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Direct and indirect data needs linked to the farms for agri-environmental indicators

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Direct and indirect data needs linked to the farms for agri-environmental indicators

This document is the result of the DireDate project's task 2. DireDate stands for 'Direct and indirect data needs linked to the farms for agri-environmental indicators'. The DireDate project is a study financed by Eurostat, European Commission, and undertaken by a consortium led by ALTERRA (NL) (Service Contract 40701.2009.001-2009.354).

The general objective of DireDate is “to create a framework for setting up a sustainable system for collecting a set of data from farmers and other sources that will serve primarily European and national statisticians for creating the agreed 28 agri-environmental indicators (AEIs) and thus serve policy makers, but as well agricultural and environmental researchers, observers of climate change and other environmental issues linked to agriculture”.

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1 Executive Summary

1.1 Introduction

From the end of the 1980s, an increasing number of agri-environmental policy measures have been implemented in the EU. These agri-environmental Strategies, Directives and Regulations often address specific agri-environmental aspects, i.e. specific components of the biosphere (air, surface waters, groundwater, natural environments), specific substances (greenhouse gas emissions, ammonia, nitrate, pesticides) and specific themes (biodiversity, rural development, renewable energy, etc.). These agri-environmental policies often have their own implementation, evaluation and reporting procedures. Member States are obliged to comply with all approved Strategies, Directives and Regulations, and have to report on the progress made with the implementation of these policy measures on a regular basis. Recently, a process has started for streamlining the reporting needs for the various policy measures, but the benefits of this process have not been cashed yet.

1.2 Aims

The overall aim of this task was to analyse the reporting needs of other EU policies that relate to Agri-Environment Indicators (AEI(s)) and require the collection of related data.

There are a range of Agri-Environment related policies operating within the EU. These policies collect data that may complement the needs of the AEIs, or conversely may benefit from data collection strategies developed to meet the needs of the AEIs. This task provides information that will help to harmonise these strategies, identify overlaps, useful synergies and any potential conflicts in AEI and related data collection.

1.3 Methods

Policies that are covered by the task are:

- United Nations Framework Convention on Climate Change (UNFCCC)
  - Land-use, Land-use Change and Forestry (LULUCF) (UNFCCC sector)
- Rural Development Policy (RDP)
- Water Framework Directive (WFD)
- Nitrates Directive (ND)
- National Emissions Ceiling Directive (NECD)
- Framework Directive on the Sustainable Use of Pesticides (FDSUP)
- Birds & Habitat Directive (BHD)
- EU Strategy for Sustainable Development (EU SDS)

The needs of each policy were first reviewed with respect to the data and reporting requirements. This was done through extensive literature review and consultation with experts within the project team and the wider steering group. The availability and quality of the data collected to date for each policy at a Member State level were then investigated, and case studies presented for a small number of individual Member States for which more detailed information was available. Alternative data sources to those that were routinely used to meet the needs of the policy were considered, as was the sustainability of data delivery and any developments and progress in data collection. Finally, the potential synergies between the data requirements of the policies and those of the AEIs were identified and summarised.

1.4 Results

The results of the policy reviews with respect to data requirements are summarised for each policy below, along with a short conclusion regarding the overall availability and quality of the data collected for each policy.

1.4.1 UNFCCC

The United Nations Framework Convention on Climate Change is an international treaty to which most of the countries of the world signed up in 1992. An addition to the treaty, the Kyoto Protocol, entered into force in 2005 and commits member Parties to stabilise their greenhouse gas concentrations by setting targets for decreases in emissions from 1990 levels by 2012. Parties are required to submit an annual inventory detailing all their national GHG emissions by gas and source sector. For agriculture, this relates to methane (CH_4) and nitrous oxide (N_2O) from various sources (fertilizers, manure management, ruminants, paddy rice production, crop residues, etc.). The data needs for calculating GHG emissions from the agriculture sector of UNFCCC are presented below.

Activity data

- Annual data on livestock populations by national climate region are necessary for the calculation of emissions from enteric fermentation, manure management and agricultural soils. If a tier 1 approach is taken, subdivision should be by broad livestock category. For tier 2, subdivision by representative types for key livestock categories is required.
- Milk production per head per year for dairy cattle is required for calculation of CH_4 emissions from enteric fermentation.
- Manure management data (% of each type) are required annually for the calculation of emissions from manure management.
- Calculation of emissions from rice cultivation requires annual activity data on the total area of irrigated land for rice production.
- Calculation of emissions from soils requires annual activity data on the total nitrogen input to soils by synthetic fertilisers (Kg N/yr). Tier 2 methods require these data by climate zone and soil type. Also requires annual activity data on dry pulses and soybeans produced and dry production of other crops (Kg/yr). Areas of organic soils (histosols) (ha) are also required for calculation of emissions from soils.
- Calculation of emissions from soils, crop residue burning and rice cultivation require activity data on crop production, including crop areas; ratios of residue to crop production; and fraction of residue burned.

Coefficients

- Emission factors for CH_4 from enteric fermentation are required by livestock category. The source and level of detail depends upon the tier level used.
- Nitrogen excretion per head by livestock category is required for estimating N_2O emissions from manure management. Emission factors for CH_4 and N_2O from manure management by livestock category and manure management system are also required.
- Emission factors for CH_4 emissions from rice fields for the various categories of water regimes are required to estimate emissions from rice production.
- Emission factors required for the calculation of direct emissions from soils are; (i) N_2O emitted from various N applications to soils; (ii) N_2O emitted from area of histosols; (iii) N_2O emitted from N deposited by grazing animals. For indirect emissions, factors associated with volatilised and re-deposited N and N loss through leaching/run-off are also necessary.
- For crop residue burning emission calculations, the dry matter; C and N content of the residue are needed.

Overall availability and quality of data

An annual inventory is available for all Member States that are Annex 1 Parties to the Convention. This means that there is no data for Cyprus and limited information for Malta. There is a 1.5 year time lag between the end of the inventory year and the submission of the inventory. There are strict methodological and reporting requirements developed by IPCC covering the majority of key sources and gases, however there are differences in quality of data between Member States due to differences in the Tier level (level of detail) used. This may be a problem that could be addressed using AEI data. If consistently collected at a particular level of detail across MS, inventories would be more comparable.

1.4.2 LULUCF

The Land-use, Land-use Change and Forestry sector of the UNFCCC reports on activities that result in GHG emissions and removals from land (i.e., CO_2). LULUCF activities can be used to offset emissions by removing GHGs from the atmosphere through afforestation, revegetation and reforestation. LULUCF should not be considered as separate from the UNFCCC as it is part of the same policy; however it is reviewed separately due to methodological differences and the significance of the sector. The data needs for estimating GHG emissions and removals from the LULUCF sector are presented below.

Activity data

The area of each of the broad land use categories (including cropland and grassland) and the area of land use change from one category to another are required annually for the calculation of CO_2 emissions/ removals from land. These activity data should be subdivided into climate regions and soil types at a minimum.

Coefficients

Coefficients are required to estimate the rates of carbon accumulation and loss for each land use category. Carbon stock changes following land use change are estimated using coefficients. Emission factors are also required for liming.

Overall availability and quality of data

An annual inventory is available for all Member States that are Annex 1 Parties to the Convention. This

means that there is no data for Cyprus and limited information for Malta. There is a 1.5 year time lag between the end of the inventory year and the submission of the inventory. Areas of land remaining the same are available for all submissions, however many Member States do not have estimates for land-use change. Again, there are differences in quality of data between Member States due to differences in the Tier level (level of detail) used. AEI data could potentially improve the quality of the inventories by providing consistently collected information on land-use change.

1.4.3 Rural Development Policy

The Rural Development Programme 2007-2013 provides a menu of measures from which Member States can choose, and for which they receive Community financial support. These measures focus on three core policy objectives corresponding to axes; (Axis 1) improving the competitiveness of agriculture and forestry; (Axis 2) supporting land management and improving the environment and (Axis 3) improving the quality of life and encouraging diversification of economic activities. Different types of indicators are used to monitor progress against targets at regular intervals and to assess the impact of the programme overall. The data needs related to agri-environment are presented below.

Baseline indicators

Baseline indicators are required nationally at the start of the programming period, and should also be monitored and updated throughout the course of the programme. Baseline indicators in the RDP 2007-13 relating to farmer experience and agri-environment are;

- Age structure of farmers
- The share of farmers with practical experience only, basic or full agricultural training
- Land cover (agriculture, forest, natural, artificial)
- UAA in LFA areas
- Areas of extensive agriculture
- Natura 2000 area (total and UAA/ forest under N2K)
- Populations of farmland birds
- High Nature Value farmland areas
- Tree species composition of forested areas
- Protected forest area
- Development of forest area (average annual increase)
- Forest ecosystem health (defoliation classes)
- NVZ areas
- Gross nutrient balances
- Pollution by nitrates and pesticides (annual trends in concentrations)
- Water use (percentage of UAA irrigated)
- Protective forests concerning primarily soil and water
- Areas at risk of soil erosion
- UAA under organic farming
- Production of renewable energy from agriculture & forestry

- UAA devoted to biomass crops
- GHG emissions from agriculture

Output indicators

Output indicators are used to measure activities directly realised within programmes, and are calculated quarterly from scheme monitoring data by measure. Output indicators relating to farmers' experience and Axis 2 are;

Axis 1

- Number of farmers using environmental farm advisory services

Measure 211 – natural handicap payments to farmers in mountain areas

- Mountain areas
- Number of supported holdings in mountain areas
- Supported agricultural land in mountain areas

Measure 212 – Payments to farmers in areas with handicaps, other than mountain areas

- Number of supported holdings in areas with handicaps, other than mountain areas
- Agricultural land area supported in areas with handicaps, other than mountain areas

Measure 213 – Natura 2000 payments and payments linked to Directive 2000/60/EC

- Number of supported holdings in Natura 2000 areas/under WFD
- Supported agricultural land under Natura 2000/under WFD

Measure 214 – Agri-environment payments

- Number of farm holdings and holdings of other land managers receiving support
- Total area under agri-environmental support
- Physical area under agri-environmental support under this measure
- Total Number of contracts
- Number of actions related to genetic resources

Measure 215 – Animal welfare payments

- Number of farm holdings receiving support
- Number of animal welfare contracts

Measure 216 – Non-productive investments

- Number of farm holdings and holdings of other land managers receiving support

- Total volume of investments

Measure 221 – First afforestation of agricultural land

- Number of beneficiaries receiving afforestation aid
- Number of ha afforested land

Measure 222 – First establishment of agroforestry systems on agricultural land

- Number of beneficiaries
- Number of ha under new agroforestry systems

Measure 223 – First afforestation of non-agricultural land

- Number of beneficiaries receiving afforestation aid
- Number of ha of afforested land

Measure 224 – Natura 2000 payments

- Number of forest holdings receiving aid in Natura 2000 area
- Supported forest land (ha) in Natura 2000 area

Measure 225 – Forest-environment payments

- Number of forest holdings receiving support
- Total forest area under forest environment support
- Physical forest area under forest environment support
- Number of contracts

Measure 226 – Restoring forestry potential and introducing prevention actions

- Number of prevention/restoration actions
- Supported area of damaged forests
- Total volume of investments

Measure 227 – Non-productive investments

- Number of supported forest holders
- Total volume of investments

Result indicators

Result indicators are used to measure the direct and immediate effects of the intervention and are required to be reported annually to the EC. The common result indicators identified by CMEF for Axis 2 are given below.

