent spending by objective. 2/3 of the money as been allocated to "Objective 1" regions. They are defined as regions with per capita incomes that are less than 75% of the EU average. Over 20% of the EU's citizens is eligible under this objective.

In the future Structural Funds may provide a wide range of possibilities for subsidies, particularly in low-income regions. Considering that some of the poorest regions in the EU are remote and/or have unprofitable farmland, it may be anticipated that structural funds there will provide money, for example, for encouraging tourism, nature protection or preserving visual amenity and the distinct character of a landscape. For farmers this means a shift in their tasks from only producing as much food as possible to a kind of countryside manager. These funds may also be used for encouraging new agricultural products like biofuel or plants for the chemical industry.

Table 1. The EU's 1992 budget on spending

| | |
|----------------------------|-------|
| CAP | 53.7% |
| Structural Funds | 31.6% |
| R&D, energy and technology | 3.3% |
| Administration | 4.7% |
| Foreign aid | 3.5% |
| Other | 1.3% |

Source: Courchene et al. (1993)

**Table 2. Structural Funds spending 1989-93
(in billion ECU)**

| | |
|--|------|
| Spending by objective | |
| 1: Low-income region | 38.3 |
| 2: Declining-industry regions | 7.2 |
| 3,4: Long-term unemployment & youth training | 7.5 |
| 5a: Agricultural structural adjustment regions | 3.4 |
| 5b: Rural areas | 2.8 |
| Other | 1.1 |
| Total | 60.3 |

Source: Eurostat (1992)

Chapter 3. East Germany

Since 1990 the former German Democratic Republic (GDR) is part of reunified Germany, with its area now being called the "Neue Länder" (the "new countries", that are Brandenburg, Mecklenburg-Vorpommern, Saxony-Anhalt, Saxony and Thuringia). 15.7 million people (1992 status) live here - with an area of 108.086 km², the population density is 145 inhabitants per km² (compared to 261 inhabitants per km² in the Old Länder).

Five years after unification, progress towards economic integration between eastern and western Germany is clearly visible, yet the eastern region almost certainly will remain dependent on subsidies funded by western Germany until well into the next century. Government transfers to the east amount to nearly \$ 110 billion annually. Eastern Germany's economy appears to be changing from one anchored on manufacturing into a more service-oriented economy. Though its economy is growing again (9% in 1994), the share of all-German GDP is only 7% and eastern productivity is just 30% that of the west even though eastern wages are at roughly 70% of western levels. Agriculture still accounts for about 10% of GDP in Eastern Germany (1% in Western Germany).

Of all the East European nations in economic transition, the former GDR has been affected most radically by the political developments of the previous years, its political system being completely superseded by that of the Federal Republic. After the German reunification EU law had to be applied to all sectors. This also meant adhering to the Common Agricultural Policy (CAP) that in itself is currently undergoing major changes. This fact will certainly lead to a major alteration in land use patterns in this area, the first effects of which have already been felt during the last few years.

Despite national differences in the agricultural sector especially in Poland (where most of the land was privately owned, and there were many small family farms), it can justifiably be assumed that many of the changes currently taking place in former East Germany will in the long term also occur in Poland and the Czech Republic.

In 1991, 57% of the total area of the "New Countries" was agricultural land and 27,5% was woodland. The percentage of built-up and traffic areas was 9,9%, and other purposes make up 5,1% (Bundesministerium für Ernährung Landwirtschaft und Forsten 1991a).

3.1 Agriculture

History

Agriculture is considered to have formed a much more significant component of the national economy of the GDR than that of the FRG. The percentage of land used by agriculture was higher than in West-Germany (57% to 54,7%), the ratio of 3,7:1 of arable area to grassland in the GDR (compared to 1,6:1 in the FRG) shows the importance of cropping in East Germany. Farming in the GDR aimed towards production increases and self-sufficiency, using "industrial production methods". As a result of large-scale land improvement, drainage and land consolidation, the fields sometimes reached a size of 400 ha (average farm size in the old FRG: 19 ha!).

Based on the communist ideology favoring collective and state property, large-scale state and collective farms were established in the GDR. Furthermore, in the 1970s, a strict separation between crop-producing farms and livestock farming was made. In the late 1980s, an average crop-producing farm had 4500 ha production area, with about 240 people working such a unit. The average livestock farm by comparison had an acutely small ground area to livestock ratio with up to 4.000 dairy cows and over 200.000 pigs for breeding and slaughter (Presse- & Informationsamt der Bundesregierung, 1994).

With the economic and monetary unification, the East German economy was under severe pressure and near collapse. To become competitive in the market economy of the EU a new organization of the whole agricultural sector was necessary. The impact has been greatest on the country's over-planned, inefficient collective farms. The number of workers per production unit was too high (14 workers/ 100 ha production unit; Bundesministerium für Ernährung Landwirtschaft und Forsten 1991b) and the productivity of labor is assumed to have been only about 50% of that of the FRG (Balz, 1990). This caused a far lower productivity per production unit in the GDR than in the FRG - in spite of a high input of fertilizers and herbicides.

Since the reunification, East-Germany is undergoing privatization. The number of (relaunched) individual farms providing the main or supplementary source of income is on the increase, with the reintroduction of farms as family concerns being supported by the EU. Arable and livestock production is being combined again. However, farming in the new federal states continues to be characterized by large-scale operations, since the former large, state-owned farms are being converted to farms owned by agro-businesses (Landwirtschaftliche Produktionsgenossenschaften or agricultural production cooperatives and Volkseigene Güter or nationally-owned estates). Such farms are now operating in a different legal form (as individual or joint-stock companies, or hybrids of these, or as registered cooperatives).

However, new price levels are causing problems for the sale of livestock in the new countries of Germany. This has resulted in decline of livestock production; between 1989 and 1992 the number of cattle has been reduced by 50%, the number of pigs by two thirds, the number of sheep by three quarters (Statistisches Bundesamt, 1993). As a result of the new agropolitical situation, the number of people employed in agriculture has shrunk dramatically in the first years of the reunification - in 1993 only 187.000 people (compared to 825.000 in autumn 1989!) were working in this sector (Presse-und Informationsamt der Bundesregierung, 1994). Corresponding to these changes, considerable areas of agricultural land were taken out of production (11% in the year 1990/1991).

Recent Tendencies in agriculture

In spring 1992, the Council of Ministers of the EU agreed on a reform of the CAP, as a new attempt to regulate the continued overproduction and to reduce the associated enormous costs. This reform, now affecting the "New Countries", set up a system of subsidies for the main crop types and set-aside, which is now based on area rather than production. The main contents of the reform are:

- Price cuts: Since the year 1992/93, EU-farmers only receive a world-market-price for the majority of their products, while direct compensation is paid for the loss of income (Presse-und Informationsamt der Bundesregierung, 1994).¹
- The condition for compensation payments (except for small-holdings) is the participation in the set-aside-program (at least 15-20% of the land has to be taken out of production) (Bundesministerium für Ernährung Landwirtschaft und Forsten, 1994a).²
- These measures are accompanied by grants for reafforestation of agricultural production areas or for ecologically based agricultural production methods. Moreover, the cultivation of raw material of plant origin (e.g. rape, miscanthus) for energy, bio-diesel, etc, is subsidized.

Due to the new agropolitical guidelines (regulation of overproduction instead of production increases), and due to the lack in availability of additional fertile land (wide areas esp. in Brandenburg and Mecklenburg-Vorpommern show a low land quality), farmland in the "New Countries" is now set aside at a high rate. In 1994, an average of 13,8% (732.750 ha) of the agricultural land of a farm was set aside, many of the farms set aside more than 15% of their agricultural area (max. 33%). The northeastern German lowland is particularly affected (Umweltbundesamt, 1994).

It is generally assumed that this policy will encourage agriculture as the dominant form of land use only in the most favorable regions with the highest potential of natural sites - sooner or later other areas will be abandoned. It is even estimated that within the next 20 to 30 years between a third and half of the areas now covered by fields could cease to be used by agriculture - for Brandenburg for example this percentage could even rise up to 85% (Agra-Europe, 1994).

But the subsidizing of farmers for not cultivating their land obviously cannot be a sensible policy in the long run. In this context, new forms of land use for abandoned farmland are at present being discussed within Germany, with ideas ranging from afforestation, recreation and nature conservation to more extensively cultivated landscapes and the growing of raw materials of plant origin (biofuel).

At the moment it is difficult to foresee to what extent agriculture will undergo extensification. Many nature conservation groups recommend extensively cultivated landscapes, preserving historical forms of land use (half cultivated areas) and extensive agriculture using as little agrochemical as possible. From 1991 to 1993, farmers in the "New Countries" participated in the EU-wide program for the promotion of extensification of agricultural production. In 1993, this program was transformed into a series of programs which are now specifically oriented to the individual Länder. In Saxony, for example, since 1994 a "program for environmentally friendly agriculture" is in action, which is financed up to 75% by the EU.³ This program includes several grants for extensive grassland use, for extensive agriculture, for fruit trees on pastures, or for the conversion of arable land into

¹ However, German farmers earned an average of 6,3% less in the year 1992/93 (compared to the year 1991/92) and it is assumed that this tendency of falling income will generally continue during the next few years.

² The CAP-regulations allow farmers to grow raw materials of plant origin on abandoned land without losing compensation payments for participation in the set-aside-programme. This possibility is used widely in the "New Countries", especially for the growing of rape (BUNDESMINISTERIUM FÜR ERNÄHRUNG LANDWIRTSCHAFT UND FORSTEN, 1994b).

³ In the meanwhile, there are 60 extensively cultivated farms (5000 ha) in Saxony (SÄCHSISCHES STAATSMINISTERIUM FÜR UMWELT UND LANDESENTWICKLUNG 1994).

grassland. In the "New Countries" a total of only 36.500 ha (0.69% of the arable area) was cultivated with ecologically orientated production methods in 1994.

In 1994, energy-plants have been grown on 160.000 ha (21%) of the abandoned land, and a number of 320.000 ha is expected for the year 1995 (Bundesministerium für Ernährung Landwirtschaft und Forsten 1994d). The percentage of abandoned land used for the growing of raw materials of plant origin will increase in the next years for the following reasons: Since 1993, it is allowed to combine these forms of cultivation with the participation in the set-aside-program. This has the advantage for the farmer that he receives compensation payments for these areas while using the energy-plants for biomass fuels, for oil-production, for technical and chemical purposes etc. Moreover, the use of products made out of raw materials of plant origin is supported by the Ministry for Agriculture and Forestry.

Since the reunification the production structure in the "New Countries" shows the following tendencies:

- Grain: In absolute figures, the area cultivated for grain decreased slightly since 1989 but still shows (with an average of about 45%) the highest share of arable land.
- Root crops: The area cultivated for sugar beets and especially for potatoes has been reduced dramatically during the last five years, with potatoes now only being grown on a fifth to a tenth of the area of 1989. Reasons for this decrease are the reduction of livestock and reduced revenues.
- Forage plants: The growing of forage plants (e.g. clover, lucerne) has also decreased since 1989 by a third to a half, again caused by the reduction of livestock.
- Oil crops: The growing of oil crops is subsidized by the EU and has therefore increased importantly since 1990 (esp. rape and sunflowers). These plants now cover a quarter to a fifth of the total arable land in the "New Countries".

The number of livestock is still being reduced, though at a slower rate than within the first two years after reunification. The reduction of livestock from 1993 to 1994 reached 11% (compared to 2% in the "Old Countries" of Germany). Mainly due to this, grassland (esp. permanent grassland) has decreased and continues to do so: In Saxony for example, grassland has been reduced between 1989 and 1994 by 25% (Source: Statistisches Bundesamt Berlin).

3.2 Forestry

27,5% of the former GDR is now covered by forest (compared to 31% of the Old Länder). Brandenburg and Thuringia show, with 34% and 33% respectively the highest percentage of land covered by woodland. Saxony-Anhalt, with 21%, had the lowest and woodlands in Saxony cover 27% (Bundesministerium für Ernährung Landwirtschaft und Forsten, 1994c).

In the beginning of 1990, 64% of this forest was state-owned, 25% was in the hands of cooperatives. The rest was owned by the military, by the church, or it was privately owned. In September 1990 the "Treuhand", a government agency charged with transferring the former state industries of the East into the private sector, started to privatize the state-owned land. This process remains unfinished, but it can be assumed that the percentage of state-

owned forest (owned by the Federal Government and the Länder) will remain relatively high.⁴

Compared to the "Old Countries", in East-Germany there is a dominance of coniferous trees (75%) and a low variety of species. The pinetree is by far the most common species, followed by the spruce, which, however, is very abundant within Saxony. Due to the severe broad scale air pollution in the former GDR, forest damage (at 36% clearly visible damage) is more than twice as high as in the "Old Countries" (Bundesministerium für Ernährung Landwirtschaft und Forsten, 1994c).

Opinions on how great the potential for afforestation is in the "New Countries" differ: Many nature conservation groups are critical of afforestation on a large scale, and favor an increase of wooded land of only about 110.000 ha (e.g. Heinsdorf, 1994). On the other hand the Ministry of Agriculture and Forestry assumes 500.000 ha (about 10% of the total agricultural area) to have a good potential for afforestation (Wagner, 1992).

However, especially in areas with poor soil quality (with a land quality index of under thirty⁵) as in the northeastern German lowland, afforestation appears to be a sensible alternative to agriculture. Moreover, it can be part of the recultivation of mine areas. In 1993, 85% of the afforestation occurred in areas with a land quality index of under 25, 97% on areas with a land quality index of under 30 (Höppner, 1993).

Afforestation of abandoned arable land is subsidized by the Federal Government, the Länder and - since 1992 - by the EU. Consequently wooded land is likely to increase. However, afforestation programs start slowly and are not expected to be too successful in the near future for several reasons: 1) The demand for domestic timber is sinking in spite of a general increase of consumption of wood. 2) The premium for abandoned land is higher than that for reforestation. 3) With the conversion of arable land into woodland, fixed assets and credit-worthiness are reduced considerably (wood: 8.000 DM/ ha; arable land: 45.000 DM/ ha). In 1993 only 1% of the abandoned arable land has been afforested.

In Saxony for example, coverage by forests is planned to reach 30% (+3%) of the total land area within the next 10-15 years. This would mean a conversion of 55.000 ha - but only 214 ha and 309 ha were actually afforested in 1991 and 1992. Former mining areas (coal, gravel) make up the largest part of the reafforested area in Saxony. In areas of bad air pollution and its resulting devastation of woodland (e.g. the Black Triangle, Erzgebirge), reforestation with pioneer-treespecies (rowan, beech, larch, pine, poplar) has begun to enable the slow re-establishment of a mixed forest with site-adapted trees.

⁴ In 1994, 10% of the forest in the "New Countries" was owned by the Federal Government, 33% by the Länder, 9% by cooperatives, 26% by private owners and 23% was still in the hand of the Treuhand (POLLEY 1994).

⁵ In Germany, the 'land quality index' (German: Ackerzahl) is defined as a standard to natural site factors and to the productivity of a location deriving from these factors: They range from 1 to 100 (1=low productivity/ 100=high productivity)

3.3 Other Areas

Mine Areas

The former G.D.R. was one of Europe's most polluted industrial countries⁶ - one of the main reasons for this being the use of brown coal, which was locally available, as energy source. After the unification the market for brown coal in the eastern Germany has collapsed and most of the open pit mines have been closed down resulting in large areas that have been devastated. Reclamation of these landscapes has started throughout the whole of Germany and will be a long term process. After the restoration of landscapes damaged by open cast mining, the land quality hardly reaches an index of more than 20 (Bundesministerium für Ernährung Landwirtschaft und Forsten 1991c). Research on open cast afteruse landscapes therefore focuses on the establishment of forest and of protected areas⁷ rather than on agricultural use of these areas.

