OECD NATIONAL SOIL SURFACE NITROGEN BALANCES

EXPLANATORY NOTES

OECD SECRETARIAT

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The searchable soil surface nitrogen balance database is available at:
www.oecd.org/agr/env/indicators.htm

If you have any questions concerning these notes or additional information that would help to improve the OECD soil surface nitrogen balances, then please contact: kevin.parris@oecd.org or yukio.yokoi@oecd.org

OECD NATIONAL SOIL SURFACE NITROGEN BALANCES: EXPLANATORY NOTES

1. INTRODUCTION

1. The issue of agricultural nutrient use is one of the priority issues in developing an OECD set of agri-environmental indicators, as part of the contribution to the analysis of the interactions between agriculture and the environment and impact of changes in agricultural policy on the environment. The reader is referred to the OECD publication: ***Environmental Indicators for Agriculture — Volume 3: Methods and Results*** (OECD, 2001), which provides the overall framework in which this and other agri-environmental indicators are being developed.[1]

2. An adequate supply of nutrients in the soil is essential to crop growth. Some nutrients are required in large amounts, particularly nitrogen, phosphorus and potassium, while others are needed in small quantities, such as copper and iron, but are essential to crop growth. The major environmental issues associated with nitrogen surpluses from agriculture include pollution of (see Figure 1):

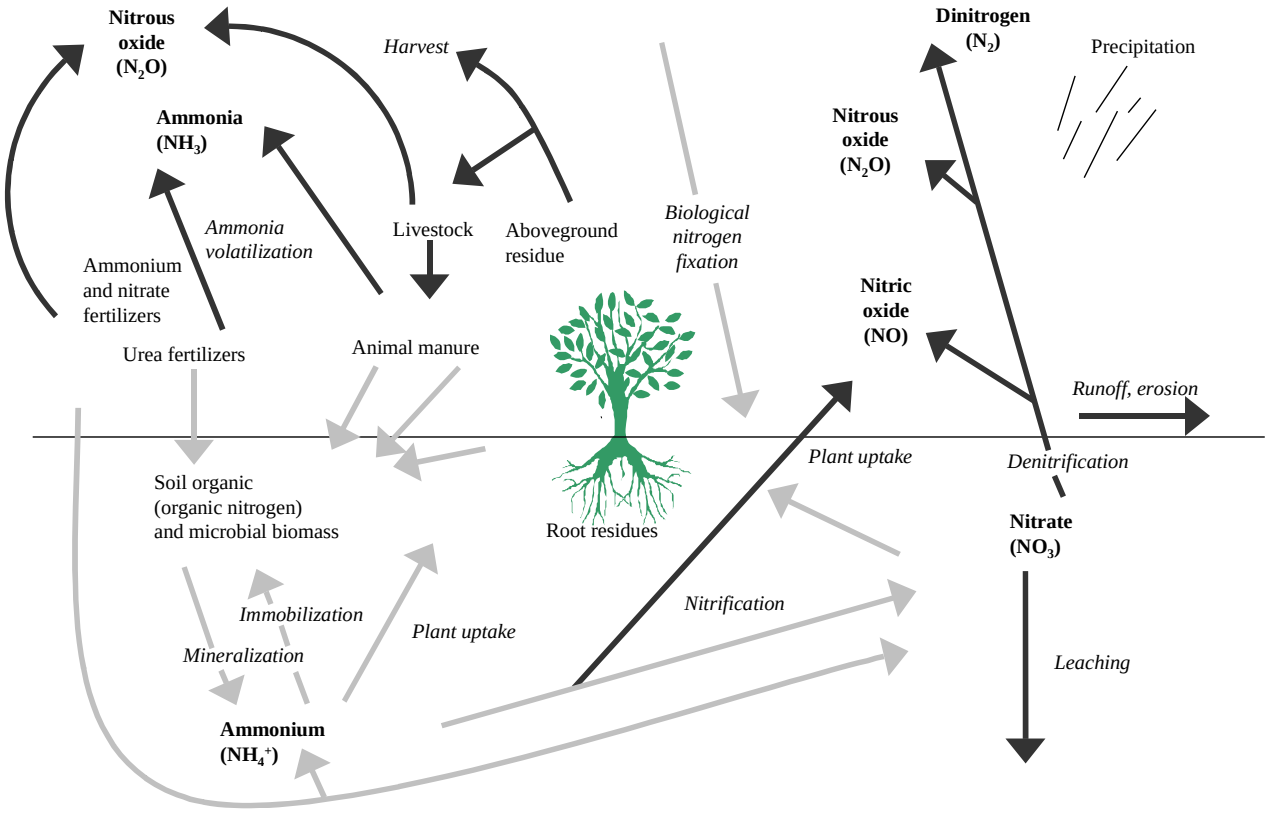
- **surface water** (rivers, lakes and coastal waters) can accelerate the process of eutrophication (i.e. algae growth and oxygen shortages in water), which can damage the biodiversity of rivers and lakes and impair their use for drinking water, fishing and recreational purposes (this mainly concerns phosphates);

- **groundwater** (drinking water), from nitrates which at high enough concentrations can be damaging to both livestock and humans health and incur higher water purification costs, moreover, groundwater pollution is potentially more problematic, than surface water pollution, because once polluted it may take many years before pollutant levels decline even when the source of pollution has been reduced;

- **air**, from nitrous oxide (a greenhouse gas which contributes to the climate change) which is directly emitted from excessive inorganic fertilisers applied to agricultural soil and also indirectly formed in the atmosphere from volatilised ammonia originally contained in livestock manure. Volatilised ammonia, once it deposits on the ground, also contributes to acidification of soils and water.