Area under successful land management contributing to:

- Bio diversity and high nature value farming/forestry
- Water quality
- Mitigating climate change
- Soil quality
- Avoidance of marginalisation and land abandonment

Impact indicators

Impact indicators are used to measure the benefits of the programme beyond the immediate effects on its direct beneficiaries, both at the level of the intervention and more generally in the programme area. They are normally expressed in "net" terms, which means subtracting effects that cannot be attributed to the intervention (e.g. double counting, deadweight), and taking into account indirect effects (displacement and multipliers). Impact indicators are required to be calculated at mid-term and ex-post evaluation. Those relating to Axis 2 are;

- Change in trend of biodiversity decline as measured by farmland bird species population
- Changes in high nature value areas
- Changes in gross nutrient balance
- Increase in production of renewable energy

Overall availability and quality of data

The lack of data for baseline indicators of the RDP is a common problem, limiting time-series and impact analyses. The requirements in terms of indicators are well defined, but the methods of calculation are left to the Member State. This means that the quality of data varies hugely across Member States, making comparability and aggregation at EU level difficult or impossible. In addition, the requirements and objectives differ between programming periods, so there is a lack of a consistent time-series. As there are so many requirements in common, well-defined AEIs would much improve evaluation of the RDP by helping to fill the data gaps and improving quality and consistency.

1.4.4 Water Framework Directive

The new EU Water Framework Directive was adopted in 2000, some of the aims of which are to (i) increase the scope of the previously fragmented water policy to cover all surface and ground waters in the EU; (ii) achieve 'good status' for all waters by a set deadline; (iii) base water management on river basins and (iv) use a 'combined approach' of emission limit values and quality standards. A 'river basin management plan' is required to be established and updated every six years, setting out the measurable objectives and how these are to be achieved. The data needs of the WFD are presented below.

Characterisation of water bodies

Surface water bodies should be categorised by type; ecoregion; altitude; catchment area and geology and maps of the geographical locations of the types submitted to the EC. Locations and boundaries of groundwaters should be defined and characterised by type of strata and pressures.

Pressures and impacts assessment

Data required for pressures and impacts assessment include, for each water body, significant point source pollution; significant diffuse source pollution; significant water abstractions; significant water flow

regulation; significant morphological alterations; and land use patterns. Further data required for water bodies that are considered at risk following characterisation include locations of abstraction and discharge points; rates of abstraction and discharge; chemical composition of discharges; land-use in the catchment.

Special protection

Member States are required to keep a register and maps of all water bodies that have been designated as requiring special protection. These include (i) those used for abstraction of drinking water; (ii) those designated for the protection of economically significant aquatic species; (iii) those designated as recreational waters; (iv) nutrient sensitive areas; (v) areas designated for the protection of habitats or species sensitive to water quality.

Monitoring

Monitoring networks (surveillance and operational) should be set up following pressures and impacts assessment with the purpose of classifying the ecological status of each water body.

For surface waters, this should cover biological quality elements (e.g. phytoplankton); hydromorphological quality elements (e.g. hydrological regime); chemical quality elements (e.g. nutrient conditions) and physico-chemical quality elements (e.g. transparency). Pollution levels should also be monitored. Under surveillance monitoring, all quality elements and pollutants should be monitored for at least one year during the six-year River Basin Management Plan. Monitoring frequency for operational monitoring is chosen by the Member State.

For groundwaters, monitoring should cover the chemical and quantitative status. This is measured by concentrations of pollutants, conductivity measurements and groundwater level. Surveillance monitoring should be carried out once every six years as a minimum; and operational monitoring at least once a year.

Overall availability and quality of data

The completeness of reporting under Article 5 of the WFD (pressures and impacts assessment) varies between Member States. Results are inconclusive for 30% of surface water bodies and 45% of groundwater bodies. Monitoring effort varies considerably across Member States, but most are monitoring more frequently than the minimum 6-year cycle. There is generally a lack of information on the levels of confidence and precision in the monitoring results. Some AEIs would help to identify pollution pressures in catchments and RBDs and hence help the classification of water bodies according to risk.

1.4.5 Nitrates Directive

The Nitrates Directive was adopted in 1991 to protect waters against agriculturally derived nitrogen pollution. Member States are required to (i) establish monitoring networks in order to identify polluted or threatened waters; (ii) establish a voluntary code of good agricultural practice; (iii) allocate all land that drains into polluted waters as nitrate vulnerable zones (NVZ); (iv) establish mandatory action programmes within NVZ and (v) review the action programmes and NVZ boundaries every four years. The data needs for reporting about the progress of the implementation of the Nitrates Directive (ND) are presented below.

Spatial data

Maps must be provided for identified polluted waters and the locations of the designated vulnerable zones, taking into account guidelines for the presentation of the spatial data.

Monitoring data

Suitable monitoring programmes must be created and implemented at least every four years to measure nitrate concentrations at ground and surface water sites. Information on the trophic status of surface waters should also be gathered.

Records of fertiliser and manure applications are required to keep within the restrictions. Member States are also required to explain the physical and environmental characteristics of the waters and land, their understanding of the behaviour of nitrogen compounds in both water and soils, and of the impact of actions taken. The Directive does not set out specific details of these data requirements but information on livestock numbers, soil crop cover in winter, land use and land management, soil characteristics and fertiliser consumption are all relevant.

Action programmes

In order to assess the impact of the action programme measures Member States will need to provide information on the following elements;

- Total number of farmers, and farmers with livestock
- Total land (km2)
- Agricultural land (km2)
- Agricultural land available for application of manure (km2)
- Permanent pasture
- Permanent crops
- Annual contribution of mineral and organic forms of N (Kg N/ha)
- Annual use of mineral and organic N (kilotonnes)
- Nitrogen discharge into the environment from agriculture, urban wastewater and industry.

Overall availability and quality of data

Reports covering 2004-07 have been submitted for all 27 Member States. Information on the annual average N concentration was provided by all. The data requirements for the physical and environmental characteristics of waters and land are not well specified, so data vary between Member States. Differences in monitoring effort and method of assessment between Member States make cross-country comparisons difficult. More standardisation of data requirements through the use of AEIs may improve the quality and consistency of reported data.

1.4.6 National Emissions Ceiling Directive

The aim of the National Emissions Ceiling Directive is to limit emissions of acidifying and eutrophhying pollutants and ozone precursors. Under the original Directive (2001/81/EC), national emission ceilings for ammonia (NH_3), sulphur dioxide (SO_2), oxides of nitrogen (NO_X) and volatile organic compounds (VOCs), were established for each member state, to be met by 2010. Proposals for the revision of the NECD, anticipated in 2009, as part of the Thematic Strategy on Air Pollution, are still in preparation. The data needs for calculating emissions of these gases from the agriculture sector for the National Emissions Ceiling Directive (NECD) are presented below.

Activity data

- Estimation of emissions arising from agricultural crops or their supporting soils for cultures with fertilizers require annual activity data on the consumption of major N-fertilizer types for arable and grassland; the amounts of crop residue returned to the soil by crop type; grazing livestock numbers by type and the area of organic soils (histosols) under cultivation.
- For cultures without soils, activity data include the area of legumes cultivated by crop type; the area of unfertilized grassland grazed by livestock; and atmospheric deposition to soils.
- For estimation of emissions from field burning of agricultural vegetation wastes, activity data on the amount (dry weight) of waste or crop residue combusted are required.
- For estimation of emissions from manure management regarding organic and nitrogen compounds, required activity data include animal numbers in relevant sub-categories; animal performance and feed; and the frequency distribution of the respective manure management systems.

Coefficients

- N concentrations of crop residues returned to the soil by crop type.
- N deposited in excreta by animals whilst grazing by livestock type.
- Dry weight of burned residue by crop type.
- Excretion rate of volatile solids as a function of animal performance and feed.

Overall availability and quality of data

In the most recent reporting round, all 27 Member States provided the mandatory information on final emissions. There are no gap-filling procedures in place; therefore the compilation of EU-27 trends is not possible at present. Methodologies and tier level vary between Member States, making cross-country comparisons difficult. Inventories could benefit from a consistent standard of activity data and coefficients provided by the AEIs to enable comparisons to be made.

1.4.7 Framework Directive on the Sustainable Use of Pesticides

The Sustainable Use Directive (2009/128/EC) was published in November 2009 and contains requirements on training provision of pesticide advisors and spray operators, and the testing of spray equipment. The Commission proposed a regulation concerning statistics on plant protection products and this was adopted as new Regulation (EC) No 1185/2009 of the European Parliament and of the Council concerning statistics on pesticides which was published on 10 December 2009 and contains details of the requirements for pesticide statistic provision by all Member States. The data needs for reporting about the progress of the implementation of the Framework Directive on the Sustainable Use of Pesticides (FDSUP) is presented below.

Sales data

The statistics regulation require that the nationally sold annual weight (kg) of all active substances identified in Annex III of the regulation be collected under certain major groups and categories of products including fungicides and bactericides; herbicides, haulm destructors and moss killers; insecticides and acaricides; molluscicides; plant growth regulators; other plant protection products.

Usage data

Usage data requirements are for representative crops (selected by Member State) within a one-year reference period within a 5-year reporting period on a regional basis. Key pieces of data required are the

quantity (kg) of each substance used on each crop, and the area (ha) treated with each substance.