Recreation and Nature Conservation

While in East Germany "industrial production methods" in agriculture led to an even more monotonous landscape than in the FRG, areas with high ecological value could develop within military training areas, hunting-grounds or in the old border zone. In these areas, numerous extensive natural and near-natural biotopes still exist in which rare or highly endangered plant and animal species have been able to develop despite the burdens of pollution. Moreover, the former GDR had a dense system of protected areas covering 19% of the country's surface.

A particular success for nature conservation was the placing under legal protection in 1990 of five national parks (one of them, the "Sächsische Schweiz" is located within Saxony, at the border to the Czech Republic), three natural parks, and the recognition of six biosphere reserves in the Young Länder. With this, the "New Countries" show a higher percentage of protected areas than the old FRG.

In implementing the objectives of nature conservation and landscape management, biotope networks are established. The Panel of Experts on Environmental Issues considers an area averaging at least 10% of the total to be necessary, though in different natural areas this may vary between 5 and 20% (Bundesministerium für Ernährung Landwirtschaft und Forsten 1994d). Landscape planners call for a new agropolitical concept which integrates especially abandoned agricultural land into biotope networks (e.g. Reschke 1994). Support of this concept also stems from the EC Flora-Fauna-Habitat Directive of May 1992, which requires an EU-wide network of protected areas ("Natura 2000"). In Brandenburg for example, the proportion of land occupied by conservation-areas is projected to increase to between 25 and 30 percent during the next years (Flade 1993). The growing numbers of protected areas are also connected with the increasing demands for tourism and recreation.

⁶ However, as a result of the closure of old and unprofitable facilities, and also as a result of the investments in environmental protection initiated by the Federal and Länder authorities, the environmental situation in the Young Länder has improved appreciably since reunification. There has been a marked drop in pollution of air, soil and water.

⁷ It has been shown (eg MÖCKEL 1993) that the nature conservation value of old tips often is surprisingly high, since they provide habitats for many species which could not survive in areas used by agriculture.

Built-up and Traffic Areas

With 9.9% of the total area, built-up and traffic areas cover a relatively high percentage of land in East Germany. In view of the increased demand for housing and the economic dynamics expected in the next few years, it can be expected that land consumption for built-up and traffic areas will increase in the "New Countries", especially near urban centers. Private motorized traffic in the "New Countries" continues growing at a high rate which induces a growing demand of transport routes. Moreover, the German reunification, the creation of the single European market and the opening of Eastern Europe are placing growing demands on transport routes in East-Germany. Forecasts expect motorized traffic in Germany to continue growing in the years to come. The transport of goods by road is actually expected to double by the year 2010 compared with 1988 (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit 1994).

Legal Framework of Landscape Planning

Political and technical decisions concerning land use changes are specified through development planning. The area of responsibility of development planning includes the preparation and the carrying through of planning concepts on different local levels. Development planning in Germany is laid down by the Federal Planning Act (Bundesraumordnungsgesetz) and by different laws on state-level.

Landscape planning as the fundamental instrument for defining and implementing the objectives and measures of nature conservation and landscape management was introduced in the Young Länder since reunification. However, resulting from the varied timing of the introduction of landscape planning in the different states there are current differences in the legislation at state level.

The instruments of development and landscape planning, through which the legislator tries to exert an influence on the development of land-use-patterns, are:

- Federal development program
- Development programs on Länder-level
- Landscape structure plans (for parts of one state) and
- Landscape plan (for one community).

Moreover, development planning is put into concrete terms by the Bauleitplanung (on the level of municipalities), which consists of the landuse-plan and the buildings-plan. The compliance with the contents of the buildings-plan is obligatory.

In general, the legal framework of development and landscape planning in Germany appears to be rather specified and highly developed and - with this - certainly exerts an influence on land use patterns.

Chapter 4. The Czech Republic

Among the transforming countries, the Czech Republic is known as one of the most successful in their transition process. "Since the second half of 1993 the Czech economy has tended to gradually recover from the transition slump. Its macroeconomic results are excellent: the economy is growing, unemployment is very low by international standards, inflation is relatively low, the current account is positive and the budget is characterized by surpluses (Pöschl, 1995)". For the agricultural sector, however, the transition means facing a crisis as the effects of macro-economic reforms deepen. The government in power since 1990, with Vaclav Klaus as Prime Minister, is firmly committed to the market economy. The Czech Republic is the most industrialized country among the Central and South-East European countries. Agricultural exports are not so important, except for a few products (including brewing barley and beer).

The structure of the Land Fund in the Czech Republic in 1993 comprises 4.2 mio. ha agricultural land (55%), 2.6 mio. ha forest (33%) and 0.9 mio ha "other" land (12%). 74% of the total agricultural area is used for arable cropping, the remaining 24% are mainly used for livestock farming on grassland (Environmental Yearbook of Czech Republic, 1994).

4.1 Agriculture

Like the majority of European countries, the agricultural land has decreased since the 1970s. For Czechoslovakia a decrease of 7.5% from 7.2 mio. ha of agricultural land in 1961 to 6.7 mio ha in 1992 has occurred. In 1988 from the 52% of the land in former Czechoslovakia devoted to agriculture, 31% of agricultural land was directly owned by the state and 64% was managed by cooperatives. From a management point of view the latter is nearly similar to a farm directly owned by the state. The remaining 5% is used by individual farmers relying mainly on agricultural activities which are not conducive to large-scale operations - such as livestock herding in mountainous areas and certain types of fruit and vegetable farming. Farm sizes are large, with an average size of 8500 ha for state farms and an average size of 2580 ha for cooperatives.

Subsidies for agriculture were high compared to Western European standards. The Producer Subsidy Equivalent (PSE) indicates the amount of subsidies given to the farmers in order to equal the difference between the world market price of an agricultural product and the domestic price. In 1986 the PSE was 135% in Czechoslovakia whilst, it was only 52% in the EC (Lukas, 1992). An indication of the strength of the former agricultural lobbies is that the wages for farmers were slightly higher compared to other professions. After the so called "soft" revolution the situation changed dramatically.

Partial or full liberalization of prices since 1989 has led to rapid increases in the prices of inputs and farm equipment. State subsidies and credit facilities are being withdrawn. As a consequence, the agricultural sector is undergoing rapid economic changes. In 1993 the contribution of agriculture to GDP was 6% and the share of employment in agriculture was 7%. These numbers are already similar to the EU average. The area of arable land decreased more rapidly than before. In the Czech Republic the decrease of arable land in favor of meadows and pastures was 1.1% during 1991 and 0 - 0.5% during 1992. Although the

acreage of agricultural soil in the Czech Republic remains relatively constant, the "unused" area increases. Per May 1994, 103,000 ha (2.5% of total agricultural area) of agricultural soil were abandoned (Czech Env. Yearbook, 1993-94). Application of fertilizers and pesticides decreased substantially (Table 3). In 1993 total NPK fertilizer input was approximately a fourth of the 1988 level and lime-bases fertilizers declined to a tenth of the 1988 level.

Table 3. The Usage of fertilizers in the Czech Republic

| | NPK [kg/ha agricultural land] | Lime-based Fertilizers [1000 tones for total CR] |
|------|---|--|
| 1988 | 233 | 2,800 |
| 1989 | 230 | 2,850 |
| 1990 | 186 | 2,650 |
| 1991 | 65 | 700 |
| 1992 | 65 | 260 |
| 1993 | 63 | 205 |

Source: Environm. Yearbook of Czech Rep., 1994

In the same period agricultural output declined. This is in particular true for the livestock sector (Table 4). Here the number of heads of cattle was reduced by 38%, sheep by 54%, poultry by 22% and pigs by 15%. Consequently livestock density decreased considerably. Output also declined for potatoes and forage plants. Production of total cereals remained approximately the same. Legumes and technical crops increased. Agricultural output declined further by 5.6% in 1994. This decline was visible in almost all areas except cereals (+5.5%) and rather extreme in case of potatoes (-47%). In 1994 a sudden shortage of meat led to a massive increase in meat imports.

Table 4. Change in agricultural output between 1989 and 1994

| livestock [1000 head] | 1989 | 1994 | change | sowing area [1000 ha] | 1989 | 1994 | change |
|---------------------------------|-------------|-------------|---------------|---------------------------------|-------------|-------------|---------------|
| cattle | 3506 | 2161 | -38% | cereals total | 1670 | 1660 | 0% |
| cow-milk anim. | 1236 | 830 | -32% | legumes | 59 | 72 | +22% |
| pigs | 4790 | 4071 | -15% | technical crops | 281 | 361 | +28% |
| sheep | 430 | 196 | -54% | potatoes | 115 | 77 | -15% |
| poultry total | 31981 | 24974 | -22% | forage plants | 1079 | 886 | -18% |

Source: Czech Env. Yearbook, 1994

In agricultural policy, while former collectives have mostly been privatized, there is tension between the government's free market principles and the growing pressure from farmers for more support. A Fund for Market Regulation has been established. It provides market intervention to implement guaranteed minimum prices for key products. Systems of viable import levies, which fluctuate to keep domestic prices stable when import prices change and some production quotas have been introduced. These policies are basically copies of policies practiced by the EU. Since joining the EU means for the farming sector adhering to the Common Agricultural Policy (CAP) this approach of introducing EU agricultural policies is imminent. The Minister of Agriculture, however, stresses the importance of

efficiency in a competitive international context. Under the Czech Republic's Agrarian Policy Program of 1992, the area under cultivation should be reduced by about 5% to 4 mio. ha and the people employed in agriculture were cut by half to around 200.000 (Hewett, 1995).

4.2 Forestry

The forest land covers 2.6 mio ha, about one third of the territory. The forest sector accounts for about 1% of the total national income and employs 1.1% of the total workforce (1992). The total forest area increased mostly in the period shortly after 1945 when large areas of poor agricultural soils (e.g. sloping pieces of land, water-logged and high altitude meadows and pastures, especially in borderlands) were transferred into forests. Since then a slow total growth of the forest area has been a permanent feature with the highest increases in the mountain districts. The total increase in forest land from 1950 to 1985 was 6.2%. Since 1989 the forest land area has hardly changed. However, official opinions foresee a further increase. "In the next decade it is possible to expect a further increase in the afforested area, as it is likely that areas peripheral to the forest which are not agriculturally competitive will become afforested, and also forest soils will be less taxed. The scale of growth will depend on the state policy for the Protection of Agricultural Soils Fund." (Env. Yearbook of CR, 1992).

Substantial changes are currently going on concerning the ownership of the forests. In 1993 2.3 mio ha (88%) of the forests were state owned. Until June 1993, 130,800 persons applied for restitution into private ownership relating to a total area of 580,000 ha. Furthermore, 1900 towns and villages applied for the restitution of 190,000 ha of afforested land (Env. Yearbook of CR, 1994).

Regarding the use of the forest the CR distinguishes several forest categories expressing the prevailing purpose of the forest. There are 1.5 mio ha commercial forests. The remaining 1.1 mio ha so called "forests of special interest" comprises protected forests, game-parks, national parks, forest demanding distinct management methods, etc.

Pollution load to forests has been substantial. One fourth of the total forest has been so affected by air pollution that they demand distinct management methods. In North and East Bohemia over 95% of forests, in Central Bohemia, Northern and Southern Moravia over 60% are damaged. These numbers include all categories from slight to heavily damaged forests. In some regions even the woodland which replaced the originally woodland was damaged. Only South and West Bohemia have a high share of healthy forests (Env. Yearbook of the CR, 1994).

4.3 Other Areas

Mining Areas

The Czech Republic has a long tradition of extensive mining activities. There are large coal reserves including brown coal, black coal and lignite, a number of major metal-mining sites throughout the country including uranium mining. As a consequence of the re-orientation to

a market economy, there was a sharp fall in the demand for raw materials and energy. In particular the consumption of solid fuels dropped with a decrease of 30% between 1985 and 1993 (Czech Env. Yearbook, 1992, 1994). Driven by this rapid decline of the coal market, coal production decreased by 24% between 1989 and 1993 and is expected to decrease by another 45% until 2005. Then lignite production may need to be as low as 30 million tons per year (produced from about three Bohemian surface mines), and hard coal production as low as five million tons per year (produced from about three underground mines, probably all in the Karvina area). In that event, total employment should not exceed a level of about 15,000 (OECD, 1994,p.152-158).

Consequently the most important question in this context is the creation of alternative employment for miners. In 1989, 190,000 people were employed in the mining sector, including services. Resulting from the restructuring of the coal sector this number decreased to 110,000 by 1993. (OECD, 1994). As a result of the ongoing and expected closure of the majority of the coal pits, large areas that have been devastated since the Second World War will be subject to recultivation.

Protected Areas

The Czech Republic has three National Parks, 24 Protected Landscape Regions and about 1500 other small protected areas. Together they cover over 1 million ha of land, which is equivalent to 15% of the area of the Czech Republic (Env. Yearbook of CR, 1994). All these areas already existed before 1990. A new legislation for protected areas was issued in 1992, which ensured conformity with international standards and enabled to link to international protection programs. However, the ecosystems in many of these areas, in particular those in mountainous regions, are severely damaged or endangered by immissions. Since 1991 a concept has been elaborated for monitoring of biotic components of ecosystems in protected areas.

The development of tourism is an indicator for the importance of the natural and historical heritage of the country. In 1993, 71 million foreign visitor traveled to the CR through monitored border-crossings (3.3% more than in the previous year). The majority of visitors remained for only one day or were in transit. An estimated 16 million guests in 1993 sought accommodation, from which 12 million were foreign guests.

Urban and built up area

In 1993 12% of the total area accounted for the category "other land", which mainly comprises urban area and area for infrastructure. Closely related to urban areas are recreation objects. An inventory of recreation facilities in 1991 showed that more than 260,000 objects of individual recreation were present. The majority of this are cottages, weekend houses that are not permanently inhabited flats used only for recreation.

Chapter 5. Poland

After a sharp fall in output during 1990 and 1991, Poland became the first country in transition to return to growth: GDP increased by 2.6% in 1992, by 3.8% in 1993 and 5% in 1994. Industry was the main contributor to the GDP growth (12% growth in 1994), followed by trade (Podkaminer, 1995). The GDP share in 1993 was 58% in service, 35% for industry and 7% for agriculture. Unemployment is high amounting to 16%. Regional disparities in unemployment, particularly urban-rural, have widened substantially. Thus the large urban, industrial centers of Warsaw, Krakow, Poznan and Katowice exhibit the lowest unemployment rates, while the less urbanized voivodeships of northern Poland, characterized by large state farms and soils of poor quality, suffer from the highest rates of unemployment, with many having rates well above 20% (OECD, 1994).

The government formed after the elections in September 1993 in Poland, despite being dominated by the "post-Communist" Alliance of the Democratic Left (SLD), seems also determined to pursue market-oriented reforms. However, the Polish Peasants' Party (PSL), which is a coalition partner and provides the Minister of Agriculture, is demanding greater support and protection for farmers.

In 1992, Poland's land use comprised 18.7 mio. ha agricultural land (60%), 8.7 mio ha forest and (28%) and 3.8 mio. ha "other" land (12%). 78% of utilized agricultural area is used as arable land and 22% as permanent grassland.

5.1 Agriculture

The agricultural sector has been of considerable importance in the Polish economy in terms of employment, contribution to national income, and exports. About four million people are employed in agriculture: this is 25-27% of the country's labor force. Agriculture produced about 6% of GDP in 1994 (down from 8.2% in 1989). A high share of the labor force in agriculture, combined with relatively low contribution to GDP, entails low labor productivity. This is associated with the predominance of small farms and inefficient marketing and processing. Being composed primarily of small private farms, agriculture does not have to pass through such a drastic privatization program as in other transforming countries, but as most farms are too small, it will have to undergo major structural adjustment, which will reduce agricultural employment.

