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AGRICULTURAL SECTOR, RURAL ENVIRONMENT AND BIODIVERSITY IN THE CENTRAL AND EASTERN EUROPEAN EU MEMBER STATES

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Abstract
During the second half of the 20th century, agriculture and the rural environment diverged in Western and Central and Eastern European countries (CEEC). CEE countries itself are heterogeneous in the respect of land use intensity and history. In the current review we focus on the comparison of the agricultural sector and threats on biodiversities of EU new-member countries from Central and Eastern Europe and the old EU(15) member states. The clustering of countries revealed groups distinguished according to the level of their economic productivity, discriminating mostly among eastern and western European countries. CEE countries sub-divided according to geographic region, including also some old members of the EU. Within the western cluster, two large sub-clusters became evident according to economy affected by altitudinal and climatic differences. Partly because there are still areas where the intensity of land use remained low, the biological diversity in many regions of Central and Eastern Europe has remained high. However, loss of extensively used habitats, the restoration on intensive agriculture, reforestation with exotic species and urbanization are major threats to nature in CEE countries. The estimated variability among CEE countries is caused by different historical and cultural backgrounds of those countries. Due to the complexity and geographical diversity of driving forces, there remains much uncertainty in the possible impacts of particular factors on land use. This complexity and diversity have to be considered when planning economic as well as ecological means for developing the agricultural sector and conserving biodiversity in the future of CEE countries.

Keywords: agricultural land use; agricultural policy, biodiversity drivers; CEEC, land use intensity; threats of biodiversity

1. Introduction

During the second half of the 20th century, agriculture and the rural environment developed in different directions in Western and Central and Eastern European countries (CEEC). In the west, the market economy resulted in an economically highly efficient agricultural sector. The rural environment was influenced both by intensive agriculture and by high population density. In socialistic Central and Eastern Europe, agriculture was known for its low labour productivity and poor output levels (Rey and Bachvarov 1998). However, CEE countries were not homogeneous in this respect and the intensity of land use differed both between and within countries.

In some countries, like the USSR, Czechoslovakia and Eastern Germany, large collective farms (sometimes called *kolkhozes*) and state farms (*sovkhozes*) predominated, and, in most of cases, legislation ruled out the private ownership of land. Small family holdings were still active, but officially all land was owned by the state. Despite restrictions on land use (max arable area of 0.3-0.5 ha was permitted for family holdings), small subsistence farms gave 1/4 – 1/3 of the total production in some agricultural production categories in the Baltic states (Mäe, 1976).

In some other countries, such as Poland or Yugoslavia, the small private farms (5-6 ha in Poland, Jurkeviciute and Mileva 2003, AllRefer 2004) continued to dominate during the socialist era. In Slovenia, for example, 93% of arable land was privately owned, though there were also some large state or collective farms (UNECE 2004). The latter had higher productivity and effectiveness of work, accounting for approximately 25-30% of the production, though using only 8-20% of the land (UNECE 2004, Rey and Bachvarov, 1998).

There was also a considerable patchiness in the intensity of land use within countries, with 3-8 fold variations in productivity for different crops (e.g. Kõre, 1982a, b). Large state-owned farms were usually located in more fertile areas with a higher rural population density and a more open landscape. Agricultural production in remote areas, or in those areas where natural conditions did not favour intensive agriculture, also remained low and intensive means of agriculture were never applied.

The transition of the whole economic system started in the mid eighties/early nineties. Agriculture was the first sector embraced by the decollectivisation/privatisation process (Rey and Bachvarov, 1998). Slightly more than two decades later, the CEECs' transition transition brought a restructuring of ownership via redistribution of landholdings to former workers (Swinnen, 1997), the new requirements to production quality concerning openness and geographical orientation of markets, cost-benefit efficiency, and the consideration of environmental risks (Bouma et al. 1998, Sumelius, 2000).

For economies in transition, both extremes, state ownership and the predominance of single-family farms, created problems. Most of family farms are too small to take advantage of economies of scale. For instance, the average size of family farms in Poland is about 7-8 ha, compared to about 16 ha in the EU (Cochrane, 2002, Jurkeviciute and Mileva, 2003). Probably only 1/3 of those small farms could be considered to be commercial producers (Cochrane, 2002). Those CEE countries (e.g. Czech Republic), on the other hand, that have transformed collective and state farms (on average about 135 ha in size; Dotlačil and Vančura, 1996) into private agricultural enterprises have experienced better performance (Slangen et al. 2004).

Intensive land use, meaning larger relative and absolute areas of arable land and higher rates of fertilizer and pesticide use, are frequently accompanied by lower biodiversity (Grashof-Bokdam and van Langevelde, 2004, Billeter et al. 2008). In addition, manure surpluses from big livestock farms have been responsible for high nitrogen and phosphorus concentrations in groundwater and in streams and lakes (Löfgren et al. 1999, Vagstad et al 2000, UNECE 2004). There is a well-established ecological theory on empirical relationship between the site productivity and species diversity, indicating that, from a moderate productivity level, there may be an almost linear decrease in diversity when productivity increases (Gross et al. 2000, Grime, 2001, Mittelbach et al. 2001).

Biodiversity is also threatened by a number of different other activities and processes, such as the ongoing acidification of soils and water bodies, the unsustainable/illegal felling of natural forests, and intensive drainage of wetlands, marshlands or flooded areas for agricultural cultivation (Kuuba, 2001, Yaroshenko et al. 2001, Szabo and Pomazi, 2003, UNECE 2004), which all has been common in most of the CEE countries. For instance, in Latvia, 15% of bogs and mires have been drained and meliorated during the Soviet period (UNECE 2004) or excessive felling has been observed in private forests of Estonia (Peterson et al. 2006).

There have also been changes in the nature conservation system in CEEC. During the years between 1950 and 1980, nature conservation networks were developed in several CEECs to link areas with different protection statuses (Sepp et al. 1999). This system was aimed at compensating and balancing the pressure of human activities on nature. Since the 1990's, however, the ongoing land reform has jeopardized the network of protected areas (UNECE 2004). The ongoing privatisation process could be threat to nature, and in particular to protected areas, if not carefully undertaken. There is a risk that privatised lands will be mismanaged or even overexploited. At the same time, conservation of the environment and sustainable development are increasingly recognised as important objectives in CEECs, supported or driven by EU reglementations.