Risk indicators

Member States are required to adopt harmonized risk indicators for pesticides, although these are still under development. Usage data required includes pesticide consumption; pesticide characteristics; soil characteristics; application rates; application timings; mitigation measures.

Overall availability and quality of data

There were no mandatory requirements for the provision of pesticide statistics to the EU up to December 2009. Several Member States have collected data on a regular basis, but there was no common methodology. The aim of the statistics regulation is to harmonise the provision of data on pesticide use across the EU. Risk indicators require further development and standardisation, which could by done in synergy with AEI development.

1.4.8 Birds and Habitats Directives

The Birds Directive was adopted by all EU Member States in 1979, with the aim of providing international cooperation for the protection of birds in Europe. The Directive sets a number of objectives for EU Member States, with the legislation and implementation determined by each individual territory. Endangered and migratory wild birds are listed on Annex I of the Directive and are protected by a network of Special Protection Areas (SPAs).

The Habitats Directive was adopted by all EU Member States in 1992 to protect natural habitats and wild species in Europe. The 216 habitats listed in Annex I and 1 182 species listed in Annexes II, IV and V of the Directive are protected by a number of Special Areas of Conservation (SACs).

The areas designated as SPAs by the Birds Directive, and as SACs by the Habitats Directive, are collectively known as Natura 2000 sites. The objective of Natura 2000 is to create and maintain networks of protected areas throughout all the Member States of the EU. The data needs for reporting about the progress of the implementation of the Birds and Habitats Directives are presented below.

Site designation

Data required for designating Natura 2000 sites include the following;

- Site identification data
- Location data including coordinates, area, altitude, NUTS and bio-geographical region
- Habitat and species present on the site including details of cover/ population.
- An assessment for each habitat and species
- Description of site characteristics
- Protection status and relationship with Corine biotype sites
- Impacts and management measures present at site

Birds Directive

Data required to be entered in a questionnaire at national level once every three years include the following;

- List of species from each Annexe of the Directive present in the MS territory, with numbers if possible
- Measures taken to protect the habitats and bird species within SPAs

Habitats Directive

Data required to be submitted in reports at national and biogeographical region level every six years include the following;

- Number of SACs and their total surface area
- Maps outlining the distribution of each habitat and species in the Annexes that are present in the MS territory at 10 x 10 km resolution ideally.
- Surface area of the range within each biogeographical region for habitats
- Quality of data concerning range
- Range trend and reasons for trend
- Population estimate within each biogeographical region for species
- Quality of data concerning population estimate
- Population trend and reasons for trend
- Main pressures and threats impacting on the habitat/ species
- Assessment of conservation status for each habitat/ species (favourable, inadequate, bad or unknown)

Overall availability and quality of data

The responses given in mandatory questionnaires are generally brief or incomplete, and data are often collected and presented differently between Member States. There are raw data stored online in a Central Data Repository for individual species and habitats; however most of the data used to assess conservation status was collected for another purpose. An estimate of trend is not made by many Member States. A priority for the Expert Group is to produce data that is more harmonised between Member States, and one of the means of doing this is to provide more clarity for the data requirements. AEIs could potentially help in this process.

1.4.9 Strategy for Sustainable Development

The Renewed EU Strategy for Sustainable Development (EU SDS) was adopted in 2006, with the aim of developing sustainable communities for the efficient use of resources in future generations. One of the core objectives of the EU SDS is to measure the progress made by EU Member States towards sustainable development. This is done by Eurostat, who monitor and report on progress based on a set of Sustainable Development Indicators (SDIs). The data collection requirements for a selection of SDIs that are related to agri-environment are presented below.

- Final energy consumption by sector – calculated as the sum of energy supplied to final users from all sources, including agriculture.
- Area under agri-environmental commitment – calculated from the percentage of the UAA that is enrolled in agri-environmental measures.
- Area under organic faming – calculated as the share of the UAA that has adopted organic farming practices.

- Livestock density index – calculated as the number of livestock units per hectare of UAA.
- Greenhouse gas emissions by sector, including the agricultural sector.
- Share of renewables in gross inland energy consumption, which is the ratio between the energy produced from renewable energy (split by source, including biomass and waste) and the gross inland energy consumption for a given calendar year.
- Common bird index, which provides information on the abundance and diversity of a selection of 135 common European bird species, including a subset of 36 farmland birds.
- Sufficiency of sites designated under the EU Habitats Directive, which measures the extent to which Sites of Community Importance (SCIs) proposed by Member States for designation, cover the terrestrial species and habitats listed in Annexes of the Directive.
- Surface and groundwater abstraction as a share of available resources. Annual total water abstraction is calculated as a percentage of the total resources available for abstraction over a long-term period.
- Biochemical oxygen demand – defined as the mean annual amount of oxygen required to decompose organic matter over a five day period and in the dark.
- Built-up areas – measured by the change in land cover from natural and semi-natural to built-up land.
- Percentage of total land area at risk of soil erosion – currently under development.

Overall availability and quality of data

Data for most SDIs is available annually, and data for others is only partially available. The SDI 'Area under AE commitment' was removed from the set in the 2009 report due to lack of sufficient accuracy. The SDI 'Area at risk of soil erosion' is currently under development. The EU-SDS would benefit from harmonised data collection with AEIs, although there are some differences in indicator definitions or measurements.

1.5 Conclusions

A large amount of data are required to be collected for the reviewed policies, and through comparison with data requirements of the AEIs, it can be ascertained that the majority of parameters required for calculation of AEIs are also required, at least in part, for agri-environmental policy. There are a number of AEIs for which data requirements have the most in common with policy data requirements and that have parameters represented across multiple policies.

The data requirements of policy that have similarities to data requirements of the AEIs can be summarised by category of AEI data (see Task 4&5) as follows:

1.5.1 Inputs

The inputs category includes pollution from fertilisers and pesticides; water abstraction; and energy use. Most of the input parameters that are also needed for policy are represented under the policies that require the calculation of pollution levels from agriculture – namely UNFCCC; WFD; Nitrates Directive; National Emissions Ceiling Directive; and Framework Directive on the Sustainable Use of Pesticides. This group of parameters is also represented under RDP and EU-SDS, however these data are usually collected from other existing sources.

1.5.2 Land use/ Nature/ Climate

Parameters on land use, nature and climate are well represented under RDP; LULUCF; Birds & Habitat Directives; and EU-SDS. Crop area by crop type and climate feature across a number of policies.

1.5.3 Crop production

The crop production parameters that are needed for policy are represented under the policies that require calculation of pollution or emissions from crop production: UNFCCC and National Emissions Ceiling Directive. The renewable energy production parameter also features under RDP and EU-SDS.

1.5.4 Livestock

Similarly, livestock parameters are required under policies that calculate pollutants from livestock: UNFCCC; Nitrates Directive and NECD.

1.5.5 Livestock and farm management

The type of manure storage is data commonly collected for policy purposes, specifically UNFCCC; Nitrates Directive and NECD. A soil tillage parameter is also required for the latter two.

1.5.6 Soil and water quality

Soil data is fairly sparsely collected for policy, the most significant being under the Nitrates Directive. Soil parameters are well represented under EU-SDS, but do not necessarily exactly match the AEI parameters. Water quality is the ultimate reporting requirement of WFD and Nitrates Directive. These data are collected from other sources for RDP and SDI as indicators.

It is clear that there are a large number of parameters that are required by more than one policy, outweighing those that are required by one policy only or not at all. This balance encouragingly points towards an opportunity to harmonise data collection and identifies synergies between policies across the EU.

2 General Introduction and Background

The overall aim of this task is to analyse the reporting needs of other EU policies that relate to Agri-Environment Indicators (AEI(s)) and require the collection of related data.

There are a range of Agri-Environment related policies operating within the EU. These policies collect data that may complement the needs of the AEIs, or conversely may benefit from data collection strategies developed to meet the needs of the AEIs. This task provides information that will help to harmonise these strategies, identify overlaps, useful synergies and any potential conflicts in AEI and related data collection.

EU policies that are covered by the task are:

- United Nations Framework Convention on Climate Change (UNFCCC)
  - Land-use, Land-use Change and Forestry (LULUCF) (UNFCCC sector)
- Rural Development Policy (RDP)
- Water Framework Directive (WFD)
- Nitrates Directive (ND)
- National Emissions Ceiling Directive (NECD)
- Framework Directive on the Sustainable Use of Pesticides (FDSUP)
- Birds & Habitat Directive (BHD)
- EU Strategy for Sustainable Development (EU SDS)

An introduction to each policy is initially presented, with the main body of the report broken into sections, each one analysing an individual policy. The sections follow a common structure to aid comparison, covering:

- The Policy needs
  - Data requirements
  - Reporting requirements
- The results of the data review
  - Availability and quality of data at a Member State level
  - Member State case studies
  - Sustainability of data delivery
  - Alternative data sources
  - Developments and progress
  - Potential uses of data to meet requirements of AEIs.

2.1 United Nations Framework Convention on Climate Change (UNFCCC)

The United Nations Framework Convention on Climate Change[1] (UNFCCC) is an international treaty to which most of the countries of the world signed up in 1992. The Convention acknowledged that climate change and its adverse effects are of common concern to humankind, and that measures must be taken to reduce the contribution of human activities to the increasing concentration of greenhouse gases (GHGs) in the atmosphere. It noted that developed countries contribute the largest share of global emissions of GHGs, and therefore encouraged these countries to stabilise their GHG emissions and provided guidance as to how this should be done.

An addition to the treaty, known as the Kyoto Protocol[2], was approved in 1997 and entered into force in 2005. The main difference between the Protocol and the Convention is that whilst the Convention encouraged a stabilisation in atmospheric GHG concentrations, the Protocol commits member Parties to do so. This was achieved by setting targets for 37 industrialised countries and the European community (Annex 1 Parties) of a 5 % decrease in national GHG emissions from 1990 levels by 2012. This commitment was placed on industrialised countries only in recognition of the fact that such countries are the primary contributors to the rise in GHG concentrations. Member Parties are required to submit an annual emission inventory and national reports at regular intervals to satisfy the reporting requirements of the Protocol. A compliance system is in place to ensure that Parties are meeting their commitments.