Even under the communist regime 76% of the agricultural land was privately owned. Half of the farmers own a farm smaller than 5 ha, 30% have 5-10 ha. However, most of the production of the smallest private farms is intended only for family use. They have additional income from outside the agricultural sector. These farmer-employees account for a relatively large proportion of job-losers after the transition (OECD, 1994). 17% of the total private farms had ten hectares or more, operating on 43% of the private sector's farmland. These constitute the most promising sector of Polish agriculture, producing more than 40% of the private sector's marketed agricultural production. In 1993 state farms occupied 16% of utilized agricultural area (3 mio. ha), co-operatives operated on less than 4%. Privatization of large state farms is slow, only about 0.5 mio ha since 1990.

In 1991, exports of food and agricultural products represented 17% of total Polish exports. Imports of food and agricultural products amounted to 14% of total imports. The EC is Poland's main trading partner, in agricultural products and in total.

As in the other transforming countries consumption of fertilizers and agricultural output decreased since the transformation. Between 89/90 and 92/93 consumption of total NPK fertilizers decreased from 3.2 mio t to 1.2 mio t (FAO, 1994). The yield (in kg/ha) in Poland still is only about half of the yield in Western countries like France, Germany or the Netherlands. The harvested area of potatoes and rapeseed declined slightly. A considerable decline is visible in the livestock sector. The number of cattle has been reduced by 30%, pigs by 11%, chicken by 23% and sheep by 71% during the period 1989 to 1994 (table 5). However, agricultural output growth is expected to resume with macro-economic stabilisation and economic growth.

Table 5. Change in Production structure in Poland between 1989 and 1994
[Area harvested in 1000 ha and livestock in 1000 head]

| | 1989 | 1994 | change | | 1989 | 1994 | change |
|---------------|------|------|--------|---------|-------|-------|--------|
| Cereals total | 8376 | 8462 | +1% | cattle | 10733 | 7607 | -29% |
| Wheat | 2195 | 2410 | +10% | sheep | 4409 | 870 | -80% |
| Potatoes | 1858 | 1761 | -5% | pigs | 18835 | 16800 | -11% |
| Rapeseed | 570 | 335 | -41% | chicken | 60000 | 46000 | -23% |
| Oat | 803 | 642 | -20% | | | | |

Source: FAO Production

In a large country like Poland, land use patterns and land management differ considerably. The project area lies in the south and the south-east, which is a highly industrialized part of Poland. Here part-time farming, i.e. the farming of one's own land combined with employment in industry, is common, in particular in the mining and industrial region of the project area. The land value of the agricultural land in terms of yield potential is medium to high except for the mountain regions. Particularly the Wroclaw area has very fertile soils combined with a favorable climate for agricultural production.

5.2 Forestry

Poland has a significant forest resource and the country's wood industry is well established. Forests cover 28 percent (8.7 mio. ha) of the land area. In spite of decreasing total annual harvesting since 1986, the forests and wood industry employed 350,000 people in 1992, corresponding to a little more than 6% of the total Polish industrial work force. The sector produced 2% of GDP in 1992 and over 2% of Polish exports in 1991 (World Bank, 1993). Poland's location in relation to the heart of the European market, as well as competitive wood costs, give the country an excellent opportunity to expand within this sector. While domestic demand was dropping after the economic transformation, wood exports remained constant, a commendable performance considering the international market recession during these years. Till now, the Polish wood industry has been based on the domestic raw material. This, however, is only due to the fact that the elementary processing of wood, the furniture and paper industries are still in the phase of deep restructurization. There is a high possibility of a dramatic increase of demand for wood in the near future. Paper consumption

will probably grow with increasing wealth. In OECD countries paper consumption is at present about 200 kg per capita, while in Poland it is only 23 kg.

The bulk of the forests in Poland (83%) are publicly owned. State Forests employ about 70,000 people and is self-financing. The remaining 17% of privately-owned forests are owned almost entirely by individuals. The average size of state forests is large, but the average private forest is only one hectare. Many of the private forests have been planted as protection for agriculture. Since 1945 the total area of forest increased by 34% from 6.4 million hectares to 8.7 million hectares in 1993. As a consequence the share of forest of the total area increased from 21% in 1945 to 28% in 1993. During the same period there was a constant increase in the proportion of deciduous in Poland's forests. In 1993 1/4 of total forest was deciduous and 3/4 comprised conifers.

During the period 1980-93, the area of forests incorporated into landscape parks and terrains of protected landscape has increased tenfold and the acreage of protective forests has doubled accounting for 3.2 million ha of forests (40% of total forest area) in 1993. Protective forests include forests which:

- protect soil against erosion,
- protect river banks against landslide
- are damaged as a result of industrial pollution
- are seed stands or supply protected animal species with refuge
- have particular natural-scientific importance
- are situated within the administrative borders of towns or up to 10 km outside of big towns (Rykowski, 1994).

In 1992 a new forest law came into force. Forest management now has to follow three main principles, the principle of universal protection of forests, the principle of durability of forests and their sustained utilization and the principle of increasing forest resources (Forest Act, Chapter 2, Art.8, 1991). This Polish forestry law was one of the pioneer legislation systems in Europe that so distinctly equaled the environment-forming and general social functions with the productive and raw-material function of forests.

Air pollution has caused a considerable deterioration in some Polish forest zones, especially in the south-west (Sudety) region and other southern regions in the industrial heartland of the country. Mass dying off of Norway spruce stands occurred in an area of about 15,000 ha (Rykowski, 1994). The project area of this report lies within this region. Despite a continuous decrease of sulfur dioxide and nitrogen oxides deposition since 1986, forest stands damage has continued to grow, due to unfavorable weather conditions. In 1993 the proportion of damaged trees in Poland with more than 25% defoliation was nearly 50%. The forest destruction is concentrated at elevations above 800 meters, while the forest cover below that level is still relatively intact.

4.3 Other areas

Mining Areas

The energy supply in Poland is primarily coal based (table 6). In 1992 nearly four fifth of total fuel consumption is based on coal (63% hard coal, 14% lignite coal). The share of coal in fuel consumption has gradually decreased during the last two decades from 84% in 1977

to 77% in 1992. Total energy consumption decreased by 25% between 1988 and 1993. The energy efficiency in Poland is well below OECD Europe. Most studies of the energy intensity of the Polish economy conclude that Poland uses two to three times as much energy to produce a unit of GDP as does OECD Europe (OECD, 1995). Though there are many reasons to assume that structural change will gradually adjust the structure of Poland's total primary energy supply towards that of OECD Europe, for the foreseeable future, the Polish economy will remain coal intensive.

Table 6. Fuel consumption in Poland for 1985 and 1992 (in percentage)

| Fuel type | 1985 | 1992 |
|-----------------|-------|-------|
| Hard Coal | 70 | 63 |
| Lignite Coal | 9 | 14 |
| Oil | 11 | 13 |
| Natural Gas | 8 | 8 |
| Others | 2 | 2 |
| | | |
| Total [1000 TJ] | 5,169 | 4,116 |

Source: Suschka, 1995

However, the coal industry including coal mining has to undergo a restructuring program to bring it back to profitability. The biggest obstacle again is the social and political implications of the job losses that will follow from the planned mine closures. Employment in the Hard Coal Industry has already dropped by 23% from 415,000 in 1989 to 320,000 in 1993, which is equivalent to about 4% of the total national labor force. As a result of the 1994-95 restructuring program it is forecasted that the total workforce in mines will reduce to 250,000. The State Hard Coal Agency's view even is that the present production level of around 130 Mt a year could be sustained with half the existing workforce.

Urban areas and Protected Areas

The project area includes some of the most densely populated areas in Poland. This is in particular true for Katowice voivodship, which has a population density of 600 persons per km² (compared to an average of about 150 persons/km²). As a consequence the share of the category "other" land in Katowice is high amounting to 22%. In the other voivodships within the project area the share of other land in total land is between 11 and 15%. About four fifth of the category "other" land comprise urban area and roads. A high population density and the industrial character of the region entails demand for recreation. The nearby mountains and hills are therefore of major touristic and recreational importance. The increase of landscape parks and protected landscapes during the past years has been discussed in Chapter 4.2 (Forestry).

Legal framework of land use planning

Poland has a system of land use and development plans on different administrative levels. The general principle is similar to those of most Western European countries. The municipality is responsible for all issues of local spatial planning and development within the region. For this purpose plans on different spatial units are developed. They should also include measures for environmental protection and indicate directions of land use changes in a decisive way. However, these plans have to be within the legislative framework of the particular sectors (e.g. agriculture, forestry, transport). Consequently their potential to influence development paths is limited.

Chapter 6. Comparison of the three countries of the Project Area

The project area is composed of three former communist countries currently undergoing transition to market economies. In 1988 they had a common starting point. Since then the political developments have been quite different between East Germany, Poland and the Czech Republic. First democratic elections took place in Poland in June 1989. In November 1989 the German wall was falling. German's reunification was one year later in November 1990. In the Czech Republic the first democratic elections took place in 1990. On the other hand it is difficult to analyze such a diverse project area and develop consistent scenarios for land use change. From this exercise we can hope to gain some important insights in connection to possible developments in the European context. This section aims at comparing and discussing the results of the analysis of the factors influencing land use change in the three countries including some comparisons with the whole of Europe and the EU.

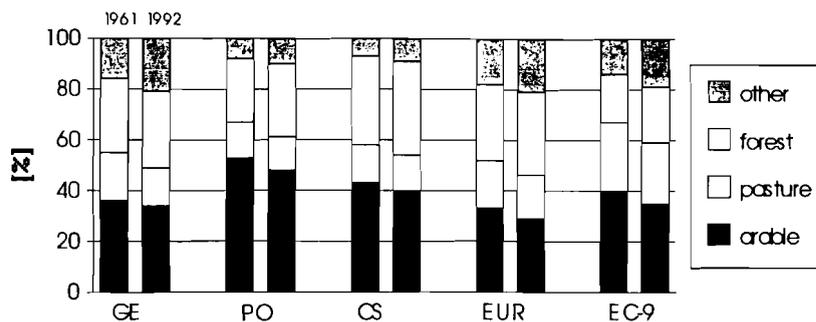
Land use change since 1960

Agriculture is the largest user of land in Europe taking up well over half of the total land area in most countries. Agriculture includes arable land, permanent crops and permanent pasture. Forest accounts for a third of Europe's land cover. The rest of the land area accounts for "other land". The major part of this category falls into urban areas and roads. For a particular country, depending on the climatic zone and topography, the distribution of land devoted to agriculture and forestry may differ considerably from the overall picture of Europe. Figure 3 shows the land use for Europe, the EC-9 and the countries of the project area in 1961 and 1992. It can be noticed that Poland and the Czech Republic have a comparatively low share in "other" area as compared to the EU countries.

For the whole of Europe utilized agricultural land (arable, permanent crops and permanent pasture) decreased from 241 Mio. ha in 1961 to 217 Mio. ha in 1992. This is equivalent to a decrease of 10% over the given 30 year period. (Reasons for the decrease in agricultural land have been discussed in Chapter 2). Forest increased by 15 million hectares (10% increase). The category "other land use" increased by 9 million ha (10% increase). These directions of land use changes, a decrease of agricultural land (arable and permanent pasture) and an increase of forest and the category "other" land use, are the same for most European countries. But the extent of change varies between the countries (figure 4).

Germany had a considerable decrease of utilized agricultural area (-11%) over the past 30 years, mainly attributed to the decrease in permanent pasture. Agricultural area was obviously converted to the category "other", afforestation was marginal. In Poland and Czechoslovakia agricultural land decreased by 7% during the same period. Poland had a comparatively large increase of forested area (13%), while Czechoslovakia's "other" land use increased substantially (34%). For comparison, in the EC-9 countries utilized agricultural area decreased by 12% (14 million hectares). Forest and other land use increased by 17% (6 million hectares) and 35% (8 million hectares) respectively.

Fig. 3 Land Use 1961 and 1992



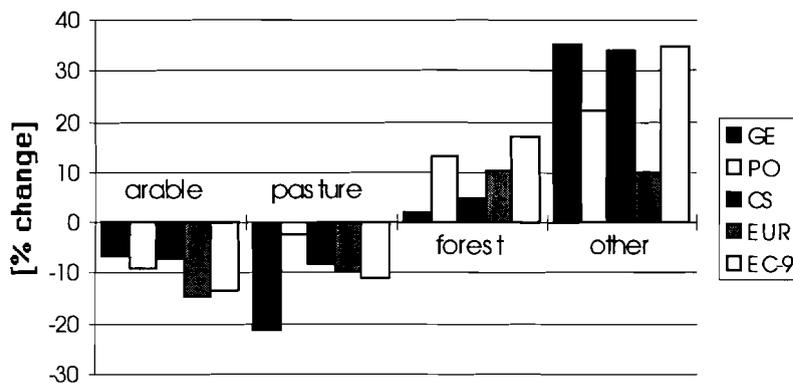
for each country: 1961... first column, 1992... second column

GE... Germany (1961 FRG + GDR); PO... Poland

CS... Czechoslovakia (1992 Czech Republic + Slovak)

EUR...Europe (from the Atlantic to the Ural); EC-9...European Community (9 countries)

Fig. 4 Percentage Change of Land Use between 1961 and 1992



Source: FAO Production

Agriculture

Since 1989 the agricultural sector has undergone drastic changes in all the three countries of the project area. The introduction of competitive free market conditions has required significant structural changes in the agricultural sector. The importance of agriculture in terms of GDP and employment contribution has decreased. Table 7 summarizes GDP and employment of different sectors in Poland, the Czech Republic and Germany in 1993. In Poland and the Czech Republic the sectors industry and agriculture still play a more important role than in Germany, where the majority of GDP and employment is generated in the service sector. The share of agriculture as percentage of GDP still is high in Poland and the Czech Republic (both 6%) compared to Germany (1%). This shows the relative importance of the agricultural sector in the Czech Republic and in particular in Poland. However, for eastern Germany only the contribution of agriculture to total GDP still is 10%. While the Czech Republic's 7% share of employment in the agricultural sector is comparable to Western European countries, Poland still has a very high employment in this sector (27%). By combining employment and GDP share it is obvious that Poland's labor productivity in the agricultural sector is very low.

Table 7. Employment and GDP share in 1993

| | Share of employment [%] of civilian empl. | | | GDP share [%] of nominal GDP | | |
|--------------------|--|----------|---------|---------------------------------|----------|---------|
| | Poland | Czech R. | Germany | Poland | Czech R. | Germany |
| Agriculture | 27 | 6.8 | 3.0 | 6.8 | 6 | 1.1* |
| Industry | 30.2 | 44.6 | 37.1 | 36.2 | 44 | 36.6 |
| Services | 42.8 | 48.6 | 59.9 | 58 | 50 | 63.3 |

Sources: Nat. Inf. Center of the Czech Republic (1995)

* for eastern Germany only it is 10%

All three countries experienced decreases in employment in agriculture. In East Germany the number of people employed in agriculture has shrunk most dramatically from 825.000 in 1989 to 187.000 in 1993. In 1988 the share of employment in agriculture was 12% in former Czechoslovakia and 30% in Poland. In both countries this share decreased down to 27% in Poland and 7% in the Czech Republic in 1993..

The agricultural sector exposed to competitive free market conditions required significant structural changes. As a result agricultural output declined, especially the livestock sector (Table 8). The changes have been most dramatic in East Germany. The harvested area of total cereals remained constant in Poland and the Czech Republic since 1989. In Germany this area decreased by 16% due to the high participation in the EU's set-aside program.

Table 8. Percentage Change in head of livestock between 1989 and 1994

| | Poland | Czech Republic | East Germany |
|--------|--------|----------------|--------------|
| cattle | -29 | -38 | -51 |
| pigs | -11 | -15 | -66 |
| sheep | -71 | -54 | -75 |

Germany's unification introduced the EU's Common Agricultural Policy (CAP) in East Germany. Unlike today's agricultural policies of Poland and the Czech Republic, the CAP still is considerably regulated by subsidies, quotas and special programs providing income for farmers. The most important of the latter is the set-aside program subsidizing farmers for not cultivating their land. In East Germany participation in the set-aside program is high. In 1994, an average of 14% of the agricultural land of a farm was set aside.