1. The Executive Summary of this publication is available at: www.oecd.org/agr/env/indicators.htm [> Publications]

Figure 1. **The Nitrogen Cycle**



Note: Grey arrows represent nitrogen (N) inputs and black arrows nitrogen outputs. The different forms of N are represented in bold text and the processes of N transformation are shown in italics.

Source: OECD (2001), *Environmental Indicators for Agriculture — Volume 3: Methods and Results*, Paris, France.

3. While a surplus of nitrogen into the environment can be potentially damaging, equally a deficiency of soil nitrogen can also impair the resource sustainability of agriculture through soil degradation, or soil mining, resulting in the declining fertility of areas under crop or forage production.

4. OECD, in co-operation with EUROSTAT, is currently in the process of improving and updating the nitrogen balances presented here. The work is also being extended to cover phosphorus balances. If you require further information concerning this work or have material that would help to improve the calculations described here please contact kevin.parris@oecd.org or yukio.yokoi@oecd.org.

5. Following this introduction, **Section 2** provides a brief overview of the method used to calculate a national soil surface nitrogen balance and the interpretation of the indicator. **Section 3** summarises the structure of the database, **Section 4** provides general notes for each section of the database, and **Section 5** covers some country specific notes.

2. METHOD OF CALCULATION AND INTERPRETATION OF THE INDICATOR

6. The *OECD **soil surface nitrogen balance*** **calculates** the difference between the total quantity of nitrogen inputs entering the soil and the quantity of nitrogen outputs leaving the soil annually, based on the nitrogen cycle (Figure 1). Therefore, nitrogen loss directly from livestock (e.g. ammonia volatilisation from stored manure) is not included in the balance, although livestock manure production is a major source of nitrogen input which affects the balance. The excess nitrogen, or surplus, may remain in the soil, leach into groundwater and volatilise into the air. The inputs and outputs included in the calculation are indicated in Figure 2 and described below.

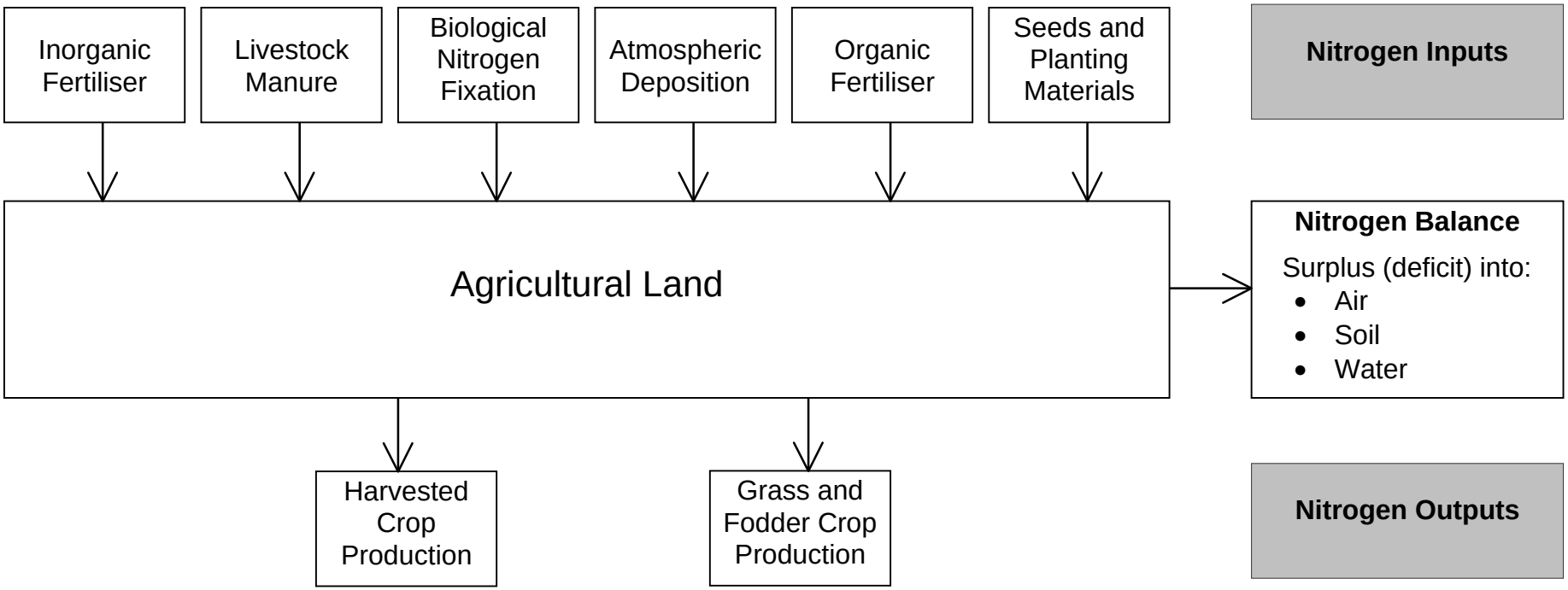
7. The estimate of the annual total quantity of ***nitrogen inputs*** for the soil surface nitrogen balance, includes the addition of :