In the current paper, we shall focus on the comparison of the agricultural sectors and threats on biodiversities of EU new-member countries from Central and Eastern Europe (belonging both to the first and the second rounds of unification) and the old EU member states (pre-2004).

2. Material and methods

We collected statistical data on 15 parameters, characterising economy, demography and land use of European countries (see Annex 1 for more details) from different databases and reports published in the web. The socio-economic statistics included population density (in 1997), share of rural population, GDP per capita, share of agriculture in GDP, and change in GDP during the last 25 years. We characterised land use through the following parameters: proportion of agricultural land, share of arable land in agricultural land, total fertilizer load per ha of agricultural land, the use of pesticides, share of organically produced crops and share of forested land. We also used a complex synthetic measure derived by FAO - agricultural production index of change, where the production level during 1989-1991 has taken as the reference. We included 33 EU and CEE countries, omitting only either very small countries, or countries, we were not able to find enough reliable data. We had to exclude also Malta and Cyprus due to their very different history and natural conditions. Cluster analysis was conducted, using Euclidean distance and Ward linking method, on standardised variables.

3. Results

3.1. The comparison of CEE and EU countries on the basis of socio-economic parameters

The clustering revealed groups of countries that corresponded quite well to our general expectations (Fig. 1). In the first order (distance for tree cutting at 75%), countries were grouped into two broad clusters according to the level of their economy - CEECs with a low GDP and western countries with a high GDP (Fig. 2). The so-called eastern cluster consisted of three sub-clusters combined by regional specificities (tree cutting at distance 40%) - northern and southern CEECs and Mediterranean cluster. Quite surprisingly, some old members of the EU(15), such as Greece, Portugal and Spain, were also included in the so-called Mediterranean cluster of CEE countries. Denmark and France, which were also attached to the northern CEEC cluster, represent in fact western countries with the highest share of agricultural land. Within the so-called western cluster, two large sub-clusters became evident. The first included Scandinavian and Alpine countries, the second one consisted of the rest of EU(15) countries and also Slovenia - probably one of the most successful CEECs according to its economic status.

As one may notice, there was a great deal of variability among CEE countries. This may be due to different historical and cultural backgrounds of those countries. This diversity has to be considered when planning economic as well as ecological means for developing the agricultural sector and conserving biodiversity in the future. Next we shall have a detailed look on some characteristic variables.

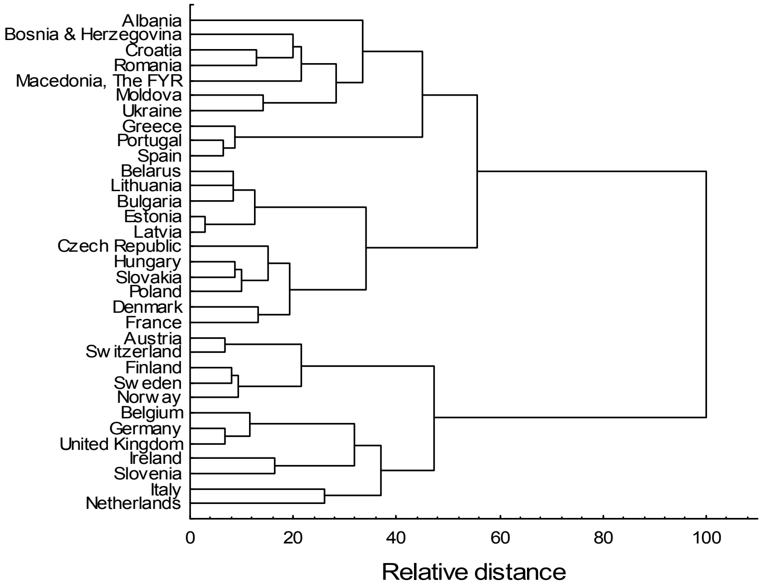

Fig. 1. Clustering of European countries according to their economic parameters (see Annex 1 for list of variables).

Since the beginning of the transitional period in the late eighties/early nineties, the share of agricultural production in GDP has decreased at least 2-3 times in CEE countries. In 2000, agriculture still made up a far higher proportion of total per capita GDP in the accession countries (an average of 6.8%) than in the EU (an average of 3%) (Fig. 2), and employed a far higher proportion of the workforce (14.9%, compared with 4%; FAOSTAT 2004, NationMaster database 2004). However, the proportion of agricultural sector in CEEC is in continuing decrease.

The dynamics of the agricultural production parameters in CEECs have been rather clear, especially when compared to those in the European Union. Fig. 3 characterises the dynamics of the cereal yields, Fig. 4 the intensity of fertilization and Fig. 5 changes in cattle and pigs. The dynamics of selected indicators in CEECs was parallel to that in EU member states until the eighties. At least in some regions, it was actually similar to that in Western Europe, while crop yields were about two times smaller (Löfgren et al. 1999, Vagstad and Deelstra, 2003). Then, around the mid-eighties, the agricultural sector in CEECs levelled out considerably, followed by a sharp decrease from the beginning of the early 1990's, while at the same time, the agricultural sector in EU(15) countries has steadily increased (FAOSTAT 2004, Mets 1974, 1979) and reached very high values (more than 50 Hg/ha) in the nineties (Fig. 3). The corresponding average for CEE countries began to diverge from that in the EU already in early eighties, when it stabilised at around 30 Hg/ha.

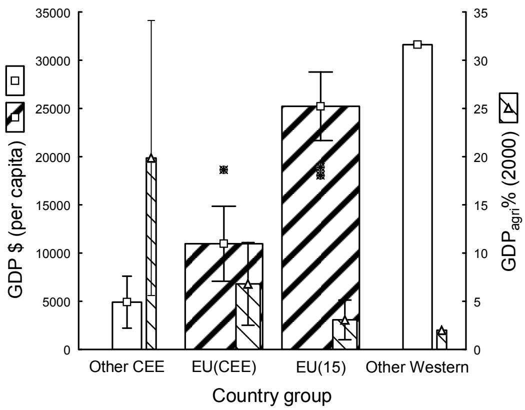

Fig. 2. Average values with 95% confidence intervals of GDP per capita and share of agricultural production in GDP (data of 2000) in four groups of European countries with outliers (Source: NationMaster database 2004)