In Poland and the Czech Republic most subsidies have been removed since the implementation of the market economy and farmers in these countries have to survive in a free market economy without any compensation payments. The future direction of agricultural policy in these countries is still very much under discussion. Recent developments show that there is a tendency to adopt policies similar to the CAP. This is not surprising since EU membership is a major political goal for the East European countries. However, it is important to consider that the CAP is currently undergoing (and probably will even more in the future) major changes in direction of a more free market economy in the agricultural sector.

A major difference between the three countries is the variation in the structure of ownership. Under the communist system in former Czechoslovakia and G.D.R. over 90% of the land was owned by cooperatives and state farms, whereas in Poland 76% was privately owned. This correlates with the size of farms. The average private farm in Poland is less than 6 ha. In former G.D.R. and Czechoslovakia average farm sizes were large compared to Western Europe amounting for 4500 ha and 8000 ha respectively. While in East Germany and the Czech Republic privatization is ongoing and farm sizes are reduced, Poland requires structural adjustments in direction of larger farming units to be competitive.

Forestry

One third of the project area is covered by forest. All three countries stress the multifunctionality of forests including commodity production, protective functions (groundwater protection, erosion, etc.) and recreational functions. Afforestation is expected to increase in all three countries and it is a general policy to encourage this. Within the EU subsidies are provided for conversion of agricultural land to woodland. However, until now the afforestation rate is slow, mainly due to the decrease in the value of land when converted to forest and the long term character of the conversion.

The Czech Government assumes increased afforestation as a side effect of liberal agricultural policy, as it is likely that non-competitive marginal agricultural land will be taken out of production and afforested. In addition tax on forest soils is planned to be reduced.

In Poland, where the country's wood industry is well established it is assumed that demand for wood will increase substantially in the near future. In 1992 a new forest law came into force in Poland. It was one of the pioneer legislation systems in Europe that distinctly equaled the environment and social functions with the productive function of forests. In particular in the project area of this study, air pollution caused a considerable deterioration in some forests zones. Thus, special management programs have been launched for these regions.

Mining Areas

Large mining areas are situated within the project area. Since the economic changes, the coal industry including mining has to undergo a restructuring program to bring it back to profitability. The biggest challenge is the dramatic numbers of job losses that follow mine closures. In East Germany most of the open pit mines have already been closed. In Poland and the Czech Republic approximately one half of the planned closures have been completed. In Poland employment in the hard coal industry has dropped from 415,000 in 1989 to 320,000 in 1993 and is expected to be further reduced to 250,000. In the Czech Republic 190,000 people were employed in the mining sector in 1989 as compared to 110,000 by 1993. The goal is a total employment of 15,000.

As a consequence of the closure of coal pits, large areas that have been devastated will be subject to recultivation. Many of these former open cast pit mines are intended to be afforested and declared as some kind of protected area.

Urban and built up Areas

Typical for industrial areas, part of the study area has a high share of urban areas and area used for infrastructure. The closure of industrial sites due to economic restructuring produced areas which are currently out of any use. This includes highly polluted derelict land with potential environmental risks like groundwater contamination¹. Clean up is expensive and therefore programs are required to distinguish high risk from low risk areas. Because of the risk to buy contaminated land, it is a typical feature that investors prefer to situate newly created housing and industry on former agricultural land instead of former industrial sites. Motorized traffic is expected to increase with growing economic wealth. This will create additional demand for roads and accompanied areas. Thus land consumption for built up areas is likely to increase during the coming years.

Legal Frameworks of Landscape Planning

Among the three countries, Germany certainly has the most specified and developed legal framework of development and landscape planning. On several administrative levels development and landscape plans are produced. They exert some influence on land use patterns, in particular in terms of declaring development zones or special protection zones. These plans also determine whether agricultural land may be converted to built up area. In general Poland and the Czech Republic have a similar legislative framework for development and landscape plans. These plans are considered to be less sophisticated and less influential than in Germany. In all three countries, development plans are determined by the legislative framework of other sectors, that are relevant for land use changes like agriculture, forestry or transport. Thus their potential to influence development paths may be limited.

¹ An estimated 80,000 places in East Germany are suspected to be contaminated (UBA,1993).

Chapter 7. Scenarios for Land Use Change

7.1 Introduction

Foreseeing future developments is a complex and uncertain task. Important factors influencing future land use and land cover may change considerably in the near future. This is in particular true for the agricultural sector in both the EU and the transforming countries of Eastern Europe. Discussing future land use and land cover by means of scenarios allows incorporation of several paths of future development in those sectors relevant for land use change. The time frame covered will be 1992 to 2050 with an intermediate step in 2020. Though the main goal here is to develop plausible scenarios for the project area of this study, the scenarios are to some extent relevant for the whole of Europe.

The analysis of Europe's land use change over the past decades is an important basis for discussing likely land use changes. The main features as discussed in chapter 6 are:

- A decrease of agricultural land (both arable and grassland)
- An increase of forest and other areas (mainly urban and infrastructure)

In the European context, agricultural policy (including forestry) is considered to be the most important driving force for land use change. As demonstrated in Chapter 2, public policy in the EU towards farming is changing substantially. The main thrust is to cut more subsidies, to reduce overproduction and lower costs. These changes will be reflected in land cover and land use. The most important tendencies in the EU's Common Agricultural Policy (CAP) that will have implications for land use change are:

- More market economy in agriculture
- Spending on CAP decreases in favor of spending on structural funds
- Price support mechanism for production reduces in favor of direct aids for farmers

Incentives are provided for:

- Afforestation
- Environmental conservation measures
- Set-aside of agricultural land
- Land management for public access and leisure activities
- More extensive forms of crops and livestock production

Today the main feature of agricultural policy in the Czech Republic and Poland is a substantial cut in subsidies resulting from the aim to introduce a free market economy in the agricultural sector. These countries today are more liberal in their agricultural policy than the EU. Today farmers in the Czech Republic and Poland face a severe economic crisis. Major short term consequences for land use changes are increasing areas of abandoned agricultural land which is in particular true for the Czech Republic.

In addition, there are also policies under discussion which may have an indirect effect on agriculture. Preconditions for agricultural production may change considerably due to changes in areas like energy policy, e.g. by emphasizing energy from biofuel. Another

example here refers to attitudes and values towards the landscape. Besides perceiving landscape as a source of marketable products, functions referring to cultural heritage, visual amenity, and landscape as a source of recreation are becoming increasingly important. In particular a wealthy society seems to be prepared to pay for these value-laden aspects.

In summary there are presently two important trends in land use change: A decline in agricultural land used for food production and an increase in the category "other" land, consisting mainly of urban area, roads and railways. They will be discussed in more detail in section 7.3. Key questions here are:

- To what alternative use will today's agricultural land (used for food production) be converted?
- What function shall a landscape fulfill if it is not used any more for food production?"
- To what degree do we accept a conversion of farmland to urban and built-up area?

All three scenarios assume the realization of an integrated world economy in the agricultural sector. With possible few exceptions most of the countries participate in the opening of their agricultural markets. Closely related to this is the introduction of a more free market economy in the agricultural sector. In the frame of today's surplus production this will result in a considerable decrease of farmland. The first two scenarios describe two different paths as how to deal with surplus agricultural land and development of rural areas in general.

- **Scenario 1: Large scale increase in wooded area**

In scenario 1 only the highest yielding farmland remains competitive. Since there is a surplus of farmland the price of this land will decrease. The alternative for farmers on non-competitive agricultural land is afforestation or, if possible, selling the land for non-agricultural use. In particular in the vicinity of urban areas this results in a considerable expansion of urban and built up areas. As farming becomes less profitable the outflow of agricultural labor continues. Some subsidies are provided for the conversion of farmland to forest.

- **Scenario 2: Alternative agricultural products**

Like scenario 1, subsidies to those agricultural products that face overproduction today are cut substantially. Since it is a major political goal is to avoid uncontrolled spreading of urban development, so as to keep the land open for future generations, and to preserve employment in rural areas, subsidies and incentives are now provided for the introduction of alternative agricultural products. They include biofuel, plants for the chemical industry, and land conserved for preservation of cultural heritage (parks, nature reserves, national parks). Afforestation of marginal agricultural land still is encouraged but it takes place to a much lesser extent than in scenario 1.

The first two scenarios are answers to the current situation of surplus agricultural production. An assessment, in particular of the long term future, of Europe's agriculture must take the global food supply and demand perspectives into account. scenario 3 discusses the possibility of a significant food demand increase triggered by population and wealth increase in some parts of the world. In combination with resource constraints like water scarcity or erosion this will lead to an increase in the world market price for agricultural food products.

- **Scenario 3: Europe as food exporter**

The main characteristic here is a dramatic increase of the world food prices by approximately 2010. Being aware of this, policy aims like scenario 2 at preserving farmland and agricultural know-how. To ensure this like in scenario 2 alternative agricultural products are emphasized before the actual price increase for food products. From 2010 onwards the situation changes and the full capacity of farmland to produce food is used again (within the framework of environmental regulations). Unlike scenario 2 no further subsidies for the agricultural sector are required.

It is obvious that a high degree of uncertainty is attached to a quantification of scenarios for land use change. This is in particular true for developments in the transforming countries of Poland and the Czech Republic. In addition there is time-related uncertainty. We do not know exactly when developments described by the scenarios will take place. For example, the Czech Republic and Poland are likely to join the EU, but whether this will be by 2005 or 2015, is impossible to foresee. The developments foreseen in scenario 3 may be reality by 2010 or only by 2040, but until then the developments of scenario 1 or scenario 2 are the most probable.

In this study we assume full or at least associate status (including full market integration), regarding EU membership of Poland and the Czech Republic by approximately 2010. Within the EU the most uncertain factor is developments in the CAP. However, since scenarios do not intend to foresee future developments, but rather to serve as a tool for assessment of possible future paths which may be presented to decision-makers, the goal here is to argue a range of the most likely developments. Each scenario will be described qualitatively and quantitatively. The latter specifically applied to the project area. There are two time steps for each scenario. The first describes land use patterns up to 2020, the second up to 2050.

Current Land Use in the Project Area

Figure 6 shows land use patterns of the project area in 1992 on the administrative levels of the "Länder", "voivodships" and "regions". For the whole project area, utilized agricultural area (UAA) accounts for 10 mio. ha (54% of the region). The major part of UAA is used for arable land (between 60 to 85% of UAA depending on the administrative unit). The remaining 1/5th to 1/3rd of UAA is used as permanent grassland. 5.9 mio. ha (32%) of the project area is covered by forest and the remaining 2.5 mio ha (14%) by the category "other" land (figure 5).

Fig. 5. Land use 1992 for the whole project area

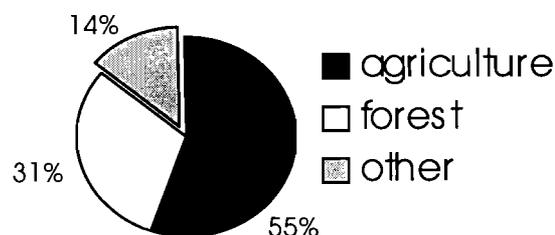
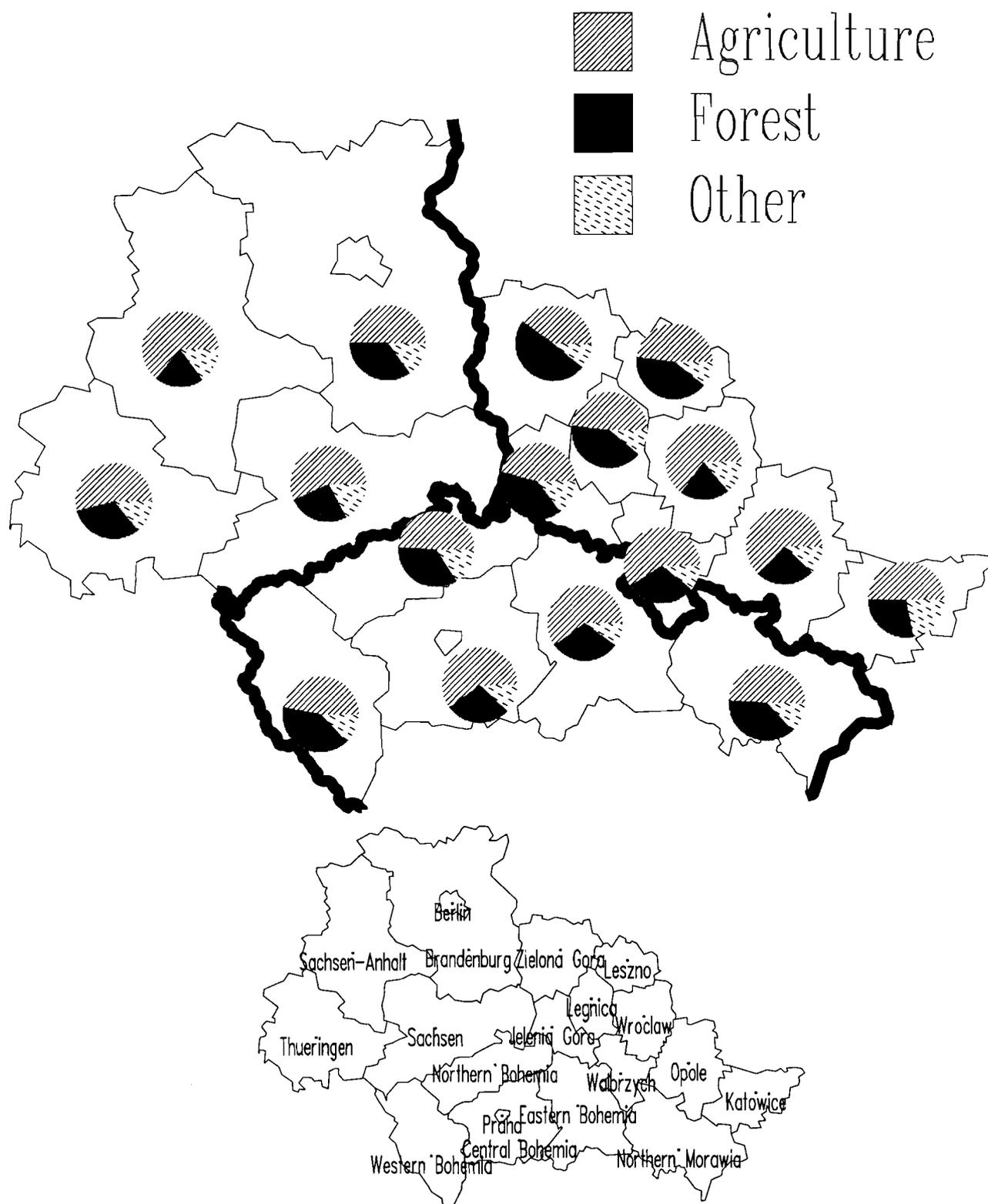


Fig.6 Land Use of Project Area 1992

LAND USE 1992



7.2 Some notes on the methodology of the scenario construction

What is a Scenario?

The scenarios presented in this report are an example of contrasting scenarios describing alternative developments of the same area. The scenario concept came into research via military and strategic gaming, but originates from theater (Becker 1983). In theater it refers to the screenplay with such components as action, catchwords, stage properties, decor, light and sound. In futures studies Herman Kahn was probably the first to introduce it (Wilson 1976). He has defined a scenario as "a hypothetical sequence constructed for the purpose of focusing attention on causal processes and decision points" (Kahn & Wiener 1967). Through frequent use, the meaning of scenario seems, however, to have become increasingly broad and vague. The major points of difference between various studies are (Anderberg, 1989):

- *Development or state?* A scenario can be a development path into the future or a future state of the world.
- *The level of detail.* A scenario can be everything from only one curve of e.g. the development of energy use, but often also a very detailed description of a future development or state.