- *inorganic or chemical nitrogen fertiliser*: quantity consumed by agriculture;
- *livestock manure nitrogen production*: total numbers of live animals (cattle, pigs, sheep, goats, poultry, horses, and other livestock) in terms of different categories according to species (e.g. chickens, turkeys), sex, age and purpose (e.g. milk cow, beef cattle), multiplied by respective coefficients of the quantity of nitrogen contained in manure per animal per year;
- *atmospheric deposition of nitrogen:* total agricultural land area multiplied by a single coefficient of nitrogen deposited per hectare;
- *biological nitrogen fixation:* planted area of legume crops or pasture (e.g. field beans, soybeans, clover, alfalfa, pasture) multiplied by respective coefficients of nitrogen fixation per hectare, plus the nitrogen fixation by free living soil organisms computed from the total agricultural land area multiplied by a single coefficient of nitrogen fixation per hectare;
- *nitrogen from recycled organic matter:* quantity of sewage sludge applied to agricultural land multiplied by a single coefficient of nitrogen content of sewage sludge; and,
- *nitrogen contained in seeds and planting materials:* quantity of seeds and planting materials (e.g. cereals, potato tubers) multiplied by respective coefficients of nitrogen content of seeds per planting materials.

8. The estimate of the annual total quantity of ***nitrogen outputs,*** or nitrogen uptake, for the soil surface nitrogen balance, includes the addition of:

- *harvested crops:* quantity of harvested crop production (e.g. cereals, root crops, pulses, fruit crops, vegetables and industrial crops) multiplied by respective coefficients of nitrogen uptake to produce a tonne of harvested crop;
- *harvested forage crops:* quantity of harvested forage crop production (e.g. fodder beets, hay, silage) and grass consumption from temporary and permanent pasture multiplied by respective coefficients of nitrogen uptake to produce a tonne of forage.

Figure 2. **The Main Elements in the OECD Soil Surface Nitrogen Balance**



Source: OECD (2001), *Environmental Indicators for Agriculture — Volume 3: Methods and Results*, Paris, France.

9. It is drawn to the attention of readers in **interpreting the indicator** that:

- The OECD soil surface balance calculation is **not a gross calculation of all nitrogen loss from agriculture**. This is because the focus is mainly on the nitrogen loss to soil and water, as volatilisation of ammonia from stored manure and livestock housing is excluded from the calculation.

- The basic data provided in the database are preliminary and data definitions may vary across countries following the definitions in the original surveys. For crop production, for example, although production data generally refer to the normal state of the specific crop unless otherwise stated, for example, dry weight for cereals, fresh weight for vegetables, while forage production may refer to weights with different moisture contents across countries.

- The coefficients used for the calculation are preliminary and their derivation may vary across countries. In any case, definition of coefficients should meet the definition of the corresponding basic data mentioned above.

- Although the basic data, coefficients and the results of the calculation provided in the database have been verified by national authorities, the Secretariat remains responsible for the choice of data, calculation and the results.

- For a more detailed analysis of the policy and environmental background to nutrient use in OECD countries and a description of the trends in the OECD nitrogen balance indicator, see the nutrient use chapter of OECD (2001), *Environmental Indicators for Agriculture — Volume 3: Methods and Results*, Paris, France.

3. STRUCTURE OF THE DATABASE (TYPE OF DATA SERIES)

3.1 Coverage

10. The database consists of four parts summarised in Figure 3:

- **Fertiliser/Headage/Crops**: basic data to calculate the nitrogen balance, covering the nitrogen inputs and outputs in the soil surface balance;

- **Coefficients**: coefficients to convert basic data (e.g. livestock numbers) into nitrogen equivalents;

- **Quantity of nitrogen**: nitrogen content, involving the multiplication of the *basic data* by the *nitrogen coefficients*, to provide the *total nitrogen content* for the nitrogen input and output items; and,

- **Nitrogen Balance**: nitrogen balance covering the main categories of nitrogen inputs and outputs, the nitrogen balance calculation (inputs minus outputs), and the expression of the nitrogen balance in kg of nitrogen per hectare of agricultural land.