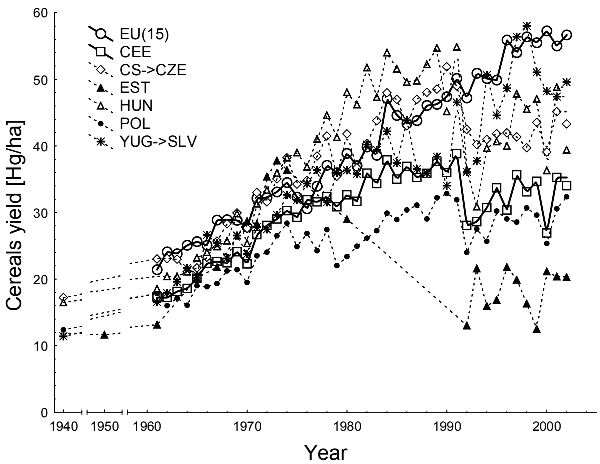

Fig. 3. Dynamics of yield of cereals per hectare in EU(15) and CEE countries with some examples from CEEC. Source: Mets 1974, 1979, FAOSTAT 2004. Note that until 1993 cereal yield of Czech republic is based on information of former Czechoslovakia; and Slovenian data for the years prior to 1992 on onformation of former Yugoslavia SFR.

In some CEE countries, like Estonia, Latvia, Bulgaria or Poland, the decrease has been particularly strong (Fig. 4; FAOSTAT 2004, UNECE 2004; Morgan 1992). For instance, the fertilizer use decreased up to ten-fold from 200-250 to 30-70 kg/ha by the early nineties (Fig. 4). By the end of 1990'ies, in Estonia, the total number of pigs and cattle was comparable to that in the years after the Word war II (Fig. 5).

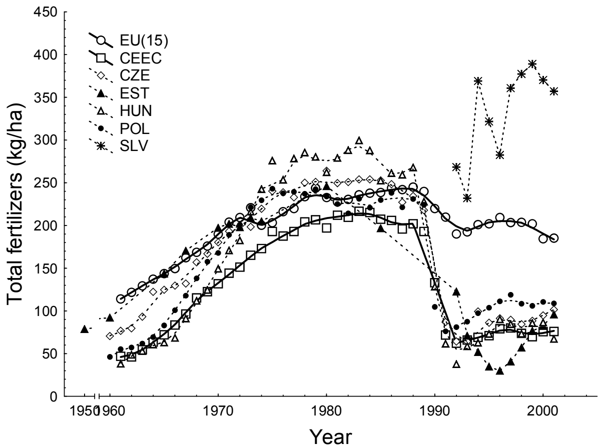

Fig. 4. Dynamics of total fertiliser use (active substances per hectare) in EU(15) and CEE countries, with some examples from CEEC (Source: Mets 1974, 1976, 1982; FAO Plant Genetic Resources for Food and Agriculture, 1996, Agricultural census of Estonia 2001, Statistical Office of Czech Republic 2002, Lillak 2003, FAOSTAT 2004)

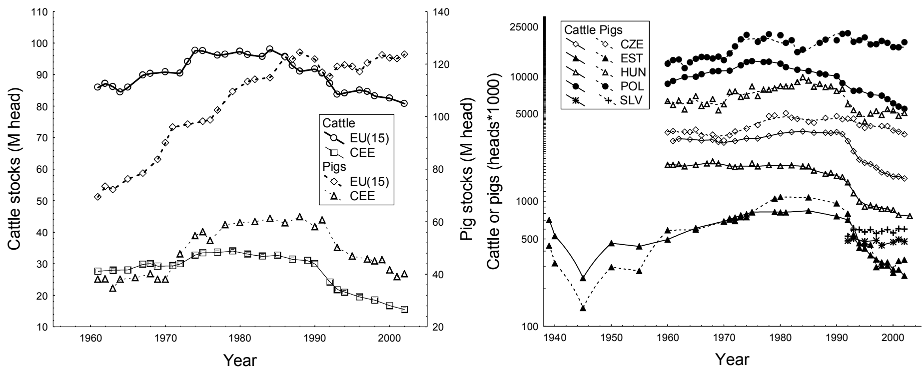

Fig. 5. Dynamics of cattle and pig stocks in EU(15) and CEE countries with some examples from CEEC (Source: Mets 1974, 1982, FAO Plant Genetic Resources for Food and Agriculture, 1996, Agricultural census of Estonia, 2001, Lillak 2003, FAOSTAT, 2004. On a Fig. for EU(15) and CEEC, number of heads are in millions, in the case of selected CEE countries, numbers of heads are in thousands)

In some respect the Czech Republic, Hungary, Slovenia and Poland, represent another extreme, where the decrease in the in the agricultural sector has been relatively small with strong yearly fluctuations. For example, in these countries, the number of pigs or the yields in cereals have been rather stable during the transition (Fig. 5). In Poland, the yields have always been rather low, evidently because of the great number of small family farms, where the intensive technologies were never applied.

An unusually steady increase in production of the agricultural sector can be observed in Slovenia. Its use of nitrogen fertilizers has been constantly high, approximately 270-280 kg/ha of nitrogen, compared to 150 kg/ha in EU countries (Hlad and Skoberne, 2001). Though this result may partly be an artefact due to the low productivity during the reference period just before liberation in 1991 and there was no data about earlier land use intensity.

Pesticides use has almost similar historical pattern to fertilizer use. After slight recovery of collapse in eastern economy and introduction of a new generation of pesticides, in 1996 EU new members from CEE countries applied about 1.4 kg of active substances on one ha of arable land, while EU(15) countries 4.4 kg/ha (FAOSTAT 2004, NationMaster database 2004).