Two basic types of scenario approaches are used in futures research (France:Datar 1975, Hall 1978):

- *Exploratory* scenarios, where one starts in the present and tries to project various trends into the future. These can be either tendential i.e. they concentrate on the consequences of certain trends if they should continue, or framework, in which the field of possible future is delimited.
- *Anticipatory* scenarios, where one starts with painting a picture of a future situation and then asks: how do we get there? or how do we avoid to get there?. This category is most often either normative, i.e. how do we reach a desirable future, or contrasted, e.g. a solar or uranium future society. Crisis scenarios, which are common in war gaming could also be added to this category.

Another difference is *methodological* and *informal* scenario writing (Asplund 1979). The methodological approach where a certain method or model is used to assure that it does not matter who constructs the scenario. The input assumptions should lead to the same output. The informal scenario writing procedure differs from situation to situation and from author to author. This does not mean that an informal scenario is unstructured or lacks logical consistency. In larger scales two forms are predominantly used for making the difference between scenarios; alternative *trends* in key factors like population, energy use or GNP, and alternative *developmental* constructs i.e. differing assumptions about the dynamics of the world. The developmental constructs in the example concern different management strategies.

Why Scenarios?

There are two particularly advantageous qualities of scenarios that are emphasized in the literature (Anderberg 1989):

1. The scenario provides a coherent framework for analysis on how various issues or sectoral developments impinge on one another and interact.
2. The scenario serves as a tool to force imagination, stimulate discussion and focus attention at specific points of interest.

For environmental projects which focus on the large-scale, long-term interactions between development and environment, scenarios are indispensable tools. Both the qualities mentioned above are essential. For long-term studies and assessments scenarios are needed for combining the various sectoral fields as well as for opening up a constructive analysis of future problems (see e.g. Hesterberg et al, 1991). In the case of long-term effects of accumulated toxic pollution, which is the major focus of the project on Regional Material Balance Approaches for Long-Term Environmental Policy Planning, there is definitely a need a broad and imaginative analysis of the risks of the past, present and future practices. It is necessary to integrate scientific knowledge for looking closer into what types of development that could be risky and how these can be avoided. For this, a scenario approach can be very valuable for stimulating analysis, for sorting out urgent research areas, and as a means for communication between scientists and policy makers.

Demands on a Scenario

There is no established doctrine on how to create, present or use scenarios. Many studies use a combination of approaches and a great diversity of methods can be found. In any case there are several demands that can be placed on a "good" scenario (Anderberg 1989):

1. Provision of adequate information and explanations of the central assumptions that the scenario is built upon. Questionable, weak or controversial points have to be brought to light, not to be hidden.
2. A logical contiguity of events during the progression of the scenario through time, and some consideration of historical experience. These are important to make the scenarios as intelligible and also acceptable as possible.
3. Sufficient detail to allow for a tolerable "performance" of the scenario. The detail requirement and the focus have of course to be adjusted according to the purpose of the scenario project.
4. Easy to understand and to follow. Concreteness should be encouraged in order to ensure that the scenario can be analyzed in practical terms.

In all these points an adaptation to the specific goals of a scenario project is implicit and this should be a major demand; a good scenario is one that fills its defined function. This is also emphasized by Brown (1968): "The function, form and content are determined by the specific research task at hand. Different levels of analysis have differing requirements of detail". Further, a range of scenarios, should be considered and discussed, including some that might be surprising or "not impossible". At the same time, it is important that a consensus be reached among the participants and users on the acceptability of the scenarios presented. Otherwise, the analysis could be dismissed as meaningless. When one presents a scenario, one should also think critically about the following (Anderberg & Stigliani, 1992):

- Are the assumptions sufficiently explained?
- Are the interesting points focused? Is there enough detail?
- Is it logically consistent and easy to understand?
- If it is a rather extreme scenario, is the plausibility and relevance for looking at this scenario sufficient?

It should be remembered that scenario construction and analysis are mainly practical processes depending on creative participation and inputs of different individuals, their knowledge and perspectives. This cannot be fully described and should not be formalized into a rigid methodology, which has not been the aim of this paper. But still some basic guidelines can be put forward to facilitate the use of scenario approaches and make scenario studies and scenario presentations as good and interesting as possible. The scenario analysis and construction should be viewed as a method to inspire and focus creative thinking and analysis of possible problems and risks in an uncertain future. The value of scenarios is their effect as catalysts for such processes.

The construction of land use scenarios

In the case of long-term effects of accumulated toxic pollution, there is definitely a need to integrate scientific knowledge, for looking closer into what types of development that could be risky and how these can be avoided. For this, a scenario approach can be very valuable for stimulating analysis and sorting out urgent research areas. The scenario analysis and construction should be viewed as a method to inspire and focus creative thinking and analysis of possible problems and risks in an uncertain future. The value of scenarios is their effect as catalysts for such processes. The first questions to be asked in a scenario study are which are goals, and which problems are to be focused? Based on this, interesting cases of development should be discussed and analyzed. The goals for the construction of land use scenarios in the project have been that they should be:

- Representative of a range of possible future developments, including some surprising, yet plausible, developments.
- Easy to understand and to follow, for an outsider and non-specialist also.
- Provide enough explanation and arguments for a “tolerable performance”
- Provide an appropriate framework for more detailed studies on long-term effects of pollution in various scales and also make connections to the institutional framework, which makes it possible to analyze and discuss policies in response to the scenarios.

The scenarios presented in this report are mostly intended as framework scenarios providing a common frame for specialized studies focusing on evaluating different effects and for providing a linkage to the agricultural and land use planning policy areas. Our scenarios are exploratory and follow different trends, based on diverging assumptions on the policy development, not the least connected to agriculture, in Europe and in the individual countries. Scenario 1 and 2 do not foresee any major changes in the basic structures of the food sector in Europe, while scenario 3 is intended as a surprise scenario, introducing a radical change in international food trade and the orientation of agriculture of Europe. The presented scenarios are informal, but based on the past development of land use. The past experiences over the last 30-40 years in Western Europe clearly suggest that even radical restructuring of agriculture and urban and economic development, land use changes take time.

Our scenarios focus on the development of the basic land use patterns and agricultural management in the study region. But the numerical presentation of the scenarios focus on the state of basic indicators in the region and the geographical distribution of land use in three points in time: 1992, 2020 and 2050. To explain the changes in land use and agriculture, forestry and the energy sector which influence land use and land management, certain developments are needed both in the region as on a higher level (EC agricultural policy, international trade etc.)

7.3 Trends in Land Use Change

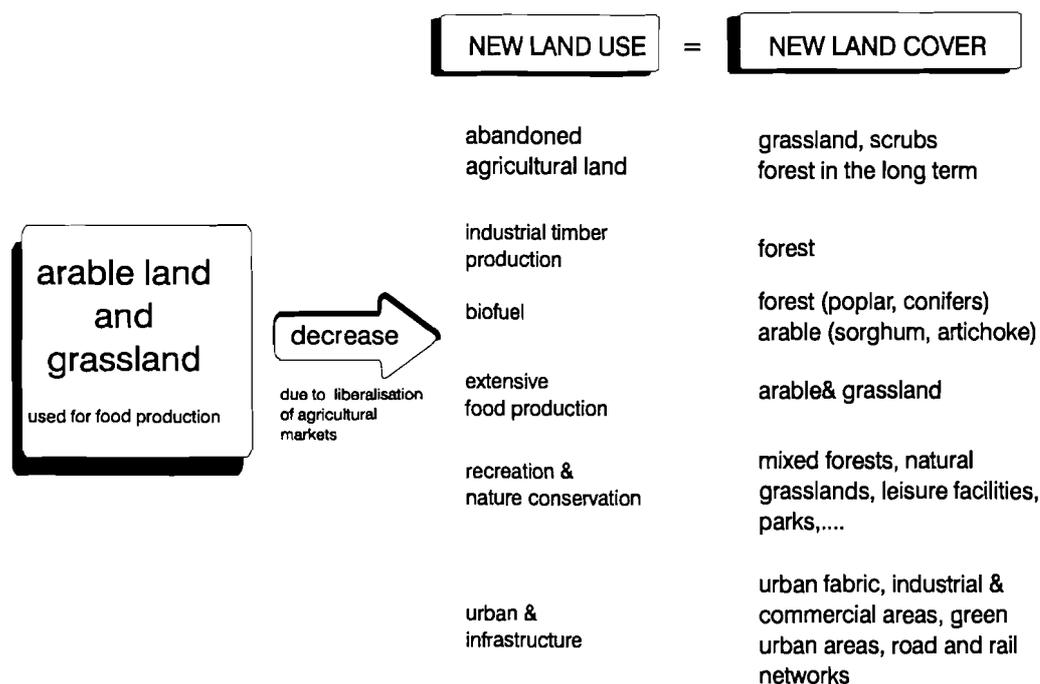
For European countries the general trend in land use change during the past three decades is a decrease in agricultural land and an increase in forest and "other" land (see Chapter 6, figure 3 and 4). Reasons for the decline in agricultural land used for food production and the increase in "other" land are discussed below.

Decline in agricultural land used for food production

After the Second World War European agricultural policy generally aimed towards and succeeded in reaching the goal of food self-sufficiency. Yields per hectare increased considerably over the past 30 years. Now Europe faces overproduction for most of its agricultural products on the one hand, and high support costs for agriculture on the other hand. In the EU more than half of its budget is spent on the Common Agricultural Policy. Hence the intention is to cut agricultural support prices to near world market price levels, i.e. to introduce more market economy in agriculture. Considering current overproduction, large areas of European agricultural land are likely to be taken out of production over the next decades. The decrease of utilized agricultural area between 1961 and 1992 ranges from 7% (e.g. Poland, Czechoslovakia) over 10 to 12% for the majority of the Western European countries, to the maximum of a 19% decrease in Italy. An analysis of the development of the EU's CAP (see Chapter 2) suggests that the decrease in the following decades is likely to be more drastic than the decrease over the past 30 years.

Figure 7 provides a general picture of those land use changes that are considered to be plausible. Here land use changes are also reflected in changes in land cover. The figure does not indicate the extent in terms of area of each land use change.

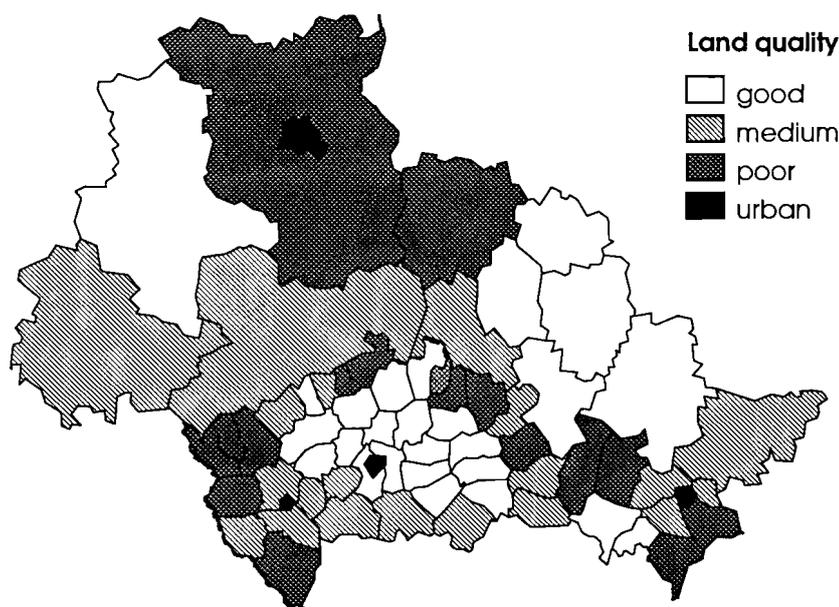
Figure 7. Likely land use and land cover changes in Europe



The decrease of agricultural area will not be evenly distributed over the continent. Under entirely free market conditions, it is logical that the highest yielding cereal area will be the most competitive. A concentration of cereal production on the best soils may therefore be anticipated. "A further concentration of agriculture to the most productive soils and a further decrease of population employed in the agricultural sector is expected" (CEC, 1993b). So called marginal areas are most likely to be taken out of production.

A possibility to identify marginal agricultural land is to analyze the land quality indexes of a region. For calculating taxes and determining agricultural subsidies, a country introduces a classification scheme to determine the quality of a piece of land for agricultural production. These so called land quality indices are commonly a combination of soil type, slope, stoniness and climate. Figure 8 shows a system of land quality indexes for the project area. Since each of the three countries has its own system of land quality indices, it was necessary to redefine the national system in order to show comparable results for the whole project area. Each country was divided into three categories. The land quality indices of Poland, the Czech Republic and the countries of the former G.D.R. were ranked in descending order. For each country, the upper 1/3 of the administrative units were assigned the index "good", the second third the index "medium" and the lower third the index "poor". It can be seen that a considerable part of the project area has a good or medium land quality index for agricultural production.

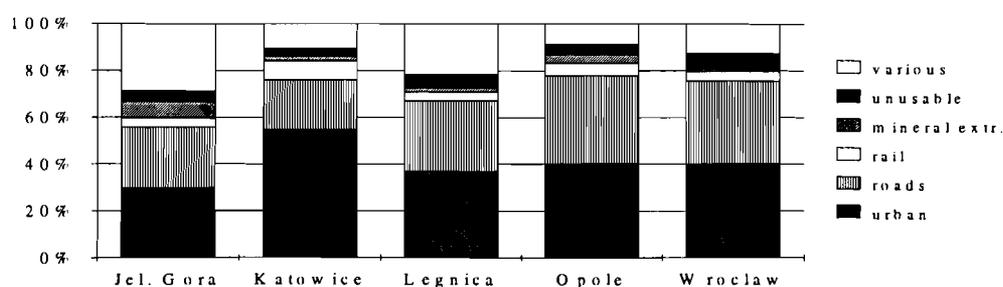
Figure 8. Land quality for agricultural production in the Project Area



Increase in "other" land

A feature that will be common for all scenarios is an increase of the category "other" land use. It consists mainly of urban, sub-urban or commercial areas and land used for infrastructure purposes (roads, railways and airports). It also comprises all those other areas that cannot be categorized as agriculture, forest or urban. For illustration figure 9 shows the share of "other" land use for the Polish voivodships of the project area.

Fig. 9. Share of category "other" land use for five voivodships in Poland



Source: GUS, 1993

The analysis of land use change in Europe since the 1950s shows a 10% increase of so called other land. For the EC-9 countries the increase was much higher (35%). The countries of the project area show an increase over the past 30 years of 35% (Germany and Czechoslovakia) and 22% (Poland). Once agricultural land has been taken out of production, in particular in the vicinity of urban areas, the pressure of urban development towards this available land increases. Only a consequent policy aiming at avoiding low density urban development can halt this trend. Converting farmland to urban area is an irreversible process. Regional development plans often favor high-density urban development to minimize spreading of built-up area. The project area is densely populated and a region of strong economic growth. Consequently the pressure of urban development will be significant.

Increase in forest area

Europe's forest cover increased by 15 Mio. ha (10%) since 1961 due to afforestation of surplus fields and drainage of wetlands. In the EC-12 an area 9 Mio. ha was afforested since 1960, which is equivalent to an increase of 18% (Table 10). This average increase, however, differs substantially from country to country ranging from only a 2 % increase in Germany to a 30% increase in the Netherlands and 40 and 70 % increases in the U.K. and Ireland respectively where forest land cover has traditionally been small.

Although the total forest area has increased, the area of exploitable forests has remained relatively unchanged since the 1950s. Unexploitable forests have increased by transfers to reserves, and placing wood production outside economically accessible areas. This reflects the trend throughout Europe that the environmental and social benefits of forests are increasing in importance compared to industrial benefits. In general, future forest management will emphasize a multifunctional management of woods including the following functions:

1. The *commodity function* - wood production function (timber industry or wood for energy) and other commodity functions like production fodder for domestic and wild animals (berries, mushrooms, game animals, etc.)
2. The *protective function* - forests are employed to control erosion, landslides, avalanches, floods, silting, strong winds, noise, emissions, etc.
3. The *social function* - forests here provide a healthy living and working environment with scenic and recreational values. Recreation includes leisure hunting and fishing and the gathering of berries and mushrooms.
4. The *cultural function* - forests provide aesthetic and symbolic values, and preserve nature reserves and historical monuments.