Figure 3. Summary of Database Structure

Basic data on **FERTILISER/HEADAGE/CROPS**	**COEFFICIENTS**	**QUANTITY OF NITROGEN**	**NITROGEN BALANCE**
Fertilisers: Inorganic and organic products (excluding livestock manure)	Fertilisers kg nitrogen / t of fertiliser	Fertilisers	Calculation of the total nitrogen balance and the balance
Livestock (Number of live animals)	Livestock manure kg nitrogen / head /year	Livestock manure	
Manure withdrawals from agriculture, manure stocks and imports	Manure withdrawals, stocks and imports kg nitrogen / t of manure	Manure withdrawals, stocks and imports	
Harvested Crop Production	Harvested crops kg nitrogen uptake / t of crop	Nitrogen uptake by harvested crops	
Forage Production	Forage kg nitrogen uptake / t of forage	Nitrogen uptake by forage	
Seeds and Planting Materials	Seeds and planting materials kg nitrogen / t of material	Nitrogen contained in seeds and planting materials	
Area of Legume Crops	Biological nitrogen fixation kg of nitrogen / ha of legume crop area and total agricultural area respectively	Biological nitrogen fixation	
Agricultural Land Use Area	Atmospheric deposition kg nitrogen / ha of agricultural land	Nitrogen fixed from atmospheric deposition	

11. Where the level of standard disaggregation is insufficient to reflect the availability of basic data and coefficients for a country, additional items are added. For example, some countries may have available data series that provides for further disaggregation of "Other Livestock" (e.g. to include not only horses and donkeys but also rabbits, deer, etc.).

4. GENERAL NOTES FOR EACH SECTION OF THE DATABASE

4.1 General notes

12. Attention is drawn to the following points when using the database:

- The classification system of crops and livestock draws on that of the original data sets, i.e. national sources, EUROSTAT (for European Union member countries), and FAO.
- Disaggregated data are provided where possible, especially for crop and livestock series, to facilitate a more accurate estimate of the nitrogen balance (e.g. piglets, sows), plus the relevant sub-total (e.g. total pigs). However, where disaggregated data does not exist, then aggregated data are provided (e.g. total pig numbers), together with the corresponding coefficients to convert these data into nitrogen composition and quantities.
- Countries use different classification systems to record the numbers of live animals, especially for cattle, pigs and poultry.
- Sub-totals may not add to totals due to rounding errors.

4.2 Basic data (Fertilisers/Headage/Crops)

4.2.1 Fertilisers

13. This category covers data on apparent inorganic fertiliser consumption and on other organic fertilisers applied to agricultural land, excluding livestock manure, which is treated separately.

Inorganic fertilisers

Nitrogenous fertilisers, covering consumption of nitrogenous fertilisers, expressed in nitrogen (N) content.

Organic fertilisers

Sewage sludge, covering use of treated public sewage sludge.

Urban compost, covering use of urban compost from public garbage collection.

Industrial waste products, covering use of industrial waste, such as products from the food processing industry .

Other products, covering other organic products used as fertilisers.

4.2.2 Livestock numbers

14. This category covers the total livestock inventory of live animals required in the calculation of the nitrogen content of livestock manure production.

15. It is important to note that the numbers of live animals include those recorded for a given census day in the year, and do not include the total numbers of animals slaughtered over a given year. The total numbers of livestock slaughtered over a year are reflected in the coefficients used to convert livestock numbers into nitrogen content in manure, described under Section 4.3.3 below. The livestock categories covered include:

Cattle, covering beef cattle, dairy cattle and calves.

Pigs, covering pigs of various range of weights.

Sheep and Goats, covering sheep, lambs and goats.

Poultry, covering chickens for broilers and layers, and other poultry, such as ducks and turkeys.

Other livestock, covering other livestock, such as horses and donkeys.

4.2.3 Manure withdrawals, stocks and imports

16. This category covers data on livestock manure withdrawn and not used on agricultural land (including manure exports); the increase or decrease of manure stocks intended for use on agricultural land; and manure imported into a country for use on agricultural land. This information provides the basis for calculating the "net" input of livestock manure on agricultural land over a given year as follows:

Net Input of Manure: = Livestock manure production – Manure withdrawals
+ Change in manure stocks + Manure imports

Manure withdrawals, representing the amount of manure withdrawn from agriculture and not applied to agricultural land. The volatilisation of ammonia and mineralisation of nitrogen after manure is applied to the soil are regarded as a part of nutrient losses (or nutrient surplus), and are not included in this category. On the other hand, destruction of manure and volatilisation of ammonia from stored manure, livestock housing and manure spreading operations are excluded from the balance.

Destruction and evaporation, covering destruction of manure and volatilisation of ammonia which occurs from stored manure, livestock housing and manure spreading operation.

Non-agricultural use of manure, such as for private gardens.

Processed as industrial waste, covering manure processed as industrial waste in a processing plant and not used on agricultural land.

Exported organic fertilisers, covering manure and other organic fertilisers exported from a country.

Other withdrawals, covering other manure withdrawals.

Change in manure stocks, covering change in livestock manure stocks, obtained by deducting the beginning stocks from the ending stocks.

Imported organic fertilisers, covering manure and other organic fertilisers imported.

4.2.4 Harvested crops and forage

17. This category covers data on harvested crop production from arable field crops (e.g. cereals); permanent crops (e.g. citrus fruits), and forage production, including both harvested fodder crops (e.g. fodder beets), and pasture production from temporary grassland and permanent pasture. The definitions and categories of crops and forage used here follows closely that used by FAO. It is emphasised that while many countries have disaggregated fruit and vegetable production data these are included only where coefficients exists to convert the particular fruit or vegetable into its nutrient content and composition

Harvested Crops, regardless of their final destination, including for human consumption, livestock feed, industrial use and seeds.