The UNFCCC and the Kyoto Protocol are seen as an important first step towards a global emission reduction regime that will stabilize GHG emissions. By the end of the first commitment period of the Kyoto Protocol in 2012, a new international framework needs to have been negotiated and ratified that can deliver the stringent emission reductions the Intergovernmental Panel on Climate Change (IPCC) has clearly indicated are needed.

2.2 Land-use, Land-use Change and Forestry (LULUCF)

The Land-use, Land-use Change and Forestry (LULUCF) sector of the UNFCCC reports on activities that result in GHG emissions and removals from land. Under Articles 3.3 and 3.4 of the Kyoto Protocol[3], LULUCF activities are included in the Annex I Parties GHG commitment targets. The principles governing LULUCF activities were agreed during the Seventh Conference of Parties (COP 7, Marrakesh Accords) in 2001, and adopted in decision 11/CP.7[4]. These principles state that activities in the LULUCF sector should not undermine the environmental integrity of the Protocol, require the use of consistent and scientific methodologies, and should focus on the importance of conserving biodiversity.

LULUCF activities can be used to offset emissions by removing GHGs from the atmosphere through afforestation (conversion of existing non-forested land), revegetation and reforestation. Emissions may also be reduced by decreasing the rate of deforestation, and improving the management of forests, croplands and grazing land. These LULUCF activities generate removal units (RMUs), which are verified by expert review teams under the Protocol's reporting and review procedure. The RMUs can then be used

[1] Available online at http://unfccc.int/resource/docs/convkp/conveng.pdf

[2] Available online at http://unfccc.int/resource/docs/convkp/kpeng.pdf

[3] United Nations. (1998) Kyoto Protocol to the United Nations Framework Convention on Climate Change. Available online at http://unfccc.int/kyoto_protocol/items/2830.php

[4] United Nations. (2002) Report of the Conference of the Parties on Its Seventh Session, Held at Marrakesh From 29 October to 10 November 2001. Available online at http://unfccc.int/documentation/decisions/items/3597.php

to reduce the Parties' emission targets for that commitment period. Naturally-occurring GHG removals cannot be included in the targets, and any re-release of previously removed GHGs need to be accounted for (e.g. from forest fires). Land subjected to LULUCF activities that result in vegetation loss will instead act as sources of GHGs. Emissions caused by these activities will result in RMUs being cancelled, or the total GHG emissions an Annex I Party allowed to release being reduced for that commitment period.

LULUCF should not be considered as separate from the UNFCCC as it is part of the same policy, however it is presented in this report under a separate section due to methodological differences and the significance of the sector.

2.3 Rural Development Policy (RDP)

Rural development programmes have evolved alongside policy developments, moving away from a sector-based approach to a territory-based approach. The focus of rural development policy has now shifted away from pure sector support for agriculture towards an integrated support for agriculture, environment and society which addresses competitiveness, environmental concerns and the wider needs of rural areas at the same time. Considerable simplification has been introduced in the RDP for period 2007-2013 compared to previous programming periods. In terms of financing, rural development policy within EU-27 is now funded through single funding and programming instrument, i.e. European Agricultural Fund for Rural Development (EAFRD). The RDP 2007-2013 [Council Regulation (EC) No. 1698/2005] continues to provide a menu of measures from which Member States can choose, and for which they receive Community financial support in the context of integrated rural development programmes. Changes have been made to the way these programs are developed by fostering the strategic content and the sustainable development, focusing on three core policy objectives:

1. Improving the competitiveness of agriculture and forestry,
2. Supporting land management and improving the environment, and
3. Improving the quality of life and encouraging diversification of economic activities

A thematic axis corresponds to each core objective in the rural development programmes. The three thematic axes are complemented by a LEADER approach (LEADER axis). These axes are:

1. Axis 1: Improving competitiveness of farming and forestry;
2. Axis 2: Environment and land management;
3. Axis 3: Improving quality of life and diversification; and
4. Axis 4: Mainstreaming the LEADER approach

A minimum funding for each axis is required to ensure some overall balance in the programme (at least 10 % of the total EAFRD contribution should be allocated to Axis 1, at least 25 % to Axis 2, at least 10 % to Axis 3 and 5 % for the Leader Axis – which will be 2.5 % in the new Member States[5]). In terms of the actual financial allocation between axes, Axis 2 has the largest share of the budget. A recent

[5] See Article 17 of Council Regulation (EC) No 1698/2005 of 20 September 2005, available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2005R1698:20080101:EN:PDF.

statistical and economic information report[6] on Rural Development in the EU showed that at EU-27 level, Axis 1 (including Leader actions contributing to this objective) represents 34 % of the total EAFRD contribution, Axis 2 receives 44.1 % and Axis 3, 17.6 %. The distribution of RDP budget highlights the need to further strengthen the monitoring system of environmental impacts, which are the main objectives of Axis 2 funding.

2.4 Water Framework Directive (WFD)

The new EU Water Framework Directive (WFD)[7] was adopted in 2000, following agreement on the need for a single piece of framework legislation to address the important issue of water pollution. Some of the main aims of WFD are to (i) increase the scope of the previously fragmented water policy to cover all surface waters and groundwaters in the EU; (ii) achieve 'good status' for all waters by a set deadline; (iii) base water management on river basins and (iv) use a 'combined approach' of emission limit values and quality standards.

Management at the river basin level (a natural geographical and hydrological unit) rather than by administrative region is the best model for a single system of water management, but can be challenging when river basins span country boundaries, and not every MS has currently adopted this approach. A 'river basin management plan' is required to be established and updated every six years under WFD, providing the context for the coordination efforts required between MS. The plan sets out the measurable objectives for the river basin and how these are to be achieved within the timescale.

The key objectives for assessing water quality and achieving good status are general protection of the aquatic ecology; specific protection of unique and valuable habitats; protection of drinking water resources and protection of bathing water. These objectives must be integrated for each river basin. Derogations can be provided for certain uses (e.g. flood protection) that adversely affect the water status, but are considered essential.

The combined approach has been developed to address the historical limitations of either applying controls at source, or setting quality standards for the receiving environment. Source controls can allow a cumulative pollution load that puts considerable pressure on the environment when such sources are concentrated, whereas quality standards can fail to correctly apportion the source contribution. The WFD incorporates both. For sources, it requires that all existing technology-driven source-based controls be implemented as a first step; and also sets out a framework for developing such controls further using a list of priority substances. For effects, it coordinates all environmental objectives relating to water quality in existing legislation, and provides a new overall objective of good status. Where source-based controls are not sufficient to achieve good status, additional ones must be implemented.

The WFD establishes an innovative approach to water management, including public participation and integration of economic approaches. The directive requires coordination of Member States' objective-setting and activities within international river basin districts, and subsequently a more cohesive approach to improving water quality across the European Union.

[6] Rural Development in the European Union - Statistical and Economic Information - Report 2009.

[7] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. OJ L327 of 22.12.2000, as amended

2.5 Nitrates Directive

The Nitrates Directive (Council Directive 91/676/EEC)[8] was adopted on the 12th December 1991 to protect waters against agriculturally derived nitrate pollution. It was established by the European Commission because excessive use of livestock manures and mineral fertilisers were recognised to have negative impacts on water quality. The consequent effects on human health and the natural environment meant that measures had to be taken to limit the contribution of farming practices to water pollution. It was also identified that an EU wide approach was necessary because water issues cross national boundaries. The Nitrates Directive, along with its sister legislation the Urban Waste Water Treatment Directive, was set up to safeguard water resources therefore ensuring clean water for human consumption and protection of aquatic ecosystems. Since its inception, new Member States have implemented the Directive and in the most recent reporting period (2004-2007) all of the EU-27 submitted reports. Norway, a non-Member State has also carried out obligations under the Nitrates Directive.

The main objectives of the Directive are to reduce water pollution caused or induced by nitrates from agriculture, and to prevent further such pollution. This legislation provides an important policy mechanism for individual countries to mitigate nitrogen pollution. Member States are required to:

1. Establish monitoring networks in order to identify polluted or threatened waters,
2. Establish a voluntary code of good agricultural practice to be adopted by all farmers in the country,
3. Allocate all land that drains into polluted waters as nitrate vulnerable zones (NVZ),
4. Establish mandatory action programmes within NVZ,
5. Review the action programmes and NVZ boundaries every 4 years and make necessary amendments.

In most Member States agriculture is responsible for more than 50 % of total nitrogen discharge to surface waters making it is essential to establish suitable action programmes. The Directive requires Member States to include a series of measures, or codes of good agricultural practice in their action programmes. Practices listed in Annex II include:

- A closed period, whereby application of specific fertilisers to land is prohibited for a given amount of time,
- Minimum manure storage capacity which must be able to last the length of the closed period,
- Limited application of fertilisers to land located near slopes or water courses,
- Land use management plans e.g. crop rotations and soil winter cover to limit leaching,
- Land application practices e.g. rate and uniformity of spreading.

The Directive also sets out specific restrictions on the storage and application of nitrogen compounds. Mineral fertiliser application should be restricted depending on parameters such as soil and climatic conditions. Livestock manure application, including direct inputs from the livestock, must not exceed 170 kg N per ha per year. The Directive allows for derogations regarding this limit providing that the objectives are still met.

[8] Council directive 91/676/EEC. Available at http://ec.europa.eu/environment/water/water-nitrates/index_en.html

2.6 National Emissions Ceiling Directive (NECD)

The aim of the National Emissions Ceiling Directive (NECD) is to limit emissions of acidifying and eutrophying pollutants and ozone precursors, in order to improve the protection in the Community of the environment and human health, against risks of adverse effects from acidification, soil eutrophication and ground-level ozone. Furthermore, longer term objectives are not to exceed critical levels and loads and of effective protection of all people against health risks associated with air pollution.

Under the original Directive (2001/81/EC), national emission ceilings for ammonia (NH_3), sulphur dioxide (SO_2), oxides of nitrogen (NO_X) and volatile organic compounds (VOCs), were established for each member state, to be met by 2010. These limits were subsequently extended to include the new accession states (Table 1). This approach was judged a cost-effective way of meeting interim environmental objectives, whilst allowing MS flexibility in determining how to comply with these objectives.

Proposals for the revision of the NECD, anticipated in 2009, as part of the Thematic Strategy on Air Pollution, are still in preparation; the revised Directive should set emission levels for the four already regulated substances and for primary emissions of particulate matter (PM2.5), as well. A cost-benefit analysis for the revision has quantified a number of health effects associated with exposure to fine particles and ozone, for each MS and for the EU27 as a whole. The quantification and valuation methodology was developed as part of the Clean Air for Europe (CAFÉ) project. The revision will also take account of the revision of the IPPC Directive and the decision by the European Council (March 2007) to reduce greenhouse gas emissions by 20 % and to have 20 % renewables by 2020.