7.4 Scenario 1: Large Scale Increase of Wooded Area

Within the project area of this study in Poland and to a lesser extent in former Czechoslovakia forest area increased, while it remained constant in East Germany (table 10). This reflects the importance of the forest sector in Poland. The shift from a mainly commodity related function to a more multifunctional management including protective, social and cultural function has already been discussed above.

Table 10. Forest area 1961 and 1992 [1000 ha]

| country/region | 1961 | 1992 | % increase 1961-1992 | % of total land area in 1992 |
|----------------|--------------------|-------------------|----------------------|------------------------------|
| Germany | 10210 ¹ | 10412 | 2 | 30 |
| G.D.R. | 2955 | 2983 ² | 0.9 | 28 |
| Czechoslovakia | 4400 | 4618 ³ | 5 | 28 |
| Poland | 7750 | 8772 | 13 | 37 |
| EC-12 | 49313 | 58127 | 18 | 25 |
| Europe | 143000 | 158000 | 10 | 33 |

Source: *FAO Production*

1... F.R.G. and G.D.R., 2... for 1990, 3... Czech and Slovak Republic

To reduce agricultural overproduction the EU encourages afforestation of agricultural land and provides subsidies for this purpose according to EC-Directive 2080/92 (see Chapter 3). Currently in the EU 50.000 ha per year are afforested. It is expected that in the coming years this will increase to 150.000 ha per year (Allgemeine Forstwirtschaft, 1993). If we assume that over a period of 50 years each year 50.000 ha of agricultural area are afforested, by 2040 approximately 2% of 1990s agricultural area would be converted to forest. Applying the same calculation for an assumed yearly conversion of 150.000 ha, approximately 5.5% of 1990s agricultural area would then be afforested.

Today farmers in the EU, however, prefer to take part in the set-aside program, rather than converting their farmland to forest. This is not surprising considering that afforestation is a more long term and irreversible decision than set aside of farmland. However, criticism of this policy is increasing. The system becomes too expensive on the one hand. On the other hand taking any land out of production is not well appreciated in general.

Nilsson et al. 1992 estimate future expansions of forest land usable for industrial roundwood production. Increase of forest for non-industrial use is not included. Based on expert knowledge the estimates for the period 1985 to 2020 are: A 8% increase of forest land for Europe, a 18% increase for the EEC-9, a 13% increase in the Federal Republic of Germany and a 12% increase in Poland. (Estimates for the GDR and CSSR foresee no increase but the figures were given in 1988 before the post-communist era and the economic changes).

The same source (Nilsson et al, 1992) analyzed demand/supply balances for industrial roundwood in Europe at present and in 2010 assuming three different scenarios (no-decline

scenario, air pollution-induced forest decline scenario and forest land expansion scenario). While the whole of Europe had a surplus wood supply in the late 1980s, the EEC-9 countries had a deficit at that time. Analyzing balances for 2010, all scenarios foresee a roundwood deficit of some 40 million cubic meters per year. The region that will experience the most serious potential deficits is the EEC-9, largely because roundwood demand is expected to grow strongly in this region. Thus it can be concluded that in the future Europe, and in particular the EEC-9, will need more forests from an economic point of view. The same may be true for Poland and the Czech Republic considering their economic growth potential. Pulp and lumber consumption commonly increases with increasing economic wealth, triggered by increased construction works and paper consumption.

A different path of increasing wooded area is to abandon agricultural land on poor soils and foresee no afteruse. Total abandonment with no after care (unlike the set-aside policy of the EU which requires regular mowing of abandoned land) would finally result in a mixed forest as the natural climax under the environmental conditions of Mid-Europe. A liberalized agriculture in the frame of today's surplus production may well result in this scenario, at least in remote areas. In the Czech Republic and in Poland an increasing area of agricultural land has been abandoned since the revolution, in particular in mountainous regions (personal communication, Mejstrik, Tichy 1995). Today it is not possible to obtain accurate data from statistical sources describing this phenomena.

Description of Scenario 1 and quantification for the project area

The basic feature of Scenario 1 is a major withdrawal of subsidies for the agricultural sector. There is no policy interest to preserve agricultural land or keep the land open. This results in a concentration of agricultural land in the best yielding areas. In marginal areas most of the farmland is abandoned and the price of agricultural land decreases. Individual farmers now have two possibilities.

From an economic point of view, the most lucrative solution is selling farmland for conversion to urban land. This is in particular true for densely populated areas (like our project area). Urban development will include extensive recreational areas consisting of landscape parks, small forests, nature conservation areas, etc. Consequently scenario 1 assumes a significant increase in the category "other land".

In more remote areas, where there is no need for urban development the final response of farmers to an unprofitable farm will be to afforest their land. (In the context of the European Union it is considered to be unlikely that large agricultural land will lay fallow). To alleviate the economic strain subsidies are available to afforest farmland. Another incentive for afforestation is an increasing demand for industrial roundwood in the near future. For those areas which already have a long established tradition in forest management the conversion from farmland to forest is more successful in involving the commodity function of forests. Forests of the other areas rather focus on the protective, social and cultural function of forests.

The socio-economic consequences of this scenario include a further further decrease of employment in the agricultural sector. The gap in wealth between rural and urban areas will widen.

In terms of land cover the scenario "increase of wooded area" means a conversion from formerly used agricultural land (arable land and grassland) to forest, either by active

afforestation or by natural succession to the climax forest. The type of forest grown (deciduous, coniferous, mixed) depends on the chosen type of management. Land cover conversions will have significant environmental consequences. Changes may occur in local climate, plant and animal species, hydrological conditions and soil properties (including dependent functions like accumulation or release of nutrients and pollutants) to name the most important ones. The direction of change (in particular of soil properties) depends heavily on the type of forest grown and management practices.

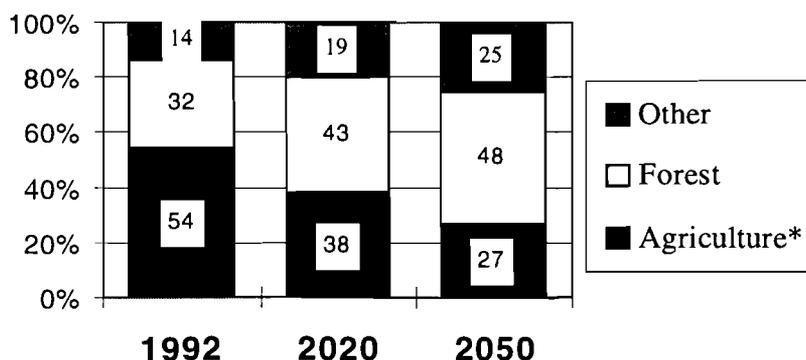
Withdrawing most of the agricultural subsidies decreases farmland considerably, in our scenario by 50% in 2050, amounting to 5 mio ha (Table 10 and figure 10). Both the forest area and the category "other" land use increase significantly, the former by 50%, the latter by 80% of their area in 1992. Consequently, the overall land cover pattern in 2050 is very different from the one in 1992. While in 1992 the majority of land was used for agriculture (54%) in 2050 the major part of the land is covered by forest (48%) and a fourth of the total area accounts for "other" land use. The use of forest (or better "wooded area") is supposed to be multifunctional, including recreational or nature conservation purposes in addition to timber production. Part of the increase of wooded area may also be due to simply abandoning agricultural land.

As discussed above, the conversion of agricultural used land to forest will not be distributed evenly over the project area, but will be concentrated on "marginal" agricultural land (see Fig. 8). In addition, it may be assumed that under the climatic and topographic conditions of the project area, agricultural land higher than 600 meters is less favorable for intensive cropland or grassland farming. Further, those areas that have already had a high share of forest land are more likely to increase their forested area than those with a low share of forest land, simply because the know-how of forestry is more likely to be available in an area with an established forest sector.

Table 11 and Figure 10. Scenario 1 applied to the project area

| | 1992 | 2020 | 2050 | change 1992-2020 | change 1992-2050 | | |
|--------------------|-----------|-----------|-----------|------------------|------------------|-----------|-----|
| | [1000 ha] | [1000 ha] | [1000 ha] | [1000 ha] | [%] | [1000 ha] | [%] |
| Agriculture | 10073 | 7051 | 5036 | -3022 | -30 | -5037 | -50 |
| Forest | 5924 | 7912 | 8892 | 1988 | 34 | 2968 | 50 |
| Other | 2587 | 3621 | 4656 | 1034 | 40 | 2069 | 80 |

Scenario 1



*only food production

7.5 Scenario 2: Alternative Agricultural Products

Farmers and foresters cultivating the land to produce food and timber is a basic feature of rural landscapes. There is a strong political will to preserve rural landscapes as contrast to urbanized areas, and to provide opportunities for development in rural areas. A reduction of today's agricultural surplus production however will result in excess agricultural land. Scenario 2 discusses two possibilities for using surplus agricultural land. On the one hand farmers may have extended responsibilities for keeping up the landscape as a kind of countryside manager, resulting in a new means of income. On the other hand the introduction of a non-food agricultural product, namely biofuels, may provide another source of income. Unlike scenario 1, in these cases farmers still receive considerable subsidies, particularly during the initial phase of change.

Farmers as Countryside Manager

One alternative being more and more favored in recent years is to increase responsibilities and opportunities for the farmer as a countryside manager. Production of food, industrial crops, and forestry products will remain the principal objective, but farmers will increasingly supplement their incomes by assuming duties related to:

- wildlife protection and promotion
- landscape conservation and maintenance
- provision of services and facilities for leisure and education

This concept offers a framework for two types of land management which today are commonly accepted as desirable.

The first is to extensify agricultural production considerably as a means to reduce overproduction. More ecologically oriented farming practices, minimizing fertilizer and pesticide use, commonly (not always) result in lower yields compared to intensively farmed agricultural land. This may be true in particular for livestock production.

The second refers to the encouragement of recreation, nature conservation and preserving the cultural heritage of a landscape. Designating landscapes that have some value for the society has a long tradition. Reasons for designations change with time and country. Values that are protected by the designation include visual amenity, heritage, nature conservation and recreational values. The idea of landscape as a source of visual amenity and recreation stems from the beginning of the industrialization and urbanization. The increasing awareness of ecological problems in the 1970s encouraged preservation of at least parts of the landscape in a "natural" condition, in particular focusing on protection of endangered plants and animals. Today's threat to the agricultural sector with the feature of declining rural communities and declining farmland emphasized the discussion on the cultural heritage of a landscape. Regions like the Alps, which have a long tradition in small scale farming are subsidized to preserve the character of the landscape.

On the international and national level several agreements have been established to encourage nature conservation. The most important include the UN Convention on Biodiversity, the Ramsar Convention on the preservation of wetlands of international importance, the EC Directive (79/409/EEC) on the Conservation of Wild Birds and the EC

Habitats Directive (92/43/EEC) on the preservation of endangered habitats, Nature Reserves, Special Protected landscapes, etc..

Examples of landscapes designated for reasons of heritage, recreational value or visual amenities include national parks, green belts around cities, country parks, and the EC Directive on Environmentally Sensitive Areas. The latter is an area where traditional farming methods have helped to create a distinctive landscape, wildlife habitats or historic features. The purpose of the scheme is to support the continuation of these farming practices and to encourage measures that will enhance the environment.

During the last decades there was a constant increase of protected areas in most of the EU countries, with the highest rates of increase over the past five years. As an example, the development of designated areas in Germany shall be demonstrated. The percentage of nature reserves increased from 0.6% in 1955 over 1.3% in 1986 to over 2% of the land area in 1992. 25% of the land area are designated for some kind of landscape protection (Landschaftsschutzgebiete). The latter are designated for their visual amenity, recreation value, variety or individuality. So called nature parks (Naturparke) are areas that are in particular suited for recreation. They mainly consist of nature reserves and landscape protection areas. In 1960 there were 12 "Naturparke" covering 2% of the land area, whilst in 1993 Germany has 67 "Naturparke" covering 15% of the total land area (UBA, 1994). The area is likely to increase over the following years since East Germany will join the scheme.

The second possibility to use surplus agricultural land is the introduction of biofuels and plants for the chemical industry.

Land for biofuel and plants for the chemical industry

The strong political and economic will to reduce overproduction encourages the introduction of new agricultural products. Reduced subsidies to the agricultural sector as outlined in the CAP reform may result in a higher competitiveness for products currently not produced in large scale. Even in the other case, if, due to social and political pressure from the agricultural lobby, a liberalization of the agricultural market does not succeed, subsidies will rather be provided for alternative products than further increasing overproduction. New products increasingly discussed nowadays are plants for energy production and industry.

In its simplest form biomass power does not depend on energy crops. All the biomass power stations now in operation use biomass residues from agriculture, forestry, urban refuse and other residues from processing timber, food and fiber. Therefore the forestry and waste management sector may also be interested in promoting biomass energy. The most promising plants grown explicitly for biomass production include fast-growing annual and perennial grasses and fast-growing "woody" plants. In temperate latitudes the trees of most interest are varieties of fir, spruce, pine, poplar and willow, grasses of interest include so-called "elephant grass" or miscanthus for Northern Europe. Technical concepts now being investigated to convert biomass to electricity or liquid fuels (so-called biodiesel) are, for example, discussed in *Patterson, 1994*.

Biomass power may attract support from two quite different lobbies in industrial countries, both already in existence and both influential: power plant and turbine manufacturers, and farmers. Another important group that may be a potential beneficiary of energy plants are waste-water companies. Many industrial countries are facing the problem of disposing of

ever-increasing accumulations of sewage sludge. Because sludge may contain industrial contaminants its use on food crops is restricted. These restrictions may not pertain, if the sludge is applied to land used for energy plants. However, controls on heavy metals and other persistent pollutants may still be necessary, since otherwise an unacceptable amount of these pollutants may cumulate in soils.

For some countries, the possibility of using indigenous biomass as fuel for electricity generation could be a welcome alternative to reduce dependence on imports of natural gas or oil. The competing fuel most affected by a vigorous expansion of biomass power would be coal. In the EU coal producers receive subsidies, without which they would already be hard-pressed to survive. In Poland and the Czech Republic the coal industry is currently undergoing major structural changes aiming at bringing the sector back to profitability. Further pressure for coal producers may result from concerns about the greenhouse effect. Biomass power makes no net contribution to greenhouse emissions, apart from those from machinery for cultivation, processing and transport, which are small compared to those from the fuel itself (Patterson, 1994). Finally there is the argument that the use of electricity will continue to increase for the foreseeable future.

The US Department of Energy (DOE) has declared that biomass power will be the most important renewable energy option for the next quarter-century (US Department of Energy, 1993). In 1990 the Directorate-General for Energy of the European Commission launched a program called THERMIE to foster innovative non-nuclear energy technologies. One area of support has been biomass gasification projects (see EC, 1994). One of the CAP objectives is to stimulate growth of raw materials for non-food uses (CEC, 1991).

However, harvesting energy from crops or forests could have significant and damaging environmental side-effects, including problems with monoculture, loss of biodiversity, soil degradation and possible overuse of chemicals. If biomass power is to be environmentally acceptable, it will have to be implemented with scrupulous care (for further discussions see Patterson, 1994 and Shell/WWF, 1993). In general, practices similar to those applied in environmentally-friendly production of agricultural food products or sustainable forest management have to be implemented for growing environmentally friendly energy plants. Further negative environmental effects may result from transport and storage of energy plants. A careful organization and management of the entire system, from fuel production in field or forest through to electricity output, together with appropriate technology is the basis for a sustainable operation of a biomass power system. Though prospects appear encouraging, many questions must still be answered. A large scale implementation of biomass power will require support from governments and international organizations by incorporating biomass energy in their overall energy policies.