Cereals, covering wheat, rice and coarse grains.

Oil crops, covering both annually sown oil crops (e.g. soybeans, rapeseed) and perennial oil crops (e.g. olives). This category also covers oil crops, such as soybeans, used for purposes other than the production of vegetable oil, such as for animal feed and processed foods.

Dried pulses and beans, in dry weight, including beans, broad beans, peas, chickpeas and lentils but excluding soybeans.

Root crops, covering mainly crops used for food and industrial use (e.g. potatoes), but excluding root crops grown principally for feed, such as fodder beets.

Fruit, covering both annually sown fruit crops (e.g. strawberries) and fruit tree crops (e.g. apples, peaches).

Vegetables, covering leaf (e.g. cabbage, lettuce), vine (e.g. tomatoes, melons) and root vegetables (e.g. carrots, beets).

Industrial crops, covering sugar crops, fibre crops and other industrial crops, for example, tobacco, hops, etc.

Ornamental crops, covering crops such as flowers.

Other harvested crops, covering any other harvested crop not covered under the sub-categories above.

Forage, covering annually **harvested fodder crops** and **pasture** used as livestock feed.

Crop residues

18. The calculation of the soil surface nitrogen balance includes, where possible, the “actual” utilisation or consumption of vegetation from pasture, and excludes that vegetation not utilised by

livestock and remaining on pasture. Very few countries regularly collect data related to pasture consumption by livestock, although statistics are more commonly available on pasture area and for some countries pasture production, which includes both pasture vegetation consumed by livestock and that remaining in the field. For those countries with only data on pasture area, calculation of pasture production was estimated from an assumed pasture yield figure.

19. For most countries, the pasture consumption was estimated, for example, from the number of grazing livestock and their average consumption levels per animal, or from pasture production and the consumption/production ratio.

20. The inclusion of crop residues in the soil surface nitrogen balance still requires further research. In particular, examination is required with respect to the use of nitrogen conversion coefficients, i.e. nitrogen uptake coefficients cover the nitrogen content not only in harvested cereal grains but also other part of the plant, which may or may not be removed from the field. Data are not provided in this entry at this stage of OECD work on the balances.

4.2.5 Seeds and planting materials

21. This category covers the quantities of seeds and other planting materials used in agriculture. This table includes data on the major categories of seeds and planting materials covering:

Cereals, covering wheat, rice and coarse grains.

Oil crops, covering both annually sown oil crops (e.g. soybeans, rapeseed) and perennial oil crops (e.g. olives). This category also covers oil crops, such as soybeans, used for purposes other than the production of vegetable oil, such as for animal feed and processed foods.

Root crops, covering mainly crops used for food and industrial use (e.g. potatoes), but excluding root crops grown principally for feed, such as fodder beets.

Other crops, covering any other crops.

4.2.6 Biological nitrogen fixation

22. This category covers the planted area of legume crops which contribute to biological nitrogen fixation, mainly **pulses**, **soybeans**, **clover**, **alfalfa** and **other legume crops**. Note that it is the planted area but not the harvested area of legumes, which is dealt under this category, since biological nitrogen fixation occurs regardless of whether the crop is harvested or not. For example, leguminous crops are often not harvested but ploughed into the field to provide soil nitrogen.

23. This category also covers the land area data, i.e. **arable and permanent crop land** and **permanent pasture**, to be used for the calculation of biological nitrogen fixation by free living micro-organisms in the soil.

4.2.7 Land use

24. This category covers the **Agricultural land**, which is sub-divided into **Arable and permanent crop land** and **Permanent pasture**.

4.3 Nitrogen coefficients

4.3.1 General comments

25. Coefficients to convert basic data to nitrogen content and composition vary over time and among countries. Where the availability of national nitrogen conversion coefficients is limited, the following approach is provisionally used to obtain a consistent set of nitrogen coefficients:

- it is assumed that nitrogen coefficients are assumed unchanged over the period 1985 to 1997, in the absence of time series data, except for the Netherlands (annual coefficients are available) and Hungary (the coefficients are increased by 20% for dry years);
- while national coefficients have been used where possible, coefficients for a "comparable" country have been used in the absence of national coefficients.

26. The sources of the nitrogen coefficients include:

- National Research Institutes, such as the coefficients used in the balances for Canada and Japan;
- EUROSTAT, referring to national coefficients provided to EUROSTAT in response to their 1996 questionnaire to European Union member countries;
- OECD estimate, referring to estimates by the OECD Secretariat based on available data and research literature; and,
- Coefficients drawn from a study of selected European Union member countries by Schleef, K.H. and W. Kleinhanb (1994), *Mineral Balances in Agriculture in the EU*, Institute of Farm Economics, Federal Agricultural Research Centre, Braunschweig, Germany.