Table 1: National 2010 emission ceilings for SO_2, NO_X, NMVOC and NH_3, as defined in Annex I of NECD

	SO_2 kt	NO_x kt	NMVOC kt	NH_3 kt
EU- 27	**8297**	**9003**	**8848**	**4294**
Austria	39	103	159	66
Belgium	99	176	139	74
Bulgaria	836	247	175	108
Cyprus	39	23	14	9
Czech Republic	265	286	220	80
Denmark	55	127	85	69
Estonia	100	60	49	29
Finland	110	170	130	31
France	375	810	1050	780
Germany	520	1050	995	550
Greece	523	344	261	73
Hungary (*)	500	198	137	90
Ireland	42	65	55	116
Italy	475	990	1159	419
Latvia	101	61	136	44
Lithuania	145	110	92	84
Luxembourg	4	11	9	7
Malta	9	8	12	3
Netherlands	50	260	185	128
Poland	1397	879	800	468
Portugal	160	250	180	90
Romania	918	437	523	210
Slovakia	110	130	140	39
Slovenia	27	45	40	20
Spain	746	847	662	353
Sweden	67	148	241	57
UK	585	1167	1200	297

(*) Emissions ceilings for Hungary are temporary and without prejudice to review of NEC Directive, according to article 10.

The emission ceilings for the EU-27 MSs as a whole, defined in Annex II of NECD (Table 2), were more ambitious than the aggregated MS emission ceilings in Annex I (Table 1), with the aim of attaining the EC interim environmental objectives set out in Article 5 of NECD by 2010.

Table 2: European Community 2010 emission ceilings for SO_2, NO_X and NMVOC as defined in Annex II of NECD

	SO_2 kt	NO_x kt	NMVOC kt
EU- 27	**7832**	**8180**	**7585**

2.7 Framework Directive on the Sustainable Use of Pesticides

In the Decision adopting the Sixth Environment Action Programme (6EAP), the European Parliament and the Council recognised the need to reduce the impacts of pesticide on human health and the environment. This objective was included in the Thematic Strategy on the sustainable use of pesticides[9]. The Thematic Strategy has three main elements – revisions of the approvals Directive (91/414/EC), a Sustainable Use Directive focussing on the usage phase of pesticides and a statistics regulation for a transparent system for reporting and monitoring progress, and the development of appropriate indicators.

The Sustainable Use Directive (2009/128/EC) was published in November 2009 and contains requirements on training provision of pesticide advisors and spray operators, and the testing of spray equipment.

The Commission proposed a regulation concerning statistics on plant protection products[10] and this was adopted as new Regulation (EC) No 1185/2009 of the European Parliament and of the Council concerning statistics on pesticides which was published on 10 December 2009[11] and contains details of the requirements for pesticide statistic provision by all Member States.

2.8 Birds & Habitat Directive (NATURA 2000)

2.8.1 Birds Directive

The Birds Directive (originally Council Directive 79/409/EEC on the conservation of wild birds) was adopted by all EU Member States in 1979, with the aim of providing international cooperation for the protection of birds in Europe. It was established by the European Commission (EC) due to declines in wild bird populations throughout Europe from threats such as habitat loss, pollution, and unsustainable hunting. It was recognised that as many species are migratory, bird populations need to be managed internationally for conservation measures to be successful. Since its inception, a number of amendments have been added to include new Member States, and to make derogations to permit the hunting of certain species in some regions (Council Directive 2009/147/EEC)[12].

The Directive sets a number of objectives for EU Member States, with the legislation and implementation determined by each individual territory. Endangered and migratory wild birds are listed on Annex I of the

[9] European Commission, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – a thematic strategy on the sustainable use of pesticides COM(2006) 373 final

[10] European Commission, Proposal for a Regulation of the European Parliament and the Council concerning statistics on plant protection products, COM (2006) 778 of 11.12.2006

[11] OJ L 324/1, 10.12.2009, p1

[12] European Commission. 2009 Directive 2009/147/EC of the European Parliament and of the Council 0f 30 November 2009 on the conservation of wild birds. Available online at http://www.ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm

Directive and are protected by a network of Special Protection Areas (SPAs), which contain suitable habitats and internationally important wetlands. Activities that directly threaten birds are banned under the Directive, including the destruction of nests and eggs, trade in live or dead birds and large-scale non-selective hunting. Some restricted hunting may be permitted for more widely distributed and abundant species, which are listed in Annex II of the Directive. Research into the status, population levels, management and conservation of wild birds is also promoted by the Directive, as outlined in Annex V.

2.8.2 Habitats Directive

The Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) was adopted by all EU Member States in 1992 to protect natural habitats and wild species in Europe[13]. It aims to promote biodiversity by requiring Member States to maintain and restore habitats and species to a favourable conservation status, enforce their protection, and to monitor trends.

The 216 habitats listed in Annex I and 1,182 species listed in Annexes II, IV and V of the Directive are protected by a number of Special Areas of Conservation (SACs), which are designated based on factors such as the surface area, representivity, and structure of the site, and the range, isolation, rarity and conservation priority of the features they contain. Before a site gains SAC status, it is first identified as a Site of Community Importance (SCI). This is then designated as a SAC when the necessary conservation measures are in place, and before six years have passed. Certain habitats and species are prioritised in the Directive for strict protection to enforce and implement conservation measures as early as possible, which are listed in Annex IV. Plants and animals listed in Annex IV are protected by the prohibition of capture, trade, disturbance and deliberate killing of those species, unless derogations have been approved. The non-selective methods of capture and killing of wild animals, and hunting transports listed in Annex VI are prohibited for use in hunting any species. Certain species and populations are permitted for sustainably managed exploitation for their community importance, which are listed in Annex V.

The areas designated as SPAs by the Birds Directive, and as SACs by the Habitats Directive, are collectively known as Natura 2000 sites. The objective of Natura 2000 is to create and maintain networks of protected areas throughout all the Member States of the EU. This network currently includes almost 26 000 protected areas, covering a total land area of over 850 000 km^2, and 130 000 km^2 of marine ecosystems.

2.9 EU Strategy for Sustainable Development (EU SDS)

The Renewed EU Strategy for Sustainable Development (EU SDS)[14] was adopted in 2006, with the aim of developing sustainable communities for the efficient use of resources in future generations. The strategy includes the aims of many other EU policies, and broadly links economic development, environmental protection and social issues, focusing on the seven key challenges listed below:

- Climate change and clean energy;
- Sustainable transport;
- Sustainable consumption and production;
- Conservation and management of natural resources;

[13] European Commission. 1992 Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Available online at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:01992L0043-20070101:EN:NOT

[14] Council of the European Union. 2006 Review of the EU Sustainable Development Strategy (EU SDS).

- Public health;
- Social inclusion, demography and migration;
- Global poverty.

One of the core objectives of the EU SDS is to measure the progress made by EU Member States towards sustainable development. This is done by Eurostat, who monitor and report on progress based on a set of Sustainable Development Indicators (SDIs). There are more than 100 SDIs in total, eleven of which have been identified as headline indicators, which aim to provide an overall summary of the progress made. The SDIs have been developed based on ten central themes, with each including a number of sub-themes to focus on the aims of the EU SDS.

Due to large parts of the region being managed as agricultural land, sustainability within agriculture plays an important role in the conservation and management of the EU's environmental resources. Historically, farming has contributed to the creation and maintenance of a wide variety of semi-natural habitats and agricultural landscapes important for wildlife and the rural community. The latest reforms of the EU Common Agricultural Policy (CAP) have responded to the double challenge of reducing agricultural pressures on the environment and favouring the delivery of sustainable environmental services through farming.

3 Policy Review

3.1 United Nations Framework Convention on Climate Change

The Kyoto Protocol and Marrakesh Accords, adopted by the Conference of the Parties (COP) in December 2005, include a set of monitoring and compliance procedures. Articles 5, 7 & 8 of the Protocol address reporting and review of information by Annex I Parties, including methodologies for the preparation of GHG inventories.

3.1.1 The data requirements including their scale and accuracy

In 1988, the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) co-established the Intergovernmental Panel on Climate Change (IPCC). One of the functions of the IPCC is to develop methodologies and produce guidelines for GHG inventories to support the UNFCCC. The *IPCC Guidelines for National Greenhouse Gas Inventories* are approved internationally, and were first accepted in 1994. The UNFCCC COP 3, held in Kyoto in 1997, reaffirmed that the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*[15] should be used as "methodologies for estimating anthropogenic emissions by sources and removals by sinks of greenhouse gases" in calculation of legally-binding targets during the first commitment period (IPCC default methods). Article 5 commits Annex I Parties to have in place, by no later than 2007, national systems for estimating GHG emissions by sources, and removal by sinks following these methodologies. If these methodologies are not followed, appropriate 'adjustments' should be applied and documented, to make the data comparable to that of other Parties.

More recently, the IPCC have published the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*[16], which build on and integrates the *Revised 1996 IPCC Guidelines* and the subsequent Good Practice reports[17]. These new guidelines cover new sources and gases, and make updates to previously published methods where technical and scientific knowledge have improved. They also describe how to identify *key categories* to assist in making a methodological choice for individual source and sink categories. The *2006 IPCC Guidelines* can be used by Annex I Parties to improve the data in their inventories by reducing uncertainties and bias in the estimates. At the time of writing, it was not a requirement for Parties to use the *2006 IPCC Guidelines*.

The Revised 1996 IPCC Guidelines frequently provide a number of different possible methodologies for calculating an emission. In some cases, these are calculations of the same form but with differences in the level of detail using a "tiered" structure. The level of detail increases from tier 1 to tier 2 (and to tier 3 in the 2006 guidelines), and the choice of tier depends on the importance of the source category (e.g. higher tier methods should usually be selected for key categories), the availability of data, and the capability of the national experts. Nations are encouraged to work at the highest level of detail possible and appropriate

[15] Intergovernmental Panel on Climate Change. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Available at http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm

[16] Intergovernmental Panel on Climate Change. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

[17] Intergovernmental Panel on Climate Change. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Available at http://www.ipccnggip.iges.or.jp/public/gp/english/

for their situation. Higher tier methods may also be chosen in order to prove that an abatement measure has been applied successfully. If a method of calculation is changed for a particular inventory year, all of the preceding years' emissions will need to be calculated using this new method to ensure an accurate representation of trend.