An increased share of electricity supply from biomass would have considerable implications for land use. In the EU the total area of arable land set aside from cultivation under the CAP at the moment is 4.6 million hectares; the potential available, including voluntary set aside and pastoral land, might be as much as 22 million hectares (about 1/5th of total utilized agricultural area in the EC12) (EC, 1992). If, say, 10 million hectares of this land were brought back into productive use to grow energy crops, biomass power might provide up to 60,000 MW of generating capacity, compared to a total generating capacity of some 456,000 MW in 1991 (EC, 1993). These numbers are based on the assumption that all biomass power is fueled by energy crops. Since some will be fueled by residues or some technology will combine biomass and other sources of fuels, the land-use impact will be reduced accordingly.

Kaltschmitt et al (1993) estimated the production potential of biomass energy based on the assumption that set-aside arable land is used for biomass production. 15% of total arable land in Germany may be set-aside under current CAP regulations. (In 1991 7% of arable land was set-aside). Depending on the type of energy plant grown, they calculated a production potential which is equivalent to about 2-3% of Germany's total energy consumption. By setting this potential in relation to those sectors which are most likely to consume biomass energy, the share increases to about 5%.

Besides biofuel, other non-food agricultural products like plants for the chemical industry are increasingly introduced. They include industrial sugar, technical starch and oil plants (as lubricant, hydraulic oil, etc.). From an environmental point of view, these biogenic raw materials may attract increasing interest, for example, as biologically decomposable products substituting for plastics or other synthetic products.

Today, the substitution of food-products in favor of biofuel and plants for the chemical industry would demand direct or indirect subsidies. The central question is whether these subsidies are higher than the subsidies currently provided for agricultural production and how envisaged changes in today's agricultural policy (e.g. GATT agreements) affect the profitability of non-food agricultural products. Relevant parameters for these calculations include the world market price of food-products, the market price of fossil fuels, the market development of the side products of oil plants (proteinrich materials as fodder for livestock), the costs of processing and storing biological raw materials, and the world market price of oil-products in general. All these questions will be embedded in a general discussion about the future of rural areas in Europe, and employment opportunities for farmers. Cultivating and processing the energy crops could create jobs in rural areas throughout Europe.

Description of scenario 2 and quantification for the project area

Scenario 2 also introduces a free market economy to those parts of the agricultural sector that currently overproduce. Major political goals are to keep the land open, avoid uncontrolled spreading of urban development, and ensure that there will not be undue dependence on imports of agricultural products from outside Europe. In order to reach these goals, means are provided for farmers to shift their production and sources of income. Particularly in the initial phase this means subsidies for the agricultural sector. They stem however mainly from regional development funds and only partly from agricultural funds. These programs emphasize on the one hand biological and more extensive forms of food production, tourist and recreational activities, preservation of landscapes protected for their nature conservation value, or for their aesthetic and cultural value. On the other hand, in accordance with the particular energy policy, the introduction of biofuel and crops for the chemical industries is encouraged. Afforestation of surplus agricultural land still takes place, but to a much lesser extent than in scenario 1.

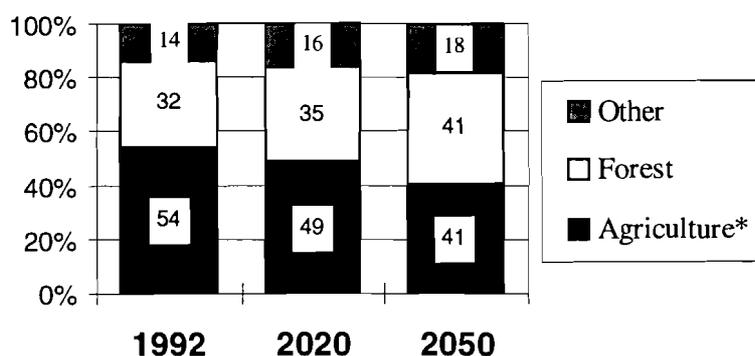
In scenario 2 there is a minimal conversion of land use and land cover, but a major change in land management. Table 12 and figure 11 summarize the results for scenario 2, calculating a decrease of agricultural land accounting for a 10% decrease by 2020 and 20% (2 mio. ha) by 2050. A bit more than half of the formerly used agricultural area will be afforested, the remaining area is categorized under "other" land use. Consequently by 2050, forest and "other" land use cover a greater share of the total land area. Agriculture still takes up 43% of the total land area (compared to 53% in 1992).

Even though the decrease of total agricultural area is moderate, there is a major change in agricultural products as shown in figure 12. By 2050, in addition to food production, alternative products, mainly biofuel, but also plants for the chemical industry, have been introduced. Restrictions on fertilizer use are strict for ecological considerations, food production is rather extensive. Designated landscape areas and nature reserves cover a major part of the farmlands. Farmers often rely on additional income from tourist activities. The purpose of agricultural production is not only to produce food or alternative products, but also to preserve the cultural heritage of a landscape and provide the means for development in rural areas. Though subsidies still are available for the agricultural sector, efforts are made to minimize them. These efforts focus on energy policies that promote the economic competitiveness of biofuels on the one hand, and improve marketing strategies for the individual farmers to ensure a market for high quality products on the other hand.

Table 12 and Figure 11. Scenario 2 applied to the project area

| | 1992 | 2020 | 2050 | change 1992-2020 | | change 1992-2050 | |
|--------------------|-----------|-----------|-----------|------------------|-----|------------------|-----|
| | [1000 ha] | [1000 ha] | [1000 ha] | [1000 ha] | [%] | [1000 ha] | [%] |
| Agriculture | 10073 | 9065 | 7555 | -1007 | -10 | -2518 | -25 |
| Forest | 5924 | 6544 | 7666 | 620 | 10 | 1742 | 29 |
| Other | 2587 | 2975 | 3363 | 387 | 15 | 776 | 30 |

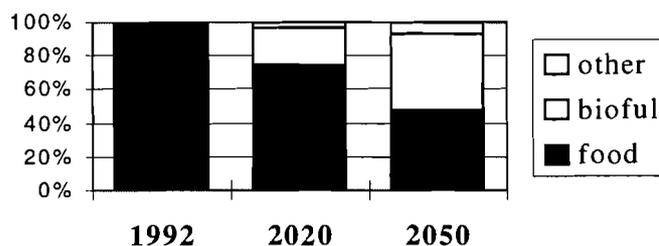
Scenario 2



* see below Share of Agricultural Products

Fig. 12. Share of Agricultural Products in scenario 2

Share of Agricultural Products



other... refers to diverse products for the chemical industry

7.6 Scenario 3: Europe as Food Exporter

Today discussions on agricultural policy are conducted in the context of agricultural surpluses on the world market, resulting from the significant support of national economies for their agricultural sectors. International and national efforts aim at withdrawing these subsidies. As outlined in scenario 1, ceasing agricultural subsidies without any compensation results in irreversible land use and land cover changes. This is in particular true for urban development, but also to a certain extent for large scale afforestation, mainly because the know-how for agricultural production disappears.

Agricultural policy, however, has to be discussed in quite a different light, if there is a justified assumption that in the near or mid-term future the demand for agricultural food products increases significantly. This will be the case if countries or regions that can afford to import grain are no longer self-sufficient in food production. If these amounts are high, they may trigger an unprecedented increase in world food prices. Several studies are available that suggest this development for the fast growing markets of China and Southeast Asia. The most recent one is a comprehensive study published by Lester Brown (1995) on the long term food prospects for China. He argues that:

"countries that become densely populated before they industrialize inevitably suffer a heavy loss of cropland. If industrialization is rapid, the loss of cropland quickly overrides the rise in land productivity, leading to a decline in grain production. The same industrialization that shrinks the cropland area also raises income, and with it the consumption of livestock products and the demand for grain." (Brown, 1995, p.12)

Consequently China is becoming increasingly dependent on food imports. The following text presents a short summary of Brown's arguments for China's dependence on food imports up to approximately 2010 or 2020.

Today China is already densely populated. Even though strict measures on reducing population growth were introduced 20 years ago, its population is projected to increase by 500 million from today's population of 1.1 billion (U.S. Bureau of the Census, 1994). In parallel China experiences strong economic growth. Between 1992 and 1995, the Chinese economy expanded by 56 percent. Per capita income has risen by 50% in this period. Never before have incomes for so many people risen so quickly (D.Kristof, 1994 & Int.Monetary Fund,1994). As incomes rise, low-income people spend money to diversify their diets, shifting to more varied foods including more meat and milk products. Wealthy countries living high on the food chain, consume more grain per person per year than poorer countries, because they consume grain not only directly as bread, pastries, etc. but also indirectly in the form of livestock products. The total use of grain per person among the highest and lowest countries ranges from roughly 800 kilograms in the Unites States to 200 kilograms in India (for China 300 kilograms). In 1977 China's meat consumption totaled 7.7 million tons. By 1994, it had climbed to 40 million tons (USDA, 1994a & FAO, 1994). The official goal for egg consumption has been set at 200 per person per year by the year 2000 - double the amount in 1990 and close the 235 eggs consumed per year by the average American. As China looks to consuming more meat and milk products in the future, it must also look for more grain to feed its livestock.

China's expected population increase, together with its increase in wealth will lead to a high demand for more grain. The central question therefore is whether China will be able to meet

this increased demand. Both population increase and industrialization generates pressure to convert cropland to nonfarm uses, including residential purposes, the construction of factories, and roads. In addition, the rapid rise in nonfarm wages, now so evident in China, typically leads to the abandonment of marginal cropland. Not only is the cropland area per person one of the world's smallest, it is shrinking rapidly. Between 1990 and 1994, the grain area harvested dropped from 90.8 million hectares to 85.7 million, just over 1 percent a year. This decline of 5.6 percent in four years, combined with a population growth of 59 million (4.9 percent), reduced the grain harvested area per person by a striking 10.5 percent (US. Bureau of the Census, 1994).

China has been extremely successful in raising grain yields over the past decades. The most dramatic increase occurred between 1977 and 1984, with total grain production increasing from 199 million to 306 million tons. Much of this phenomenal growth came from a dramatic rise in the use of fertilizer (USDA, 1994 a). Another important part of the success of raising yields stems from a near tripling of irrigated land since the 1950s. However, this expansion mainly took place from 1950 to 1977, when irrigated area increased by more than a million hectares annually. From 1977 to 1991, it increased by only 170,000 hectares a year (USDA, 1994b & Nickum, 1989). Spreading water scarcity now threatens agricultural production. Irrigation is competing with growing water claims of large cities and industrial areas. Smil (1993) describes the extent of falling water tables in northern China. Some regions are affected to an extent that the amount of irrigation water applied is less than optimum. It is likely that in the future yields will increase only modestly. After 1984, yields slowed, increasing less than 2 percent a year through 1990. Then from 1990 to 1994, yield per hectare rose even more slowly, edging up only 0.7 percent annually (USDA, 1994b).

In China the production of grain from 1990 to 1994 has been static. Although production of wheat and corn are up slightly, that of rice - which is concentrated in the south, where industrialization is most rapid - has dropped by more than 8 percent between 1990 and 1994. If industrialization continues and spreads more into the central and northern provinces as government policy is fostering, then production of corn and wheat may soon follow the same downward trend as rice.

In an other line of argument L. Brown examines the food balance of three countries that were, like China, densely populated before they industrialized, namely, Japan, South Korea and Taiwan. All three countries shifted from self-sufficiency to importing food. Since 1985, imports have accounted for roughly 72 percent of consumption. For example Japan's harvested area of grain peaked in 1955 at 5.1 million hectares. By 1994, it had shrunk to 2.4 million hectares, a decline of just over half. From 1950 to 1960, grain production rose more or less in parallel with consumption. But then production began its long-term gradual drift downward. Consumption, on the other hand, continued its rapid rise until the mid-1980s, generating an ever widening gap between demand and supply.

It is obvious that a similar development in China with a population of 1.5 billion in the next century must have an effect on the world production and price of agricultural products. In 1994/95 China's record grain imports propelled them to the number two grain importer position with their total grain imports surpassed only by those of Japan. Projected total imports of wheat, barley, rye and rice in 1995/96 will be a near record. Domestic production in China is now estimated to supply just under 90 percent of its internal utilization. (USDA, 1995).

Besides China, other food importing countries will increase their demand over the next decade, mainly resulting from population increases. Even if their grain imports are much

less than those of a wealthy country like Japan, they compete with the overall grain supply on the world market. On the supplier side today only North America, Western Europe, Australia and New Zealand export grain (table 13). In addition demand for land of other products like cotton, vegetable oil and sugar intensifies competition.

Table 13. Pattern of World Grain Trade, 1970-90¹ (million tons)

| Region | 1970 | 1980 | 1990 |
|-------------------------|-------------|-------------|-------------|
| North America | +56 | +130 | +110 |
| Western Europe | -22 | -9 | +27 |
| E.Europe & Soviet Union | -2 | -44 | -35 |
| Latin America | +4 | -15 | -10 |
| Africa | -4 | -17 | -25 |
| Asia | -37 | -63 | -81 |
| Australia & New Zealand | +8 | +19 | +14 |

¹Plus sign indicates net exports, minus sign, net imports.

Source: Brown, 1995, p.105

All this suggests that the world grain market soon will be converted from a buyer's to a seller's market. From mid-century onward, exporting countries always seemed to be competing for markets that were never large enough. Now it seems that we head towards a turning point where scarcity of food products will replace current overproduction.

Folmer et al. (1995) discuss likely developments of the EU's Common Agricultural Policy in their recent publication "The Common Agricultural Policy beyond the MacSharry Reform". One scenario assumes a rapidly increasing global demand for food. In general their arguments are similar to those of Brown, referring to general population increase, population increase combined with wealth increase in South-East Asia, water scarcity, erosion and other forms of land-degradation, urbanization and industrialization competing with agriculture for land and water and a lack of new promising yield-increasing technologies.

In the publication "State of the World 1996" Gary Gardner (1995) also demands the preservation of agricultural resources in the light of likely food scarcity in the near future. His main arguments are a general increase in demand for food products, an ongoing decrease of farmland per capita and possible water shortages.

The OECD also discusses developments in the growing economies of South East Asia, especially China and possible implications for agricultural commodity markets and world food security in their recent publications "The Agricultural Outlook - Trends and Issues to 2000" (OECD, 1996) and "The Chinese Grain and Oilseed Sector: major changes under way" (OECD, 1995b). The OECD's forecasts suggest good prospects for market driven growth in world commodity markets over the medium term, with prices generally higher than in the past, but possibly more volatile. Much of the projected strength in world commodity prices is due to rapid economic growth in the non-OECD region and growing imports, particularly in Asia. In the medium to longer term, China may require higher feed grain imports to sustain growth in the livestock sector. However, they also state that imports may turn to be lower than those projected by some analysts.

The relevance of these developments for Europe's agricultural sector is obvious. The Common Agricultural Policies envisioned introduction of a free market economy in the agricultural sector would be successful without losing significant amounts of farmland and jobs. However, today we still have surplus production and the need to subsidize the sector in order to keep it alive. Scenario 3 assumes that approximately by 2010 a scarcity of agricultural products will stimulate intensive agricultural production in Europe. It also assumes that decision-makers today are aware of this potential. Consequently the aim is (unlike in scenario 1) not an immediate strict introduction of a free market economy, but rather to preserve the potential for agricultural production in Europe. For this purpose a similar strategy like in scenario 2 is chosen, i.e. encouraging alternative agricultural products. scenario 1 shows the consequences of the introduction of a free market economy in a time of surplus food stocks without offering alternatives for farmers. This results in a major loss of farmland, which is not desirable in the framework of scenario 3.