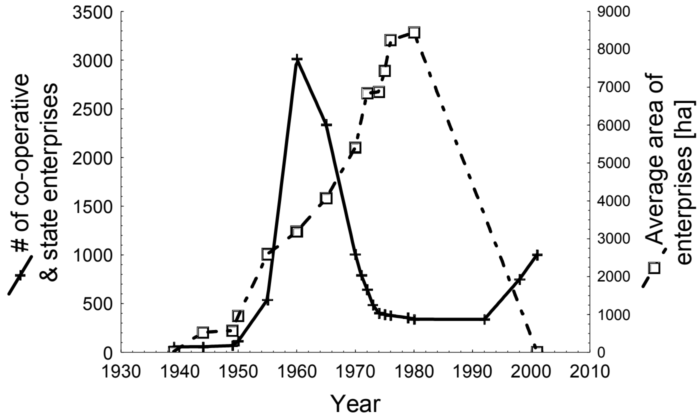

Fig. 6. Number and average area of agricultural enterprises (kolkhozes and sovkhozes) in Estonia during Soviet period and after restoration of independence (Source: Kasepalu, 1973, Vint, 1982, Agricultural Census of Estonia 2001, Lillak, 2003)

Parallel to changes in yields and the use of agro-chemicals, there have also been changes in the structure of land use both in EU and CEE countries. In most CEE countries, intensive privatisation increased the share of land owned by private farms. Reliable data about the size of farming units is difficult to obtain, and the situation is changing rapidly. In general, the agricultural holding and enterprise size, in those acceding countries where collective and state farms were created, increased from the fifties onwards, while data from the nineties shows considerably smaller farm areas. In Hungary the proportion of private farms has increased from 14% in 1990 to over 45% by 2001, at the expense of the land is mostly utilized by co-operatives (55% -> 13%) (Szabo and Pomazi, 2003). Fig. 6 characterises the dynamics of the number of farm enterprises in Estonia (Kasepalu, 1973, Vint, 1982, Agricultural Census of Estonia 2001, Lillak, 2003) – there was a clear decrease in the number of enterprises until the mid of seventies, due to the unification of smaller collective and state farms. In last years the number of farm enterprises shows an increasing trend again. Published data about the average size of commercial enterprises in a period 2000-2002; the smallest size was recorded for Lithuania and Poland (69 and 83 ha) and the largest size for Slovakia (1168 ha) (Slangen et al., 2004). The average size of agricultural enterprises for CEE countries is about ca 411 ha (calculated from various resources).

Threats to biodiversity in CEE countries

Partly because there are still areas where the intensity of land use remained low, the biological diversity in many regions of Central and Eastern Europe remained high (Fig. 7). Changes in landscape structure have a major impact on biodiversity as well, mostly via habitat availability (Schweiger et al. 2005, Liira et al. 2008). Small family holdings with different types of production contributed significantly to overall landscape diversity in Hungary (Szabo and Pomazi, 2003). Forest patches scattered within agricultural landscapes are important sources of biodiversity (Benayas et al 2008). In Hungary, for example, about 45% of spontaneous vascular plant species originate from forest vegetation, while forests cover only 19% of the total land area (Szabo and Pomazi, 2003).

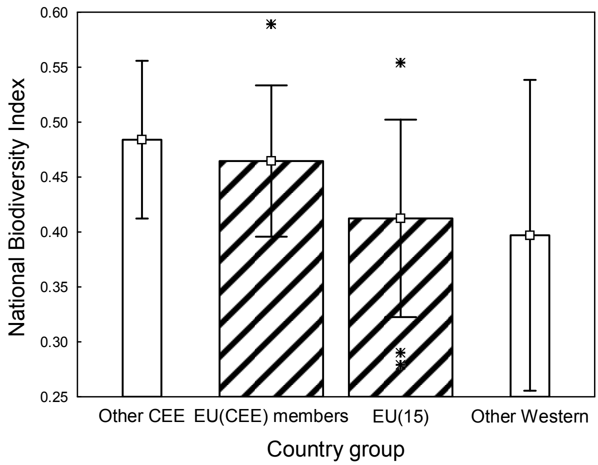

Fig. 7. Average values with 95% confidence intervals of National Biodiversity Index in four groups of European countries with outliers (Source: SCBD 2001)

Within agricultural landscapes, the share of forest varies from 30-32% in Latvia and Estonia to 10% in Hungary and 6.3% in Poland (UNECE 2004, Report on the agricultural census, Poland 2002, Szabo and Pomazi, 2003, UNECE 2004). According to the agricultural census in Estonia in 2001, 61.8% of operating agricultural holdings owned forest land. Among those holdings, an average of 32.1% of the total area of holdings was occupied by forest patches larger than 1 hectare (Agricultural Census of Estonia 2001).

Biodiversity in Eastern European countries may be influenced by abandonment of formerly extensively managed areas. According to Heath and Evans (2000) and Donald et al. (2002), nearly one-fifth of all important bird areas in Europe are threatened by agricultural abandonment, the majority of them in the CEECs. Abandonment of agricultural lands has evidently taken place in all CEECs. In Poland, between 1996 and 2000, 5.5% of land was abandoned (Agricultural census of Poland 2002), the share of fallow land reached up to 38% of arable land, or 13% of agricultural land. In Slovenia, where the level of agricultural production remained relatively high, the proportion of set aside lands is about 9.6% (Agricultural Census, Slovenia 2000), which is comparable to Western countries like Sweden (8%). However, those figures are changing very fast. During the last years, active farmers in CEECs are renting or buying all available arable lands, and formerly abandoned areas may start to be used as well.

Abandonment of formerly extensively used agricultural areas is one of the largest threats to biodiversity. For example, seminatural grasslands are very important habitats, distinguishing by their very species rich flora and fauna (Baldock, 1991, van Dijk, 1991, Konecny, 2003), and there is an ongoing abandonment process in EU (15) and Eastern European states already during last 50 years (e.g. Baldock, 1991, Kukk and Kull, 1997, van Dijk, 1991, Klimeš, 1995). Though the figures are often rather approximate, since there has been no satisfactory system for monitoring changes in different habitat types. The FAOSTAT publishes data about the area of permanent pastures, but this Fig. takes into account all cultivated grasslands and quite frequently includes only a small proportion of real semi-natural grassland areas. However, in some countries it has been estimated that seminatural grasslands comprise even currently almost half of all permanent pastures, particularly in CEECs. For instance, in Slovenia they make up even 54% in Slovenia (Konecny, 2003) of total agricultural area.

We use Estonia – a small country (4533 kha) – as an example of how the use of seminatural grasslands has changed during the post Second World War period. From 1 570 kha of seminatural grasslands in 1939, 788 kha was left by the end of the fifties and 303 kha in the early eighties. Part of the land was turned into cultivated areas, while a larger part just overgrows with forest (Aug and Kokk, 1983, Krall et al. 1980). In the early eighties, only 151 kha of intact seminatural grasslands remained (Kukk and Kull, 1997), which makes less than 10% of the area in the thirties. At the same time, those seminatural grasslands were distinguished by very high species diversity (cf. Kull and Zobel, 1991, Pärtel et al. 1999). Formerly, 22% of the total area is overgrown or overgrowing seminatural grasslands, and 8% under abandoned crop fields (Aug and Kokk 1983, Kukk and Kull, 1997, Peterson and Aunap, 1998).