Under the Revised 1996 IPCC Guidelines, Annex I Parties are required to estimate and report all anthropogenic emissions and removals of GHGs. These are grouped into the following major sectors:

1. Energy

Total emission of all GHGs from stationary and mobile energy activities including fuel combustion and fugitive emissions from fuels.

2. Industrial Processes

By-product or fugitive emissions of GHGs from industrial processes.

3. Solvent and other product use

Pertains mainly to emissions resulting from the use of solvents and other products containing volatile compounds.

4. Agriculture

Includes:

(a) Enteric fermentation: methane is produced from herbivores as a by-product of enteric fermentation;

(b) Manure management: methane and nitrous oxide are produced from the decomposition of manure under low oxygen or anaerobic conditions;

(c) Rice cultivation: methane is produced via the anaerobic digestion of organic material in flooded rice fields;

(d) Agricultural soils: methane and nitrous oxide can be both emitted from and removed by agricultural soils/ land. Nitrous oxide emissions may be related to the use of fertilisers, biological nitrogen fixation, and return of crop residues to the soil;

(e) Prescribed burning of savannas: methane, carbon monoxide, nitrous oxide and nitrates can all be emitted from burning of savannas to control vegetation growth, reduce pests etc.

(f) Field burning of agricultural residues: non- CO_2 GHGs are emitted from burning of crop residues and other agricultural wastes. Net emissions of CO_2 are considered to be zero as the biomass burned is generally replaced with regrowth the following year.

5. Land-use change and forestry

This sector includes changes in forest and other woody biomass stocks; forest and grassland conversion to other land uses; abandonment of managed lands; CO_2 emissions and removals in soil associated with land-use change and management; and any other emissions and removals from land use change activities (see section 2.2).

6. Waste

Total emissions from solid waste disposal on land, waste water, waste incineration or any other waste management activity.

7. Other

This sector should only be used if it is impossible to fit an emission source or sink into the above six sectors.

Within each of these major sectors, further levels of breakdown of statistics at the category and sub-category level may be required.

In the 2006 IPCC Guidelines, agriculture and land-use, land-use change and forestry have been integrated into a single volume, removing the rather arbitrary distinction between them in previous guidance and promoting consistent use of data.

In the following sections, the data and approach described in the *Revised 1996 IPCC Guidelines* and the associated *Good Practice Guidelines* (with clarification from the 2006 IPCC Guidelines where appropriate) is summarised for the Agriculture sector. The land-use change and forestry sector is covered in section 2.2.

Tier 1 (or basic) approach

Tier 1 methodology aims to provide simple, yet realistic procedures for estimating GHG emissions. Default emission factors, and in some cases activity data, are provided. These data are often very general, and in most cases will not capture regional or national level variations that can significantly influence emissions. Countries are encouraged to use more detailed methodologies, emission factors or activity data where these are available and compatible with IPCC source categories, as long as they have been shown to given consistent and more accurate results.

(a) Enteric fermentation (CH_4)

Activity data: The average annual population of livestock by broad category (e.g. dairy cattle, non-dairy cattle, sheep, swine) is required. It is recommended that three-year averages are used. Data should be sourced from official national statistics or industry sources where possible. Alternatively, Food and Agriculture Organisation (FAO) of the United Nations data can be used if national data are unavailable, but only as a last resort. In the EU, national data should always be used. FAO annually publishes *The FAO Statistical Yearbook*[18], which provides a selection of indicators on food and agriculture by country. The data are drawn from FAOSTAT, the Organisation's corporate statistical database[19], as well as several FAO divisions and other sources within the UN system. FAOSTAT is based on data submitted by member countries in response to standard questionnaires, supplemented by a review of national sources and estimates or imputations to cover critical gaps. It brings together data from different domains and sources, and provides time series and cross sectional data relating to food and agriculture. The milk production per head per year is also required for dairy cattle, which can be obtained from the *FAO Statistical Yearbook* or country-specific reports.

Emission factors: Default emission factors from previous studies are provided in the IPCC guidelines for methane from enteric fermentation by livestock type, and separately for developing and developed countries. A more detailed breakdown for cattle is also given based on regional characteristics of the industry, due to this being the most important source. These emission factors have an uncertainty of

[18] Food and Agriculture Organisation of the United Nations Statistical Yearbook 2007-2008 available at http://www.fao.org/economic/ess/publications-studies/statistical-yearbook/fao-statistical-yearbook-2007-2008/en/

[19] Available at http://faostat.fao.org/

approximately ±20 % due to variations in animal management and feeding.

Calculation of emissions: Methane emissions from enteric fermentation are calculated by multiplying the livestock population by the most appropriate emission factor for each animal category.

(b) Manure management (CH_4 & N2O)

Activity data: The livestock populations used in the enteric fermentation category must be disaggregated by climate (warm, temperate or cool) for the purposes of estimating emission from manure. The fraction of the livestock population within each climate can be estimated from country-specific climate maps and livestock census reports. Manure management system usage data is also required, the preferred source being regularly published national statistics. If these are not available, independent surveys should be conducted or expert opinion used. IPCC defaults are also available by region and livestock category. The manure management systems for which default values are provided are (i) anaerobic lagoon; (ii) liquid system; (iii) daily spread; (iv) solid storage and drylot; (v) pasture range and paddock; (vi) used fuel; and (vii) other system.

Emission factors: Default methane emission factors are provided in the IPCC guidelines. These are broken down by livestock type, developed/ developing countries, and by climate. For cattle, swine and buffalo, the most important sources, emission factors are further broken down by regional characteristics of manure management systems, and by annual average temperature in the 2006 Guidelines.

To calculate annual N excretion for each livestock category, annual average nitrogen excretion rates and the typical animal mass for each category are required. These can be country-specific, or IPCC defaults provided by region can be used.

Calculation of emissions: Methane emissions from manure management are calculated by multiplying the livestock population by the most appropriate emission factor for each animal category.

The variables required in estimating N_2O emissions from manure management systems are (1) the numbers of livestock by representative type; (2) the nitrogen excretion per head by livestock category; and (3) the percentage of manure nitrogen by manure management system. The product of these three values for each livestock category is the nitrogen excretion for each manure management system. The N_2O emissions from all manure management systems in the country is then calculated by summing the products of the nitrogen excretion for the manure management system by emission factors specific to the management system (IPCC defaults provided). The nitrogen excretion and N_2O emission default values have a large degree of uncertainty.

(c) Rice cultivation (CH_4)

Activity data: Default activity data on the harvested area of rice are provided from the FAO Yearbook, IRRI RICE Almanac[20] and World Rice Statistics[21]. All of the European countries in which rice is cultivated use irrigation on 100 % of the rice growing area.

Emission factors: Default emission factors are provided for various categories of water regimes.

Calculation of emissions: Emissions of methane from rice fields for a particular rice water regime are calculated by multiplying the methane emission factor by the annual harvested area cultivated under those

[20] Maclean, J.L., Dawe, D.C., Hardy, B. & Hettel, G.P. (eds) 2002. Rice Almanac (Third edition), IRRI.

[21] Available at http://www.beta.irri.org/solutions/index.php?option=com_content&task=view&id=250

conditions.

If a country has sufficient data and expertise to go beyond the basic method, they are encouraged to do so. Additional detail should be based on laboratory and field experiments and theoretical calculations to arrive at a more accurate estimate of emissions from rice cultivation in their country. For example, the continuously flooded water regime category could be subdivided into different fertiliser types – chemical or organic.

(d) Agricultural soils (N_2O)

Adequate information exists to enable the calculation of (i) direct N_2O emissions from agricultural soils; (ii) direct soil emissions of N_2O from animal production and (iii) indirect emissions of N_2O from nitrogen used in agriculture. A common set of activity data are required for each emission pathway.

Activity data: The input data required are;

- Total use of synthetic fertiliser (kg N/yr) – annual fertiliser consumption data should be obtained from official national statistics – often recorded as sales – where available. Otherwise, data from the International Fertiliser Industry Association (IFIA)[22] or FAO may be used.
- Number of livestock by category (non-dairy cattle; dairy cattle; poultry; sheep; swine; other animals) – used to calculate nitrogen from animal manure (organic fertilisers)
- Dry pulses and soybeans produced (kg/yr) – data on crop yields should be obtained from national sources where available. Otherwise, FAO publishes data on crop production.
- Dry production of other crops (kg/yr) – as above.
- Area of cultivated organic soils (Histosols) (ha) – usually obtained from official national statistics, or from FAO.

Emission factors: Three emission factors are needed for estimation of direct emissions; (i) the amount of N_2O emitted from the various N applications to soils; (ii) the amount of N_2O emitted from an area of cultivated organic soils and (iii) the amount of N_2O emitted from N deposited by grazing animals on pasture, range and paddock. The most up to date default values for each of these are provided in the 2006 IPCC Guidelines.

For the estimation of indirect emissions, two additional emission factors are required – one associated with volatilised and re-deposited N, and the other associated with N lost through leaching/ run-off. Default values for these are provided.

Calculation of emissions: The calculations involved in estimating emissions from agricultural soils are complex, and it is not necessary to describe them here, other than to say that the Tier 1 methodologies use the above activity data and emission factors, but do not take into account different land cover, soil type, climate or other management practices. The terms Tier 1a and Tier 1b are used in the Good Practice Report to differentiate between the equations in the Revised 1996 IPCC Guidelines (Tier 1a) and the Good Practice Report (Tier 1b), the latter representing increased precision. The most appropriate to use depends on the availability of the necessary activity data. Tier 1 calculations in the 2006 IPCC Guidelines are different again, following methodological improvements made in the interim period.

[22] http://faostat.fao.org/

(e) Field burning of agricultural residues

Crop residue burning is a significant net source of CH_4, CO, NOx and N_2O. It is not a net source of CO_2 because the carbon released is reabsorbed during the next growing season. Only a few of the Annex 1 countries in the EU burn agricultural wastes in fields as common practice.

Annual crop production statistics by country for most of the crops from which residues are burned can be obtained from the FAO Statistical Year Books. If available for individual countries, crop specific data on ratios of residue to crop production, fraction of residue burned, dry matter content of residue, and carbon and nitrogen contents of residue should be provided. Otherwise, default values are given in the Guidelines.