4.3.2 Fertilisers

27. This category provides the nitrogen composition coefficients to convert quantities of inorganic and organic fertilisers. From its definition (to be expressed in nitrogen contents, not in the weight of fertilisers), nitrogenous inorganic fertiliser has a fixed nitrogen conversion coefficient of 1000 kg/t. Note that livestock manure is not included under this category.

4.3.3 Livestock Manure Production

28. This category provides the coefficients to convert numbers of livestock into nitrogen composition in annual manure production, however, the following should be noted regarding these coefficients:

- in terms of the level of disaggregation, the set of nitrogen conversion coefficients correspond as closely as possible to the data for livestock numbers;
- the coefficients take into account the slaughtering of animals over a given year, as already discussed above in Section 4.2.2.

4.3.4 Manure withdrawals, stocks and imports

29. This category provides nitrogen composition coefficients for manure withdrawals (including manure exports), change in stocks and imports.

4.3.5 Harvested crops and forage

30. This category provides the nitrogen uptake coefficients to convert the production of harvested crops and forage into quantities of nitrogen uptake from the field, however, the following should be noted:

- in terms of the level of disaggregation, the set of nitrogen conversion coefficients correspond as closely as possible to the data for crop and forage production;
- where coefficients are not available for certain crops, nitrogen coefficients that are available for similar crops are used provisionally (e.g. applying the coefficient for barley to oats); and,
- since nitrogen uptake includes the nitrogen content in crop residues which remain in the field, further methodological work is required to properly take into account this point.

4.3.6 Seeds and planting materials

31. This category provides coefficients to convert the quantities of seeds and planting materials into their nitrogen composition. Note that coefficients in this group are not the same as those for crops, which do not concern nitrogen composition but uptake (including uptake for by-products, such as stems and leaves).

4.3.7 Biological nitrogen fixation

32. This category provides coefficients to calculate the biological nitrogen fixation from the planted area of leguminous crops and biological nitrogen fixation by soil micro-organisms on all agricultural land.

4.3.8 Atmospheric deposition

33. This category provides the coefficients to calculate atmospheric deposition of nitrogen on all agricultural land.

4.3.9 Denitrification

34. Denitfication process on agricultural land is important for Japan and Korea, where rice production is dominant in the agricultural systems. This process is release of mineralised nitrogen as gaseous nitrogen (N_2), which is deemed to be harmless to the environment being a major component of the atmosphere). However, the data are not included in this database at this stage.

4.4 Quantity of Nitrogen

35. This category provides the total nitrogen content of the inputs and outputs in the soil surface balance in terms of tonnes of nitrogen. The nitrogen content data in these tables are basically derived from the *multiplication of the basic data (fertilisers/headage/crops) by the nitrogen coefficients*.

4.5 Nitrogen Balance

36. The calculation of the nitrogen soil surface balance is, as follows:

NITROGEN INPUT (tonnes of nitrogen)	=	Fertilisers + Net Input of Livestock Manure + Other Nitrogen Inputs (Seeds and planting materials, Biological nitrogen fixation, Atmospheric deposition)
NITROGEN OUTPUT (tonnes of nitrogen)	=	Total Harvested Crops + Total Forage
NITROGEN BALANCE (tonnes of nitrogen)	=	Nitrogen Outputs – Nitrogen Inputs
NITROGEN BALANCE PER HECTARE OF AGRICULTURAL LAND (kg per hectare)	=	Nitrogen Balance (tonnes of nitrogen) divided by the Total Area of Agricultural Land (hectares)

5. COUNTRY SPECIFIC NOTES

37. Detailed country notes are as follows.

Austria

Seeds and planting materials

- Coefficients in this group are the same as those given to convert crop and forage production into nutrient uptake and composition, because the Austrian coefficients do not include crop residues.

Belgium

Livestock

- EUROSTAT data refer to December survey.

Czech Republic

- Data for 1985-92 refer to the Czech part of the former Czechoslovakia.

Fertilisers

- There are no systematic data, but information reveals that in 40% of farms the slurry (especially pig slurry) is poor quality (2-3% dry matter) and there is storage capacity only for 2-3 months. In many large farms they have "cleaning" stations, where the slurry, sometimes together with municipal or industrial liquid waste, is processed. The solid produce of "cleaning" is returned to the soil, see F121: sewage sludge.

Livestock

- Census data refer to 1 January until 1992 and 1 March since 1993
- Nitrogen content coefficient represents the whole amount of N in excrement, i.e. faeces and urea.

Withdrawals

- Destruction and Evaporation of Manure: N losses from manure are calculated as 30% of total N content in manure. The ratio is derived as follows:

  Most N loss takes place during storage of farmyard manure (FM) and mainly when transferred from farm storage to field storage. Dungwater outlet (DW) (i.e. N leaching out) is another cause of N loss during storage (this also applies to K and P losses as well).

  Average N loss of 45.6% for slurry (representing 78% of total N in cattle excretion) and that of 24.1% for combination FM+DW (22%) derives average N loss for cattle of 40.9% (= 45.6%*0.78 + 24.1%*0.22). With the 1997 shares in total livestock N excretion (cattle: 61.3%, pigs: 24%, poultry: 13.1%, and other: 1.6%) and with the average N loss ratios (cattle: 40.9%, pigs: 24.1%, poultry: 30%, other: 40%), the weighted average N losses (practice) 35% is obtained (= 61.3%*0.409 + 24%*0.241 + 13.1%*0.30 + 1.6%*0.40). By applying this result to the “norm” data, the norm average N losses of 30% is derived, which is used in the nitrogen balance calculation.