Reforestation of abandoned land may also create problems for biodiversity conservation. In some countries like Hungary, exotic tree species have been widely used for reforestation (10% of total forest in Hungary), often in the remnants of unique grassland ecosystems. Only about half of the total forest area still consists predominantly of natural tree species (Szabo and Pomazi, 2003). In northern CEE countries, e.g. Estonia, the area of planted forests is about 25% of the total forest area (FAO Plant Genetic Resources for Food and Agriculture 1996) and dominated by native species, but the structural uniformity of stands may still lead to a decrease in plant and animal diversity.

Intensified use of fertilizers and pesticides had and will have adverse effects on habitat quality and on biodiversity in agricultural landscapes (Billeter et al. 2008). The agriculture in Eastern Europe contributed about 50-76% of the nitrogen input to water bodies (Löfgren et al. 1999, Vagstad et al. 2000, UNECE 2004) in the late eighties/early nineties. In agricultural areas of CEECs, contamination of surface/subsurface water with nitrates and phosphate is common. After the decrease in fertilizer load on landscapes, nitrogen and phosphorus are still leaching to rivers from the soil of riverside protection forest belts, due to the large amount of these elements accumulated during the previous years (Mander et al. 1995, Mander et al. 2000).

Soil acidification is still more common in EU(15) countries (33% of the total agricultural area, compared to 25% in CEECs) (NationMaster database 2004). The extent of chemical land degradation, taking into account the loss of nutrients on poor or moderately fertile soils, pollution with industrial and urban wastes, air-borne pollutants and pesticides, as well as human-induced salinization, was estimated by Van Lynden (1995). According to this overview, a number of eastern European countries (e.g. Baltic states, Slovenia) were classified as countries with no observable degradation. However, according to other databases, several CEE countries had and have a very high rate of acidification of agricultural soils, particularly in Poland and the Czech Republic (53% and 89% of total agricultural land in 1990, respectively, NationMaster database 2004), and also a high concentration of soil suspension in running waters, which is an indicator of soil erosion from agricultural landscapes.

4. Discussion - development of agriculture, environment and biodiversity

One may conclude that the agricultural sector in CEE countries has experienced a strong decrease in most of parameters since the late eighties, and in many cases the decrease in production has even been two- or threefold. At the same time, the agricultural sector in the European Union has experienced a steady rise. Accession countries negotiated their export quotas to the EU on the basis of the production figures following the decline in the agricultural sector, which means that when they join the EU their diminished level of agricultural production will tend to be sustained.

The general development of the agricultural sector in a country results in a specific pattern of land use. The major categories of driving forces are political, economic, demographic, environmental, and also possibly historical-cultural (Bouma et al. 1998). Due to the complexity and geographical diversity of driving forces, there remains much uncertainty in the possible impacts of particular factors on land use. It is evident that crucial determining factors of future land use are increasing urbanisation, liberalisation of world market, technical progress, and increasing social pressure regarding issues related to human health and the environment. The liberalisation of the markets for agricultural products in the former centrally planned economies in Central and Eastern Europe creates a special problem.

Prior to their transition to market economies, CEECs supported agriculture through state ownership and planning. During the socialist period, agriculture in CEECs was characterized by the extensive use of heavy machinery and by the high rates of fertilizer and pesticide usage. During transition, the costs of variable inputs, such as fertilizers or pesticides, increased at a higher rate than did wages, causing a decline in agricultural intensity (Donald et al. 2002). Reduced investments into agriculture have also resulted in decreased productivity and pressure on nature (Rey and Bachvarov, 1998, Turnock, 1999). In principle, such a situation would give the EU a theoretical possibility to favour extensive agriculture in the current EU countries and spread part of the environmental burden to acceding countries, where the present land use intensity is not high.

In contrast to EU member countries, in most of the CEE countries, biodiversity conservation is more focused on protection and much less on restoration. For example, valuable agricultural habitats that require low-intensity management are still far more widespread in the accession countries than in the EU (Donald et al. 2002). At the same time, one has to take into account the fact that new member states are also distinguished by high natural biodiversity and relatively low abundance of alien species, including many species in national lists of protected species or in national Red Lists, as well as in Annexes of the Habitats Directive of the European Union, 1992 Annexes of Natura 2000. Consequently, any further increase in the intensity of land use has to be planned carefully, in order to diminish the threat to biodiversity.

There has to be more emphasis on low-external-input agriculture (Bouma et al. 1998). In this context, considering the future diet requirements and the expected increase in food demand on the world market, the current cultivated land area in Europe should not necessarily decrease. There is certainly a need for a rural social policy to ensure welfare for the farming population and to encourage diversification (Turnock, 1999). For example, it is calculated that to maintain structural change and farm consolidation in Poland, eliminating 750 000 very small farms of 1-3 ha, 1 500 000 new jobs must be created every year (Gorz and Kurek, 1998).

One has to recognise that under current conditions of increasing yields and saturated consumer markets, there is a growing concern for the need to protect the environment through sustainable forms of land use (Bouma et al. 1998). Extensive biodiversity-enhancing land use, and organic farming together with developing nature tourism and the creation of hunting grounds with well developed infrastructure, may represent a possible future scenario for many agricultural regions in new member states. Such a scenario may create a further possibility to connect two tasks that are still kept somewhat separate – biodiversity conservation and organic farming (van Elsen, 2000). However, the increase in country-tourism, without the development of infrastructure, has contributed to several environmental problems: pollution with garbage, the eutrophication of lakes, the deterioration of some landscape elements and loss of biodiversity. Further development of tourism in sensitive areas and the improvement of transport infrastructure will increase the impact on ecosystems in the future (Szabo and Pomazi, 2003).

The conservation of the farmland environment will be best achieved through a number of measures (Donald et al. 2002) like: 1. preventing large-scale abandonment of farmland, 2. encouraging changes in agricultural practices that make less intensive agriculture more profitable, 3. increasing support on agri-environment schemes, 4. identifying and protecting farming areas of particularly high biodiversity, 5. integrating nature conservation into agricultural policy.