Tier 2 approach

The Tier 2 approach requires country specific information on livestock populations and manure management practices, and a more detailed characterisation of livestock. This approach is recommended when the country's livestock and manure management practices do not correspond well with the data used to produce the default values. Countries with large cattle, buffalo or swine populations should also use the Tier 2 approach, since there is a large degree of variation in cattle characteristics and in buffalo/ swine manure management between countries. The Good Practice Guidelines for agriculture recommend that a Tier 2 approach is used for all key source categories; defined as a category that is prioritised in the inventory system because its estimate has a significant influence on a country's total inventory of direct GHGs, or has a high influence on the trend.

(a) Enteric fermentation

Activity data: For Tier 2 methods, an additional level of detail is required for categorising the cattle, buffalo and swine populations into representative types in order to improve emission factor estimates. The minimum representative types for cattle are mature dairy cattle, mature non-dairy cattle and young cattle. Similar categories can be used for buffalo. Swine can be divided into sows, boars and growing animals. These can be further divided into sub-categories if data are available. The annual average population is required for each representative type. Population data at the required level of detail are generally available from country-specific livestock census reports.

Emission factors: The enteric fermentation emission factors for each representative type of livestock are estimated based on the average daily feed intake and methane conversion rate. These should be obtained from country-specific studies, and some data may be available from production statistics.

(b) Manure management

Activity Data: For manure management calculations, the annual average population for each representative type (see enteric fermentation) is required by climate region. Information on the portion of manure managed in each manure management system for each representative animal type must also be available. If country-specific data are not available, IPCC default values may be used.

Emission factors: For the manure management methane emission factors, data is required on the average daily volatile solids excretion, the methane-producing potential of the manure, and the manure management system usage. Volatile solids values may need to be estimated from feed intake levels. The methane-producing potential of manure varies by species and diet, and country-specific data should be

used where possible.

Under Tier 2, it is recommended that annual N excretion rates be derived from N intake and N retention data for each livestock category, which may be available from national statistics or from animal nutrition experts. Alternatively, default IPCC N retention values are provided in the 2006 guidelines.

(c) Agricultural soils

The Tier 2 method for estimating emissions of N_2O from agricultural soils can be used if more detailed (disaggregated) emission factors and activity data are available – for example application of fertiliser under different climate or soil conditions.

Tier 3 approach

Livestock and manure management systems can vary significantly across and within countries, which default values may not adequately reflect. The emission estimates can be improved by collecting key country or region-specific data, including cattle weight, feed intake, manure production and manure management. In addition, measurement programmes could be used to improve the basis for the estimates, for example, measurements of emissions from manure management systems under field conditions. Spatially disaggregated models driven by high-resolution activity data can be used under Tier 3, but should be validated and fully documented.

3.1.2 The reporting requirements: timescale, format, quality

The UNFCCC Reporting Guidelines on Annual Inventories[23] and Article 7 of the Protocol requires Annex I Parties to submit annual GHG inventories covering emissions and removals of direct GHGs (CO_2, CH_4, N_2O, HFCs, PFCs and SF6) from the six sectors described above by 15th April each year. A complete inventory should be provided for 1990 (the base year), and an annual inventory for subsequent years. These submissions are in two parts:

1. Common reporting format (CRF) – a series of standardised data tables containing mainly numerical data and submitted electronically
2. National Inventory Report (NIR) – a comprehensive description of the method of compiling the inventory, the sources of data, the structure of the institutions involved in the inventory, and the quality assurance and control procedures used

The UNFCCC require inventories to be prepared using comparable and agreed methodologies. The inventories should be transparent (assumptions and methodologies clearly explained); consistent with inventories of other years; comparable among Parties; complete (covering all sources, sinks and gases); and accurate in that emission estimates are systematically neither over or under estimated and that uncertainties are reduced as far as practicable. Parties should estimate the uncertainties associated with their emission estimates using the best methodologies available to them.

From April 2006, Annex I Parties were requested to submit their annual GHG inventories using the CRF Reporter software to assist the secretariat in the review process. A web-based submission interface called

[23] Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories. FCCC/SBSTA/2006/9. Available at http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf.

the "UNFCCC Submission Portal" is also available to Annex I Parties as of February 2009, and enables easy submission of all required information under the Convention and the Protocol.

Inventories should be prepared on a calendar year basis, with the exception of the Agriculture and Land-Use Change/ Forestry sectors, where it may be more suitable to report average emissions over a several year period. The recommended period is three years for all Agriculture categories, and between three years and twenty years for Land-Use Change/ Forestry categories.

The CRF tables include Sectorial and Summary Report Tables, enabling the inventory to be reported at different aggregate levels of detail. The six Sectorial Report Tables report emissions and removals at the more detailed sub-category level. The Summary Report Table and the Short Summary Report Table report at the category and the sector level respectively.

Countries are also required to provide worksheets, containing activity data and emission factors at a minimum, to enable transparency and reconstruction of the inventory. At a minimum, results should be checked for arithmetic errors, country estimates compared to independently published estimates, and national activity data checked against international statistics.

The NIR should include the annual inventory information, the detailed inventory calculations in each sector for all years from the base year, a description of the methodologies including an indication of the level of complexity (tiers) applied, references to sources of information, assumptions and conventions underlying the estimates, any recalculations of previously submitted inventory data, information on uncertainties, quality assurance procedures, and changes with respect to previous years.

3.1.3 Availability and quality of data at a Member State level

The data availability, methods and emission factors used, and the results of uncertainty analyses for the activity data and the emission factors for each Member State are provided in Appendix A. All Member States that are Annex I Parties to the Convention are required to submit an emissions inventory and report annually, and therefore data exists for all Annex I Parties in a time series from the base year (usually 1990) to the most recent submission, which at the time of writing was the 2007 inventory[24]. There is therefore a 1 ½ year time lag between the end of the inventory year and the submission of the inventory. Non-Annex I Parties in the EU are Cyprus and Malta. Cyprus has no data on GHG emissions available, whereas Malta has submitted its first communication to UNFCCC, covering the time period 1990-2000.

Due to the strict methodological and reporting requirements of the UNFCCC, all Annex I Parties have annual GHG inventories covering the majority of key sources and gases. There are, however, differences in the quality of the data between Member States. These differences are mainly due to the quality of activity data and emission factors used, and differences in the level of complexity of the methodology. The main similarities and differences by emission category, and the range of uncertainty estimates in activity data and emission factors are summarised below.

Enteric Fermentation

The majority of Annex I Member States use a combination of Tier 1 and Tier 2 methods, along with IPCC default and country specific emission factors. The notable exceptions are Bulgaria, Denmark, Latvia, Romania and the United Kingdom, who only use a Tier 1 approach; and France, who use a Corinair method. Finland, Germany, Spain and Sweden also use a country-specific method.

[24] Since this review was carried out for UNFCCC, NIR reports and CRF tables for 2010 (covering the 2008 inventory) have become available on the UNFCCC website (http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5270.php)

Manure Management

Again, the majority of Annex I Member States use a combination of Tier 1 and Tier 2 methods, and IPCC default and country specific emission factors. The Czech Republic, Estonia, Greece and Romania only use a Tier 1 approach; and France use Tier 1 plus Corinair methodology. Denmark and Germany use additional country-specific methods.

Rice Cultivation

The only Annex I Member States to grow rice are Bulgaria, France, Greece, Hungary, Italy, Portugal, Romania and Spain. Of these, all use a Tier 1 method with the exception of France, who use Corinair, and Italy, who use Tier 2.

Emissions from Agricultural Soils

All Annex I Member States use the basic methodology for estimation of emissions from agricultural soils, with the exception of Denmark and Slovakia, who use higher tier or country-specific methods. Austria, France, Germany, the Netherlands, Poland, Spain, Sweden and the UK use other methods in addition to the basic. A number of countries use country specific emission factors as well as IPCC defaults. Denmark only use country specific emission factors.

Burning of Agricultural Residues

All countries for which this category is applicable use IPCC default methodology and Spain also uses country-specific methods. Bulgaria, Italy and Poland use country-specific emission factors.

Each year, a centralised review of the annual submission of each Annex I Party is undertaken, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. Each review is conducted by a team of nominated experts from the UNFCCC roster of experts; generally two for each sector. These reviews provide a good indication of the quality of the submission for each Member State, and have been used, in conjunction with the review of methodologies and uncertainty analyses, to identify the best examples of data collection and presentation. These are discussed as case studies in the following section.

3.1.4 Member States collecting the best data for policy requirements

CASE STUDY: AUSTRIA

This case study takes the majority of its information from the 2009 centralised review for Austria[25]. Austria's 2008 Inventory submission relates to the inventory for the year 2006 and contains a complete set of CRF tables from 1990-2006 and a NIR. The IPCC tier 1 approach was used by Austria to identify its key categories, consistent with the IPCC good practice guidelines.

For the Agriculture sector, Austria has taken steps to improve the transparency of the NIR following recommendations made in the previous ERT. For enteric fermentation, a tier 2 approach is used for cattle and a tier 1 approach for all other livestock. For cattle, a country-specific approach to calculating the gross energy intake from milk yields has been taken and is well documented. Livestock statistics are taken from Statistik Austria, with detailed explanations of trends in livestock populations over the 1990-2006 time period. An improvement could be made to future inventories by reporting emissions from non-dairy adult females and young cattle separately.

In the 2006 inventory, Austria used a manure management distribution based on a study from 1995

[25] UNFCCC (2009) Report of the individual review of the greenhouse gas inventories of Austria submitted in 2007 and 2008. FCCC/ARR/2008/AUT

across the entire time-series. Following recommendations from previous ERTs, Austria were undertaking a study to update their manure management statistics for subsequent inventories.

With respect to the calculation of N_2O from agricultural soils, Austria has improved its values for the fraction of nitrogen in N-fixing and non N-fixing crops in response to an issue raised at an earlier review stage. It has also improved its country-specific approach for estimating volatilization losses from animal manure applied to soils using country-specific factors.

Austria reports a 10 % uncertainty in their estimation of livestock populations and manure management regimes, which is high compared to the majority of other member states. The 5 % reported uncertainty in estimation of activity data for agricultural soils is among the lowest. Uncertainty in emission factors are approximately average for the member states.