The major uncertainty of Scenario 3 seems to be related to the timing of the envisaged shift from surplus production and today's price level to more scarcity and a price increase of food commodities. The Food and Agriculture Organization (FAO) does not foresee these developments until 2010 (FAO, 1995), though they agree with many of the developments that are the basis for Scenario 3. They foresee a decrease of farmland per capita. Related to this a high dependence of production increases on the growth of yields. Further a strong growth in the livestock sector, population and wealth increase in China. However, their general conclusion is that there will be no food shortage by 2010.

Description of scenario 3 and quantification for the project area

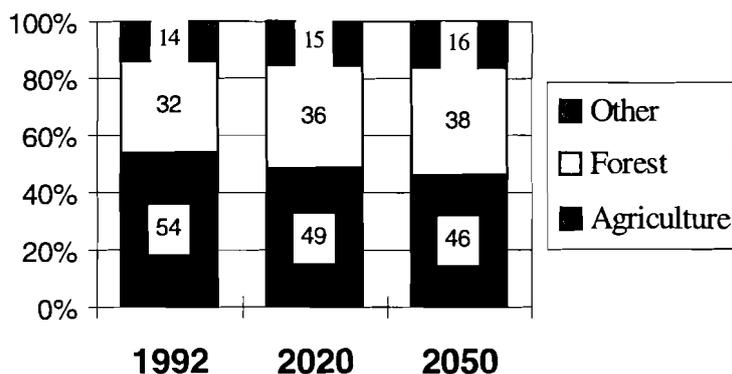
The basic feature of scenario 3 is a considerable increase of demands for agricultural products by approximately 2010 which triggers an increase in the world market price for grain. Until about 2010 the developments in scenario 3 are similar to those in scenario 2. The main goal is again to keep the land open and avoid dramatic losses in employment in the agricultural sector in order to preserve the "know-how" for potential future demands in agricultural products. Like in scenario 2 until 2010 subsidies and political regulations are provided to shift agricultural production to alternative products including biofuel, plants for the chemical industry, high quality food and landscapes preserved for their cultural and nature conservation value. After 2010 the path of development between scenario 2 and scenario 3 diverges. The growing demand for agricultural food products alleviates the transition from subsidized farming to a free market economy. All those alternative agricultural products that still would require subsidies are replaced by intensive food production. The full potential of the existing farmland producing food is used.

Table 14 and figure 13 show the results of the translation of the assumptions of scenario 3 to land use changes. Overall the rates of change in land use are small. Farmland declines by 15% until 2050, forest increases by a fifth and "other land" by 15%. There is a shift in agricultural production however. In 1992 all the farmland is used for food production. By 2020 approximately a third of agricultural land cultivates biofuel and other alternative agricultural products. Another third practices extensive agriculture and the remaining third intensive. Some subsidies are still available for the agricultural sector. In 2050 the pattern changes again. Since the world faces food scarcity, the world market prices for agricultural products are high enough to encourage production on all available farmland. As a result most of the farmland is used for intensive food production within the frame of environmental regulations.

Table 14 and figure 13. Scenario 3 applied to the project area

| | 1992 | 2020 | 2050 | change 1992-2020 | | change 1992-2050 | |
|--------------------|-----------|-----------|-----------|------------------|-----|------------------|-----|
| | [1000 ha] | [1000 ha] | [1000 ha] | [1000 ha] | [%] | [1000 ha] | [%] |
| Agriculture | 10073 | 9065 | 8935 | -1007 | -10 | -15118 | -15 |
| Forest | 5924 | 6674 | 6674 | 750 | 13 | 1123 | 19 |
| Other | 2587 | 2845 | 2975 | 257 | 10 | 388 | 15 |

Scenario 3



7.6 Comparison of Scenarios

Figure 14 reproduces the changes in land use for all scenarios. All three assume the continuation of the already initiated trend toward a free market economy in the food production sector. This tendency has immediate implications in a time of agricultural surplus. The way of addressing the problem of surplus agricultural land, and its implications for employment prospects in rural areas differs between the scenarios.

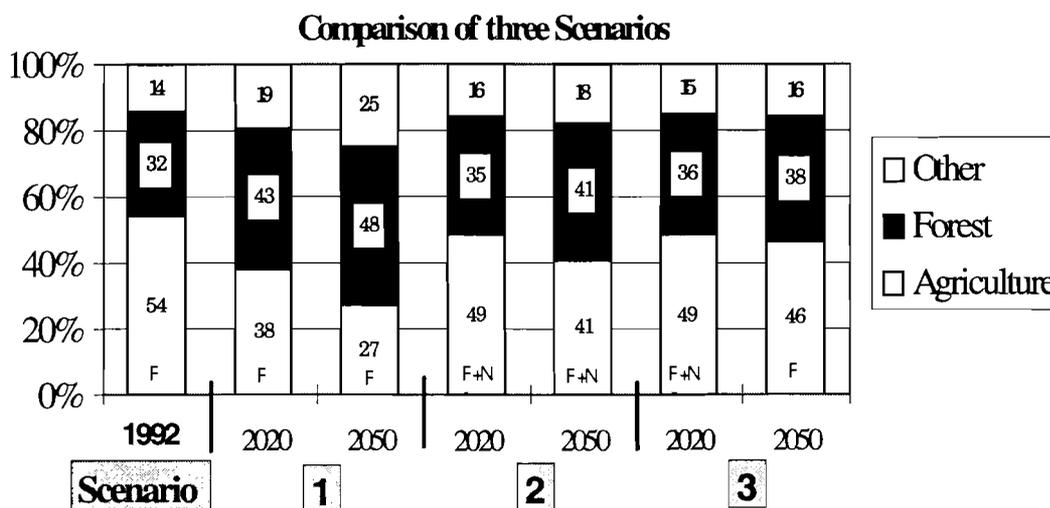
Scenario 1 experiences the dramatic changes in land overall land use patterns. In contrast, scenario 2 and 3 have only a modest change in overall land use and land cover patterns. An important feature characterizing the difference between the scenarios is the extent of decrease of agricultural land. Scenario 1 anticipates the most drastic decrease in utilized agricultural area, amounting to a 50% reduction by 2050. In Scenario 2 and 3 there is only a 20% and 15% decrease, but the changes of management and production are important. While in scenario 1 agricultural production only focuses on food production, scenario 2 and 3 aim at introducing alternative agricultural products like biofuel or plants for the chemical industry. In addition, means for farmers are provided to upkeep the landscape and foster a more extensive, ecological production.

The difference between scenario 2 and 3 is a change in the world market for agricultural food products by about 2010. Scenario 3 assumes an increase in the world market price of grain and other food products triggered by wealth and population increases in South East Asia (in particular in China). As a consequence, Europe can emerge as food exporter in the

frame of a free market economy. By 2050 no further subsidies are required for the agricultural sector in scenario 3. At that time scenario 2, which does not foresee the proposed increased demand for food, still produces considerable amounts of biofuel and other alternative agricultural products.

Afforestation of marginal poor farmland occurs in all three scenarios. The extent however, differs significantly. In scenario 1 the share of forest in total area increases from 32% in 1992 to 48% in 2050, while in scenario 2 and 3, there is only an increase up to 41 and 38% of total area. The major reason for these different developments is the general economic situation of agriculture. Scenario 2 foresees means to preserve farmland. In Scenario 3 the agricultural market increases the value of farmland. In contrast scenario 1 assumes no protection for farmland and no increased demand for food commodities. Consequently afforestation will be the final solution for many farmers.

Fig. 14. Comparison of the three scenarios



Scenario 1: Large Scale Increase of Wooded Area
 Scenario 2: Alternative Agricultural Products
 Scenario 3: Europe as Food Exporter
 F... Food products; F+N... Food- and Non-food products

In order to maintain the sustainability of soil resources in terms of ensuring multiple soil functions for future generations, the increase in the category "other" land use is of importance. A land use change towards urban and built up areas is in practice an irreversible change. Scenario 1 shows a high increase in "other" land because the price of surplus agricultural land decreases. Cheap land encourages urban and infrastructure development. Therefore scenario 1 anticipates a 40% increase of "other" land in the project area by 2020 and a 70% increase by 2050. In contrast in scenario 2 it is a major policy goal is to preserve farmland. Here the increase in "other area" is more moderate, amounting to 30% by 2020 and 40% by 2050. Finally, scenario 3 which assumes high demand for agricultural products shows only a 30% increase by 2020 and 2050.

Analyzing today's agricultural policy of the three country's of the project area suggests that developments of scenario 2 are most likely for the European Union. Within the EU, farmers are a powerful group and it is unlikely that shock therapies like scenario 1 are possible. It could cause large scale bankruptcy and social unrest to an extent that is unacceptable for EU countries. The capacity of the EU to produce food is too valuable for so radical changes. Future prospects and development of rural areas are important political issues. Though not introduced on a large scale, alternative agricultural products have already been encouraged by the MacSharry CAP Reform.

For the transforming economies in Poland and the Czech Republic it is difficult to foresee the developments of their agricultural policy. Today it seems that the Czech Republic and to a lesser extent Poland follow the path of scenario 1. In the Czech Republic liberalization of agriculture has a high priority. Consequences like production decrease, labor outflow and decrease of farmland are accepted as a necessity in the transformation process. Areas of marginal agricultural land are severely affected and the social burden there is high, but the general positive economic development with relatively low unemployment rate and the already low share of employment in agriculture facilitates this development.

The situation is different in Poland, where agricultural employment is much more important. Though the overall economic situation has improved with GDP growth since 1992, unemployment, especially in rural areas, is very high. The Polish Peasants' Party, which is a coalition partner and provides the Minister of Agriculture, is demanding greater support and protection for farmers. For all these reasons, it may be concluded that subsidies for the agricultural sector will be available more readily than in the Czech Republic. A different reason for scenario 1 being likely for Poland is the well established and successful forest sector which is likely to expand in the future.

Both transforming countries aim at EU membership as soon as possible. Then their agricultural policy will be superseded by the EU's agricultural policy. Hence, their agricultural policy today is likely to be relevant only for a short period. However, once they will be EU members, the CAP has most probably undergone changes towards more renationalization, simply because today's CAP would become too expensive. This means less regulations and subsidies from the EU and more autonomy and responsibility for the national countries for their agricultural sector.

Issues on global food security, which form the basis for scenario 3, are expected to increase in importance. The possibility of a global food scarcity will influence agricultural policies. Assuming that the developments of scenario 3 take place, sustainable agricultural production or preservation of farmland will become essential goals. Assessing the first two scenarios in the light of the third scenario, developments of scenario 2 may be emphasized. Important labor outflow from agriculture and major decrease in farmland as in scenario 1 then are not desirable. However, if there will be price increases in food commodities as suggested in scenario 3, already in the near future, it will automatically halt the conversion of farmland to forest or built-up area.

Chapter 8. Conclusions

The three scenarios presented shall provide a framework of discussion for possibilities of the future development of land use and land cover in the European context. The scenarios are quantified for the project area of this study embracing parts of southern Poland, the Czech Republic and eastern Germany. Each scenario may be assessed from different perspectives. This report focused on the social, economic and policy related (mainly agricultural policy) point of view. The scenarios may also provide a basis for certain environmental assessments. In the frame of the broader IIASA project on "Regional Material Balance Approaches to Long-Term Environmental Policy Planning" they will be incorporated in an assessment of risks related to heavy metals, with particular focus on agricultural land.

The land use changes between 1960 and the mid 1990s have been characterized by a decline in agricultural land and an increase in forest and the category "other" land. The latter mainly consists of urban areas and land for infrastructure. Agricultural policy including forestry has been the most important driving force for land use change in the European context.

All three countries of the project area have recently undergone major changes in their agricultural policy due to economic restructuring after 1989. The German unification superseded eastern Germany by the EU's Common Agricultural Policy (CAP). Liberalization of the agricultural market has resulted in a decline in employment and agricultural output, primarily in the livestock sector. These changes have been most dramatic in eastern Germany, but also quite significant in the Czech Republic and Poland.

These developments pose the question of the future and prospects for rural areas in the study region within a changing and probably more integrated Europe. Liberalization of agriculture versus subsidizing the sector for different tasks are key issues in discussions on agricultural policies. The three scenarios, which are presented in this study, show different possible paths of development.

Scenario 1 "Large scale increase of wooded area" foresees a major decrease in farmland in favor of forest and "other" land. The economic basis is a withdrawal of subsidies to the agricultural sector in the frame of today's overproduction of agricultural commodities. Scenario 2 "Alternative agricultural products" emphasizes a shift from surplus food production to alternative products including biofuel and more extensive production methods. The sector still receives subsidies, but for alternative products instead of surplus food production. The motivation for this agricultural support policy is to preserve farmland and provide jobs in rural communities. Scenario 3 "Europe as food exporter" assumes an increase in global food commodity prices by about 2010 due to increasing demand. Major reasons are a combination of population and wealth increase in south-east Asia, resource constraints on farmland availability and water scarcity.

It is difficult to argue similar developments for each of the three countries. Today the probability of each scenario seems to be different for Poland, the Czech Republic and Germany. Eastern Germany is part of the European Union. Poland has a high employment in the agricultural sector, while in the Czech Republic agriculture is of similar importance in the overall economy as in most western European countries.

Land use and land cover changes are significant in Scenario 1. Major conversions of farmland to forest and "other" land occur. Scenario 2 and 3 have small land cover changes, but major changes in land management and types of agricultural products grown. While in Scenario 2 agricultural products is diverse comprising of food and livestock products, biofuel and plants for the chemical industry, in Scenario 3 alternative products are soon replaced by intensive food production for the growing market.

Biofuel and crops for the chemical industry may be alternatives to food production or the EU's set-aside policy. A successful implementation of these products is dependent on support from the energy sector and subsidies at least for launching new programs. Consequently it is a political decision whether money will be redirected to this sector.

In this context future public opinion and policies on spreading of urban and other built up area will be important determinants for the probability of the three scenarios. The decisive factor for converting farmland to urban and other built up area is the price of land. In scenario 1 surplus farmland will decrease in price, while in scenario 2 and 3 the price will change little. The project area is likely to experience a strong economic growth. This commonly increases pressure of urban development on farmland.

Besides the land price, landscape planning and other development plans will determine the use of land. However, their influence is expected to be small compared to the land value, especially in Poland and the Czech Republic. In eastern Germany the impact of landscape planning may be significant due to Germany's highly developed legislative planning framework.

A key question for the probability of each scenario is the motivation to offers prospects and employment opportunities in rural areas. Scenario 2 and 3 offer more prospects for rural development than scenario 1. In the case of scenario 2 and at the beginning of scenario 3, however, for the price of allocating resources from the non-agricultural sector. Some support will be needed, at least during the launch of the production of alternative agricultural products and the introduction of environmentally friendly production methods. Considering the overall high and still increasing unemployment rate in most EU countries, a general reorganization of work and redistribution of wealth may be necessary. In this framework, support of new technologies for renewable energy resources and sustainable agricultural practices may be a welcome opportunity for providing jobs in rural areas. Within the project area high job losses have occurred and are still ongoing in the coal and mining industry. Technical innovations of the energy sector towards diverse renewable energy sources may provide a possibility to transfer employees.

The project area was subject to diverse pollution loads during the last decades. As a result environmental degradation of forests and to a lesser extent of farmland require special management techniques and pose restrictions on production. The closure of mines will require special recultivation programs for former mining areas.

Both, future forest and agricultural production will emphasize multifunctional management. Besides the commodity function, the social, cultural (recreation and nature conservation) and protective (erosion control, water protection) functions will grow in importance.

Even if there are significant changes in land cover and land use, these changes are slow in terms of area. Consequently only a long term perspective of about two or three generations is able to analyze consequences of today's policy. The challenge will be to convince policy makers and the public to consider these long term developments and effects.

In the light of scenario 3 a key question for Europe's highly productive agriculture should be how to preserve farmland and agricultural know-how until food commodity prices rise. The arguments in favor of these price increases are strong, however it is very difficult to assess when this will happen.

The possibility of the developments described in scenario 3 highlights the importance of a long-term perspective of the food production sector and demands for preserving multiple options of land use for future generations.

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