Harvested crops

- Coefficients to convert yields of “Other Fruit” to nutrient uptake (2.6 kg N/t; 0.42 kg P/t; 3.7 kg K/t) are the weighted average of:

  apples and pears (N:2, P:0.3, K:2.5); peaches (N:3, P:0.7, K:7.5); apricots (N:4, P:0.57, K:5); plums (N:4, P:0.65, K:5.8); and cherries (N:5, P:0.6, K:5). The result might be too high since the calculation does not take into account the nutrients remaining in branches and leaves.

Finland

Livestock

- Cattle: Livestock numbers are from May-June census.
- Pigs: Livestock numbers are from December survey. The classification for the number of pigs changed in January 1995, when Finland entered the EU (previously the numbers were presented by age categories and now they follow weight categories).

Withdrawals

- Destruction and Evaporation of Manure: Data are based on the model developed in the Finnish Environment Agency, where evaporation of manure is estimated as follows:
  - loss at and after spreading: 11% of total N in livestock manure production
  - loss before spreading: 24.1% (= 14.6% during storage + 9.5% during the period of raising livestock)

Germany

- Data for 1985-90 refer to former East Germany and West Germany

Livestock

- Nitrogen content coefficients do not include the amount of evaporation from manure.

Withdrawals

- Destruction and Evaporation of Manure: Evaporation of manure is estimated as follows:
  loss during storage: 10% of total N in livestock manure production
  loss during spreading: 18%

Greece

Forage

- Pasture consumption by livestock: Due to recent large fires, it is estimated that about 60% of production is consumed by livestock, of which almost 60% is consumed by sheep and goats.
- Temporary pasture production: More than two-thirds of pasture is considered to be used as forage from May until about October of each year.

Hungary

- The calculations reveal, there are two periods for the Hungarian N-balances between 1985 and 1995:
  1985-1989: "intensive" period
  1990-1995: "extensive" period

Fertilisers

- Nitrogenous Fertilisers: While there is no fertiliser use in parks and forests, the data may include both N fertiliser use for crop use or non-crop use in private gardens.
- Sewage Sludge: The amount of sewage sludge applied to poplar plantations is not included, with a share of 40% in the broad definition of "agricultural use" according to the survey of Horvárth (1997).
- Urban Compost and Industrial Waste Products: These are not applied to agricultural land in Hungary.

Livestock

- Total numbers of live animals, available by species, refer to data collected at December 31 each year, including the livestock in co-operatives, state farms and in the private sector. More detailed data are available only for some years, and the classification system may differ over time. Usually 40% of Total Cattle are Dairy Cows and 8% of Total Pigs are Sows.
- Nitrogen content coefficients do not include the amount of evaporation from manure.

Withdrawals

- Destruction and Evaporation of Manure: Data refer to the N as evaporated ammonia and other N loss from stored manure. According to Hungarian research, about 22-28% of N in manure is lost partly (10-15%) because of evaporation, partly because of processing as industrial waste.
- Processed as industrial waste: Data refer to the amount of livestock manure which was not used either in agriculture, or for other purposes.
- Exported and imported organic fertilisers: The amounts are so small that they were considered as nil.

Harvested crops and Forage

- The weather has a strong influence on yields, i.e. there are dry years regularly. For those years the nutrient coefficients of crops are increased by 20%.
- Forage: Fresh weight is used for Fodder beet, Silage maize, and Other green fodder; and dry weight for Clover, Alfalfa, Other harvested fodder crops, and Permanent pasture production.
- Pasture: Production data are used instead of consumption data because the majority of livestock are fed in stalls and not grazed in Hungary.

Seeds and planting materials

- The figures are between 0.2 and 0.5 thousands tonnes and are considered as negligible.

Biological nitrogen fixation

- Coefficients are low reflecting low yields, dry climate and N fertiliser application, which is not advantageous for biological N fixation. Therefore, there is no Biological Nitrogen Fixation by free living organism.

Iceland

Fertilisers

- Nitrogenous Fertilisers: The nitrogen amounts in 1991-95 are estimated from the total nitrogen amounts in 1991-95 (including the nitrogen fertilisers for non-agricultural use) and the average share of horticulture and farming in 1985-90.

Livestock

- Pigs: Since the only available information is the total number of pigs (slaughtering records obtained from Farmers Associations), the disaggregation is derived as follows: Piglets<20kgs is estimated as 50% of total pigs; piglets between 20-50kgs as 30%; and Fattening Pigs>50kgs as 20%. Only the aggregation of sows and boars is available in 1985-91, so the number of sows is estimated as 90% of the total and that of boars as 10%.
- Poultry: The number of broilers was only recorded in 1986-91. It is estimated by using the 1990-91 average ratio of broilers/layers for 1992 and later, and 1986 average ratio for 1985. Other chickens counted separately in 1992-95 refers to the breeding stock for broilers and layers.