Accession countries increase the agricultural area of the EU by 40% (Donald et al. 2002, FAOSTAT 2004). However, the new member states from Eastern Europe will not change the average proportion of agricultural land very much, since agricultural land makes up 47.5% (53.7%, when Finland and Sweden are excluded) of the surface area of EU(15) countries, while in CEECs the average percentage is 50.8% (Donald et al. 2002, FAOSTAT 2004). However, agricultural areas of CEE will be distinguished by considerably lower land use intensity on a country level considering land use history during the last ten-twenty years or even longer.

The existence of large agricultural areas in Eastern Europe, where the current land use has not been and is not so intensive compared to EU(15) countries, and the presence of high level of biodiversity there, should be carefully considered on the scale of the whole EU. Particularly important is to consider the historical and cultural diversity within enlarged EU, when the planning of further measures in the agricultural sector, called Common Agricultural Policy (CAP) is in process. From the point of view of biodiversity conservation, it is therefore necessary to maintain or even increase financial support for sustainable and historically traditional agriculture in CEE, and extend this support to acceding countries, but to fully decouple this support from productivity (Bignal, 1996, Donald et al. 2002, Luoto et al. 2003).

Last and not least, comprehensive exploratory studies on future land use in Europe can only be realistically pursued when adequate data is gathered on current land use, degree of soil degradation, and feasible production levels. Available data is frequently inadequate and does not allow a satisfactory risk and error analysis to be made (Bouma et al. 1998, Billeter et al. 2008). The elaboration of reasonable schemes for the development of the agricultural sector, the rural environment and biodiversity conservation in new member states, as well as in the whole of the EU, has to be based on simple, reliable and easily accessible data.

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References

Agricultural Census of Estonia 2001 (2002): Statistical Office of Estonia. Tallinn

Agricultural Census, Slovenia, 2000 (2002): Statistical Office of the Republic of Slovenia. Ljubliana.

Aug, H. – Kokk, R. (1983): *Eesti NSV looduslike rohumaade levik ja saagikus*. ENSV ATK Informatsiooni ja Juurutamise Valitsus, Tallinn.

Baldock, D. (1991): Implications of EC farming and countryside policies for conservation of lowland dry grasslands. *The conservation of lowland dry grassland birds in Europe* (Goriup,P.D., Batten, L.A. and Norton, J.A. eds.), pp. 111-117. Joint Nature Conservation Committee, Newbury.

Benayas, J.M.R. – Bullock, J.M. – Newton A.C. (2008): Creating woodland islets to reconcile ecological restoration, conservation, and agricultural land use. *Frontiers in Ecology and the Environment*, 6, 329-336.

Bignal, M. – McCracken,. I. (1996): Low-intensity farming systems in the conservation of the countryside. *Journa of Applied Ecology* **33:** 413-424.

Billeter, R. – Liira, J. – Bailey, D. – Bugter, R. – Arens, P. – Augenstein, I. – Aviron, S. – Baudry, J. – Bukacek, R. – Burel, F. – Cerny, M. – De Blust, G. – De Cock, R. – Diekotter, T. – Dietz, H. – Dirksen, J. – Dormann, C. – Durka, W. – Frenzel, M. – Hamersky, R. – Hendrickx, F. – Herzog, F. – Klotz, S. – Koolstra, B. – Lausch, A. – Le Coeur, D. – Maelfait, J.P. – Opdam, P. – Roubalova, M. – Schermann, A. – Schermann, N. – Schmidt, T. – Schweiger, O. – Smulders, M.J.M. – Speelmans, M. – Simova, P. – Verboom, J. – van Wingerden, W.K.R.E. – Zobel, M. – Edwards, P.J. (2008): Indicators for biodiversity in agricultural landscapes: a pan-European study. *Journal of Applied Ecology* **45:** 141-150.

Bouma, J. – Varallyay, G. – Batjes, N.H. (1998): Principal land use changes anticipated in Europe. *Agriculture, Ecosystems and Environment* **67:** 103-119.
Donald, P.F. – Pisano, G. – Rayment, M.D. – Pain, D.J. (2002): The common agricultural policy, EU enlargement and the conservation of Europe's farmland birds. *Agriculture, Ecosystems and Environment* **89**: 167-182.
Dotlačil, L. – Vančura, K. (1996): Czech Republic: Country report to the FAO International Technical Conference on Plant Genetic Resources. *International Technical Conference on Plant Genetic Resources. Leipzig 1996*. FAO, Leipzig.
Grashof-Bokdam, C.J. – van Langevelde, F. (2004): Green veining: landscape determinants of biodiversity in European agricultural landscapes. *Landscape Ecology* (in press).
Gorz, B. – Kurek, W. (1998): Poland. *Privatisation in rural Eastern Europe: the process of restitution and restructuring* (Turnock,D. ed.), pp. 169-199. Edward Elgar, Cheltenham.
Grime, J.P. (2001): *Plant strategies, vegetation processes, and ecosystem properties*. 2nd. John Wiley and Sons, LTD, Chichester.
Gross, K.L. – Willig, M.R. – Gough, L. – Inouye, R. – Cox, S.B. (2000): Patterns of species density and productivity at different spatial scales in herbaceous plant communities. *Oikos* **89**: 417-427.
Heath, M.F. – Evans, M.I. (2000): *Important bird areas in Europe: priority sites for conservation, Vol.2*. BirdLife International, Cambridge.
Hlad, B. – Skoberne, P. (2001): *Biological and landscape diversity in Slovenia : an overview.* Ministry of the Environment and Spatial Planning, Environmental Agency of the Republic of Slovenia, Ljubliana.
Jurkeviciute, A. – Mileva, M. (2003): *Nature conservation in rural policy. Emerging practices in Central and Eastern Europe*. The Regional Environmental Center for Central and Eastern Europe, Szentendre.
Kasepalu, A. (1973): Kolhooside ja sohvooside kujunemisest. *Põllumehe teatmik 1974* (ed E. Mets), pp. 127-131. Valgus, Tallinn.
Klimeš, L. (1995): Small-scale distribution of species richness in a grassland (Bile Karpaty Mts., Czech Republic). *Folia Geobotanica et Phytotaxonomica* **30**: 499-510.
Konecny, M. (2003): *The CAPacity building manual*. Friends of the Earth Europe, Brussels.
Krall, H. – Pork, K. – Aug, H. – Püss, Õ. – Rooma, I. – Teras, T. (1980): Eesti NSV looduslike rohumaade tüübid ja tähtsamad taimekooslused. Eesti NSV Pällumajandusministeeriumi Informatsiooni ja Juurutamise Valitsus, Tallinn.
Kukk, T. – Kull, K. (1997): Puisniidud. *Estonia Maritima* **2**: 1-249.
Kull, K. – Zobel, M. (1991): High species richness in an Estonian wooded meadow. *Journal of Vegetation Science* **2:** 711-714.
Kuuba, R. (2001): Raiemahtude dünaamika ja iseloom Eestis kahekümnenda sajandi viimasel kümnendil. *Forest Studies* **35**: 59-73.
Kõre, E. (1982): Lehmade produktiivsus kolhoosides ja riiklikes majandites 1980. aastal. *Põllumehe teatmik 1982* (ed E. Mets), pp. 230-237. Valgus, Tallinn.
Kõre, E. (1982): Teraviljade saagikus ja omahind kolhoosides ja riiklikes majandites 1980. aastal. *Põllumehe teatmik 1982* (ed E. Mets), pp. 204-213,Valgus, Tallinn.
Liira, J. – Schmidt, T. – Aavik, T. – Arens, P. – Augenstein, I. – Bailey, D. – Billeter, R. – Bukacek, R. – Burel, F. – De Blust, G. – de Cock, R. – Dirksen, J. – Edwards, P.J. – Hamersky, R. – Herzog, F. – Klotz, S. – Kuhn, I. – Le Coeur, D. – Miklova, P. – Roubalova, M. – Schweiger, O. – Smulders, M.J.M. – van Wingerden, W.K.R.E. – Bugter, R. – Zobel, M. (2008): Plant functional group composition and large-scale species richness in European agricultural landscapes. *Journal of Vegetation Science* **19**: 3 - 14.
Lillak, R. (2003) : *Eesti põllumajanduse ajalugu.* Eesti Põllumajandusülikool, Tartu.
Luoto, M. – Rekolainen, S. – Aakkula, J. – Pykälä, J. (2003): Loss of plant species richness and habitat connectivity in grasslands associated with agricultural change in Finland. *Ambio* **32**: 447-452.