Harvested crops

- Barley: Total area of barley is estimated from seed imports and seeding rates.

Forage

- Other Green Fodder: Green fodder area 1988-95 is estimated from the amount of seed imported and seeding rates. The total yield is estimated from the area, assuming 5 tonnes dry matter per hectare and 20% dry matter in the green fodder.

Ireland

Livestock

- Sheep and Lambs: Lambs are not included as the nutrient quantities given cover both ewes and lambs.
- Chickens: There are no data which show layers separately, but the nutrient content of the manure produced per bird for both layers and broilers is very close.

Withdrawals

- Withdrawals for other uses/imports/exports of organic fertilisers are negligible and are not recorded.

Japan

Fertilisers

- Inorganic fertiliser: Consumption is calculated from national chemical fertiliser production, imports, exports and stock changes.
- Organic fertiliser: Organic fertiliser consumption is calculated as the sum of domestic production and imports, which are reported to MAFF under the Fertiliser Control Law. The data covers rapeseed meal, steamed bone meal, etc., while manure is not included. Exports and changes in stock are negligible and not taken into account in the calculation.

Harvested crops and Forage

- The coefficients of nutrient content in harvested crops and forages are estimated from the results of work in national and regional research stations.

Atmospheric deposition

- The coefficient of atmospheric deposition, 7.36 kg/ha/year, is obtained from the average of the results from experiments at 63 national or regional experimental stations.

Biological nitrogen fixation

- The coefficient of biological nitrogen fixation by legume crops is taken from the study by Kondo and Yoneyama (1990) of nitrogen fixation by several legume crops.

Land use

- Agricultural land use area, which is taken from the official MAFF statistics, does not include the area of grazing forests (forests used by livestock) and pasture fields.

Korea

Withdrawals

- Korea does not import or export organic fertilisers.

Luxembourg

- Luxembourg is not included in the database.

New Zealand

Forage

- Pasture consumption is calculated from estimated yield. The least productive unimproved pastures (tussock grasslands / rangelands) yield 2.5 tonnes dry matter per hectare per year, and the most productive pastures yield over 16 tonnes. A weighted average of 9 tonnes per hectare per year is provided as a best estimate on the basis of MAF officials' experience and scientific advice.

Norway

Fertilisers

- Figures are based on sales of commercial fertilisers and are adjusted for sales to non-agricultural sectors (estimated at 5% of total sales).

Livestock

- The coefficients for livestock manure production represent the amount of nitrogen produced per head directly from the animals.

Withdrawals

- Destruction and evaporation of manure: It refers to the evaporation from livestock manure and commercial fertilisers in terms of nitrogen. The evaporation from rough grazing is excluded.

Harvested crops

- Fruit, Vegetables: Vegetables production comprise main crops grown both on field and in greenhouses. Before 1989, fruit and vegetables production included production in kitchen gardens, but as from 1990, the statistics are limited to production on horticultural holdings. It should be noted that production of berries and fruit in kitchen gardens represent a major part of the total berries and fruit production in Norway.

Forage

- The production and the nitrogen content coefficients refer to dry weight.

Seeds and planting materials

- Seeds of cereals and potatoes are estimated based on the crop area multiplied by average seeding rate, as follows: Wheat: 0.21 t/ha; Rye: 0.20 t/ha; Barley: 0.20 t/ha; Oats: 0.21 t/ha; Potatoes: 2.20 t/ha.

Biological nitrogen fixation

- The area of leguminous crops is marginal and is not reported in surveys.

Poland

Livestock

- Livestock numbers are from June census.

Slovakia

- Slovakia is not included in the database.

Switzerland

Livestock

- Nitrogen content coefficients include the evaporation from manure.

Harvested crops

- Total Ornamental Crops: production of flowers and ornamental plants is not included in the calculation.

Forage

- Data and coefficients for forage crops and pasture refer to fresh matter.

Seeds and planting materials

- Total Seeds and Planting Materials: production of seeds is included in the crop harvest quantities.

Biological nitrogen fixation

- Clover: The area of clover is estimated from all grassland area (including summer mountain pasture), based on the table “Fläche und Erträge von Wiesland 1996”.

United Kingdom

Livestock

- Pigs: Coefficients for pigs reflect the nitrogen content of excretal output prior to spreading on land.

Withdrawals

- Destruction and Evaporation of Manure: Destruction and evaporation of manure represents 19% of total manure. This percentage is an OECD estimate based on Lord and Anthony (1996). The estimate assumes 19 % of total manure evaporation from storage stables but not ammonia losses from spreading fertilisers or manure on fields.

- 335 kt (fresh weight) of broiler litter is burned for fuel. This is based on the capacity of the two power plants currently in operation, minus two weeks down-time a year. No plants were operating before 1992.

Forage

- Pasture production, which is used for the estimation of pasture consumption, does not include rough grazing, as it is considered negligible.

Nitrogen balance

- The final calculation of N in kg/ha includes rough grazing in the total agricultural area.

United States

Livestock

- Pigs: Data refer to 1 June.