Löfgren, S. – Gustafson, A. – Steineck, S. – Ståhlnacke, P. (1999): Agricultural development and nutrient flows in the Baltic States and Sweden after 1988. *Ambio* **28**: 320-327.
Mäe, Ü. (1976): Kolhoosnikute, tööliste ja teenistujate isiklik abimajapidamine. *Põllumehe teatmik 1976* (ed E. Mets), pp. 156-160. Valgus, Tallinn.
Mander, Ü. – Kuusemets, V. – Ivask, M. (1995): Nutrient dynamics of riparian ecotones: A case study from the Porijogi River catchment, Estonia. *Landscape and Urban Planning* **31**: 333-348.
Mander, Ü. – Kull, A. – Kuusemets, V. – Tamm,V. (2000) Nutrient runoff dynamics in a rural catchment: Influence of land-use changes, climatic fluctuations and ecotechnological measures. *Ecological Engineering* **14**: 405-417.
Mets, E. (1974): Põllumehe teatmik 1974. Valgus, Tallinn.
Mets, E. (1979): Põllumehe teatmik 1979. Valgus, Tallinn.
Mets, E. (1982): Põllumehe teatmik 1982. Valgus, Tallinn.
Mittelbach, G.G. – Steiner, C. – Scheiner, S.M. – Gross, K.L. – Reynolds, H.L. – Waide, R.B. – Willig, M.R. – Dodson, S.I. – Gough, L. (2001): What is the observed relationship between species richness and productivity? *Ecology* **82**: 2381-2396.
Morgan, W.B. (1992): Economic reform the free market and agriculture in Poland. *Geographical Journal* **158**: 145-156.
Peterson, U. – Aunap, R. (1998): Changes in agricultural land use in Estonia in the 1990s detected with multitemporal Landsat MSS imagery. *Landscape and Urban Planning* **41**: 193-201.
Peterson, U. – Liira, J. – Budenkova, J. – Kiviste, A. (2006): Forest cover changes since mid-1980s in the eastern Baltic region, evaluated with multitemporal Landsat imagery. *Patterns and processes in forest landscapes. Consequences of human management*, (Lafortezza,R. and Sanesi,G. eds.), pp. 393-397. Accademia Italiana di Scienze Forestali, Firenze.
Pärtel, M. – Kalamees, R. – Zobel, M. – Rosen, E. (1999): Alvar grasslands in Estonia: variation in species composition and community structure. *Journal of Vegetation Science* **10**: 561-570.
Rey, V. – Bachvarov, M. (1998): Rural settlements in transition - agricultural and countryside crisis in Central-Eastern Europe. *Geographical Journal* **44**: 345-353.
SCBD (2001): Global Biodiversity Outlook. Secretariat of the Convention on Biological Diversity. Montreal.
Sepp, K. – Palang, H. – Mander, Ü. – Kaasik, A. (1999): Prospects for nature and landscape protection in Estonia . *Landscape and Urban Planning* **46:** 161-167.
Slangen, L. H. G. – van Kooten, G. C. – Suchanek, P. (2004): Institutions, social capital and agricultural change in central and eastern Europe. *Journal of Rural Studies* **20**: 245-256.
Szabo, E. – Pomazi, I. (2003): *Environmental indicators of Hungary 2002*. Ministry of Environment and Water, Budapest
Schweiger, O. – Maelfait, J.P. – Van Wingerden, W. – Hendrickx, F. – Billeter, R. – Speelmans, M. – Augenstein, I. – Aukema, B. – Aviron, S. – Liira, J. (2005): Quantifying the impact of environmental factors on arthropod communities in agricultural landscapes across organizational levels and spatial scales. *Journal of Applied Ecology* **42**: 1129 - 1139.
Swinnen, J.F.M. (1997): Agricultural privatisation, land reform and farm restructuring in Central and Eastern Europe. Ashgate Publishing Company, Aldershot.
Turnock, D. (1999): Rural diversification in Eastern Europe: Introduction. *Geographical Journal*, 46, 171-181.
Vagstad, N. – Jansons, V. – Loigu, E. – Deelstra, J. (2000): Nutrient losses from agricultural areas in the Gulf of Riga drainage basin. *Ecological Engineering* **14:** 435-441.
van Dijk, G. (1991): The status of semi-natural grasslands in Europe. *The Conservation of Lowland Dry Grassland Birds in Europe* (eds P.D. Goriup, L.A. Batten, and J.A. Norton) pp. 15-36. JNCC, Reading.
van Elsen, T. (2000): Species diversity as a task for organic agriculture in Europe. *Agriculture, Ecosystems and Environment* **77:** 101-109.
van Lynden, G.W.J. (1995): European soil resources. nature and environment, No.71. European Council, Strasbourg.

Vint, E. (1982): Eesti NSV põllumajanduse arengu põhinäitajad. *Põllumehe teatmik 1982* (ed E. Mets.), pp. 147-155, Valgus, Tallinn.
Yaroshenko, A.Y. – Potapov, P.V. – Turubanova, S.A. (2001): *The last intact forest landscapes of Nothern European Russia. Greenpeace Russia.*

Internet and other unpublished references

AllRefer (2004): Reference and Encyclopaedia Recourse. Country study and guide. http://reference.allrefer.com/country-guide-study/
Cochrane, N. (2002): ERS/USDA Briefing Room - Poland: issues and analysis. http://www.ers.usda.gov/Briefing/Poland/issues.htm
FAO Plant Genetic Resources for Food and Agriculture (1996). 1996 State of the World. Regional reports. International Technical Conference on Plant Genetic Resources. Leipzig. http://www.fao.org/WAICENT/FaoInfo/Agricult/AGP/AGPS/Pgrfa/index_e.htm
FAOSTAT (2004): Agricultural data. http://faostat.fao.org/faostat/collections?subset=agriculture
NationMaster database (2004): http://www.nationmaster.com/
Report on the agricultural census, Poland (2002): CSO. Warszawa (http://www.stat.gov.pl/english/psr/raport.htm)
Sumelius, J. (2000): A review of state of sustainability of farming systems in the selected Central and Eastern European countries. FAO working paper. Farm Management and Production Economics Service Agricultural Support Services Division. 58 p. (http://www.fao.org/regional/SEUR/Review/cover.htm)
UNECE (2004): Environmental Performance Reviews. Countries' reviews. United Nations Economic Commission for Europe. 2004. http://www.unece.org/env/epr/countriesreviewed.htm
Vagstad, N. – Deelstra, J. (2003): Agriculture and the Water Quality Impacts. Challenges in terms of Quantification, Control and Management. In: Drainage basin nutrient inputs and eutrophication: an integrated approach. (eds P. Wassmann, and K. Olli, K.). http://www.botany.ut.ee/~olli/eutr/Eutrophication.pdf
WCMC (1992): Development of a national biodiversity index. A discussion paper prepared by the World conservation Monitoring Centre, Cambridge, UK. Unpublished.

Annex 1. Description of economical and ecological variables used in the paper, with references on sources.

Parameter variable	**Description**	**Data sources**
Acidification area %	Share of land area with acidification exceedance (data of 1990'ies)	Stockholm Environment Institute at York, Acidification in Developing Countries: Ecosystem Sensitivity and the Critical Loads Approach at the Global scale, 2000 via ciesin.org; adapted by NationMaster database, 2004
Agricultural % in GDP	Share of agriculture in GDP (data of 2000)	CIA World Factbook, December 2003 via NationMaster database, 2004
Agricultural Area (ha)	The sum of area under arable crops, permanent crops and permanent pastures	FAOSTAT 2004; UNECE 2004 reports
Agricultural land %	Share of the agricultural land area in total land area of a country (data of 2000).	FAOSTAT 2004
Agricultural production index (PIN) (1996-98)	The FAO index of agricultural production shows the relative level of the aggregate volume of agricultural production for each year in comparison with the base period 1989-91.	FAOSTAT 2004
Agricultural water use %	Share of agricultural water use in total water use (data of 2000)	AQUASTAT 2004; www.seerecon.org
Arable land %	Share of arable land in agricultural land (data of 2000)	FAOSTAT 2004
GDP $ (per capita)	GDP ($) per capita (average of 2000-2002)	CIA World Factbook, NationMaster database, 2004
GDPgrowth% (1975-2000, per capita)	GDP per capita annual growth rate (%) from 1975 to 2000	CIA World Factbook, December 2003 via NationMaster database, 2004
Irrigated area %	Share of irrigated land area in agricultural land	FAOSTAT 2004; AQUASTAT 2004
Land area	Total area of country excluding area under inland water bodies	FAOSTAT 2004
National Biodiversity Index	National Biodiversity Index (NBI) is based on estimates of country richness and endemism in four terrestrial vertebrate classes and vascular plants; vertebrates and plants are ranked equally; index values range between 1.0 (maximum: Indonesia) and 0.0 (minimum: Greenland).	SCBD 2001.
Nonnative plant species density	Proportion of non-native plant species in total speices list in map grid of the Flora Europaeae	The Flora Europaeae 1997

Organic crop %	Share of the cropland under organic management in all cropland from period 2001-2003.	Konecny 2003; World Resources Institute via NationMaster database, 2004
Pesticide use kg/ha	Average pesticide use (kg/ha of cropland). Calculated by WRI by dividing the total pesticide consumption, measured in kilograms of active ingredients, by the total hectares of arable and permanent cropland.	World Resource Institute, World Resources 2000-2001, Washington, DC: WRI, 2000. via ciesin.org and NationMaster database, 2004; Environ in Sloven 1996 Tab P-13
Population density	Population density of country (1993-1997) (inh/km²)	compiled from UN reports, and Earthtrends
Protected area %	Share of environmentally protected areas according to IUCN categories I to IV (data of 1997)	SCBD. 2001; Jacaranda Atlas via NationMaster database, 2004
Rural population %	Share of rural population in total population (data of 2000)	FAOSTAT 2004
Suspended soils in water ln(mg/l)	Suspended solids in water (natural log of Milligrams/Litre). The country values represent averages of the station-level values for the three-year time period 1994-96, except where data were only available for an earlier time period (1988-1993).	United Nations Environment Programme (UNEP), Global Environmental Monitoring System/Water QualityMonitoring System. http://www.cciw.ca/gems/, with data for an additional 29 countries from Prescott-Allen, R.The Wellbeing of Nations, Washington, DC: Island. via NationMaster database, 2004
Total Fertilizer kg/ha	Fertilizer consumption kg/ha of arable land (data of 2001). Total fertilizer is sum of consumption of various plant nutrients (N, P_2O_5 and K_2O)	FAOSTAT 2004