Overall, Austria was seen to have addressed the majority of the issues and recommendations raised in previous ERTs and to have provided a fully transparent and complete inventory for the agriculture sector.

CASE STUDY: IRELAND

This case study takes the majority of its information from the 2009 centralised review for Ireland[26]. Ireland's 2009 Inventory submission relates to the inventory for the year 2007 and contains a complete set of CRF tables from 1990-2007 and a NIR. The NIR is complete for the agriculture sector in terms of categories and years, and transparent in relation to the methodologies, activity data and emission factors used.

Several improvements were made following the previous submission, including recalculations for emissions from enteric fermentation, manure management and agricultural soils. These recalculations resulted in emissions estimates that followed IPCC good practice guidance, using tier 2 methods to estimate methane emissions for enteric fermentation and manure management in cattle. Improvements included an adjustment of the milk production patterns in the tier 2 model following provision of revised data on milk yield from the Ireland Central Statistics Office; revised statistics for the poultry population in 2006; and refined estimates of the quantities of sewage sludge applied to agricultural land.

New information obtained from a national farm facilities survey[27] was used to derive emission factors for manure management. This resulted in a much improved representation of the apportionment of animal waste among the relevant waste management systems, whilst the excretion of organic matter by cattle was fully characterised as part of the analysis of their feed and energy requirements relating to enteric fermentation.

Ireland have also planned improvements to the inventory, including a methodology for estimating the N_2O emissions from soils that systematically accounts for the influences of soil type, fertiliser type and application rates, temperature and rainfall, which are not captured in the IPCC methods.

Improvements recommended by the ERT include the provision of information to support the use of adjusted default emission factors; an explanation of the inter-annual variation in N_2O emissions from nitrogen-fixing crops; and further investigation of the high inter-annual and spatial variability of rates of N_2O emissions from agricultural soils found by recent studies.

Ireland has one of the lowest reported levels of uncertainty for agricultural statistics (1 %) and in the lower half for other activity data. The uncertainties in emission factors reported by Ireland are approximately average compared to other member states.

[26] UNFCCC (2009) Report of the individual review of the annual submission of Ireland submitted in 2009. FCCC/ARR/2009/IRL

[27] Hyde B., Carton O.T. and Murphy W.E. (2008) Farm facilities survey – Ireland 2003. Report prepared for the Department of Agriculture by Teagasc, Johnstown Castle, Co. Wexford.

3.1.5 Sustainability of delivery of data

An annual GHG inventory and NIR for each Annex I country is required by the UNFCCC, and the guidelines for methodological approaches, activity data and emission factors are continually under review. The system that is in place to enable countries to prepare and submit their inventories is very well developed. The recent availability of an online submission portal will reduce the burden on Member States and the UNFCC secretariat, and ensure that data delivery is sustainable and consistent. It is unclear what will happen after the 2012 target date for reduction of GHG emissions to 5 % of 1990 levels; however it is likely that new targets will be set for Annex I countries for 2050 and beyond. A post-2012 global agreement under UNFCCC was scheduled for the Copenhagen Climate Change Conference in December 2009 (COP15), but a binding agreement was not reached.

3.1.6 Alternative sources of information

There are no known alternative sources of information on GHG emissions at a country level.

3.1.7 Developments and progress

Many Member States are carrying out research that will enable them to use Tier 2 or Tier 3 methods in future inventories, including the improvement of activity data and the development of country-specific emission factors. One such example is the United Kingdom, whose government have just commissioned an extensive programme of work to improve their GHG inventory for the agriculture sector.

CASE STUDY: UNITED KINGDOM

In the UK, agriculture contributes ~7 % to total GHG emissions. This includes 73 % of total nitrous oxide and 38 % of total methane emissions. Current estimates of agricultural GHG emissions have high levels of uncertainty, particularly for nitrous oxides, the estimated emissions of which from soils have a 95 % confidence interval of ±252 %. Currently, GHG emissions from agriculture are estimated using Tier 1 methodology and emission factors. These methods do not differentiate between standard practices, innovative processes, or the effect of mitigation measures to reduce GHG emissions.

Until now, Tier 1 estimation has been acceptable for UNFCCC requirements, but the Climate Change Act 2008 (UK legislation) makes the UK the first country in the world to have a legally binding long-term framework to cut carbon emissions through the use of carbon budgets. The Secretary of State has agreed to put in place an industry-led voluntary action plan for reducing emissions from agriculture. Progress is to be monitored through indicators against agreed milestones, with a link between the indicators and emission reductions measured as part of the improved inventory.

These new plans will require the adoption of a more sophisticated method of measuring and reporting emissions for the GHG inventory (i.e. Tier 2 or 3). This means achieving a significant reduction in the uncertainties currently associated with the inventory, and the development of country-specific emission factors to better characterise and allocate agricultural emissions. The aim is to complete this work and incorporate it into the national inventory by 2012, to enable the impact of voluntary action by the industry, and/or policy instruments, to be tracked well before the start of the third carbon budget period, which will start in 2018.

3.1.8 Potential synergies of reviewed data with AEIs

AEI indicator	Assessment of requirement/ provision under the UNFCCC	Units and resolution
AEI 5 – Mineral fertiliser consumption	Calculation of emissions from soils requires activity data on the total nitrogen input to soils by synthetic fertilisers, which is consistent with the AEI parameter 'absolute volumes of N'.	*Units:* Kg N/yr *Tier 1 spatial resolution:* national *Tier 2 spatial resolution:* e.g. by climate zone and soil type *Temporal resolution:* Annual
AEI 7 – Irrigation	Calculation of emissions from rice cultivation requires activity data on the total area of irrigated land for rice production. This is related to the AEI parameters 'Irrigated areas', 'Irrigated crop areas' and 'Irrigated crop area/ cropped areas'.	*Units:* % of rice growing area *Tier 1 spatial resolution:* national *Temporal resolution:* Annual
AEI 10.1 – Cropping patterns	Calculation of emissions from soils, crop residue burning and rice cultivation require activity data on cropping patterns.	*Units:* Hectares *Tier 1 spatial resolution:* national *Tier 2 spatial resolution:* e.g. by climate zone and soil type *Temporal resolution:* Annual *Subdivision:* specific crops
AEI 10.2 – Livestock patterns	Data on livestock populations is necessary for the calculation of emissions from enteric fermentation and manure management. Each Annex I country is required to present this activity data in national reports. These data are consistent with the parameters 'Number of major livestock types' and 'Share of major livestock types'.	*Units:* Annual pop^n *Spatial resolution:* national climate region *Temporal resolution:* Annual *Tier 1 Subdivision:* broad livestock category *Tier 2 Subdivision:* representative types for key livestock categories
AEI 11.3 – Manure storage	Manure management data is necessary for the calculation of emissions from manure management. Each Annex I country is required to present this activity data in national reports. These data are consistent with the parameter 'Share of manure stored in different manure storage systems'.	*Units:* % of manure management *Spatial resolution:* National *Temporal resolution:* Annual *Tier 1 Subdivision:* default manure management system type and broad livestock category *Tier 2 Subdivision:* manure management system and representative livestock type
AEI 19 – Greenhouse gas emissions	GHG emissions are reported by each Annex I Party for agricultural sources annually, fully consistent with this AEI.	*Units:* Kt CO_2e/yr *Spatial resolution:* National *Temporal resolution:* Annual *Subdivision:* Source (enteric fermentation; manure management; rice cultivation; agricultural soils; prescribed burning of savannahs; field burning of agricultural residues) and GHG (CH_4; N_2O)

3.2 Land-use, Land-use Change and Forestry

It is important to clarify that LULUCF is a sub-sector in reporting emissions to the UNFCCC and is not a separate policy. It is considered here in a separate section due to the methodological differences compared to the calculation of CH_4 and N_2O emissions from agriculture, and the significance of the sector.

3.2.1 The data requirements including their scale and accuracy

The Intergovernmental Panel on Climate Change (IPCC) were invited by the UNFCCC to develop good practice guidelines for LULUCF, as part of the Marrakesh Accords in 2001. The resulting Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUFC) report[28] was adopted during COP 9 in 2003 for use by Annex I Parties in GHG inventories from 2005 onwards (decision 13/CP.9)[29]. GPG-LULUFC compliments the existing Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories[30], and provides guidance for preparing accurate land use inventories that have standardised reporting methods and low levels of uncertainty.

The LULUCF sector is grouped into six broad land-use categories, which represent all land areas and national classification systems. If the existing land classification system of a Party does not match these categories, it is recommended that the system is converted to fit with them, and that the procedures and definitions used are reported. The land-use definitions applied by a national land classification system should be kept consistent over time and for all instances where that land-use category occurs. Each broad land use category is divided into two sub-categories: land remaining the same throughout the inventory period, and land that has been converted from other land-use categories. These sub-categories may also be divided further by a Party into groups such as crop and woodland types. Definitions used for the land-uses must be kept consistent when reporting subsequent years. The IPCC broad land-use categories for LULUCF are defined below:

1. Forest Land

This category includes all lands that have managed woody vegetation which are subject to periodic or ongoing human interventions, whether for commercial or non-commercial purposes. National threshold values may be used for defining forests, with any areas that have vegetation values currently below the threshold, but are expected to exceed them at maturity also being included. Unmanaged and undisturbed forests cannot be included in the national inventory estimations.

2. Cropland

All annual and perennial crops, temporary fallow or grazed land (as part of a crop-pasture rotation), and agro-forestry systems that have vegetation below the national threshold values that define forest land.

3. Grassland

Grasslands typically consist of vegetation dominated by perennial grasses, and a tree canopy cover below national threshold values. Grasslands are primarily used for the grazing of livestock, and

[28] Intergovernmental Panel on Climate Change. (2003) Good Practice Guidance for Land Use, Land-Use Change and Forestry. Available online at http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_contents.html

[29] United Nations. (2004) Report of the Conference of the Parties on Its Ninth Session, Held at Milan From 1 to 12 December 2003. Available online at http://www.unfccc.int/documentation/decisions/items/3597.php

[30] Intergovernmental Panel on Climate Change. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Available online at http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm

include all wild land, recreational areas, rangeland and pasture land that are not considered to be cropland.

4. Wetlands

Includes lands which are saturated by water for all or part of the year, and do not fall into any of the other land categories, such as peatlands, reservoirs, and natural rivers and lakes. Artificially created or managed wetlands such as reservoirs should be distinguished from natural, unmanaged wetlands.

5. Settlements

Includes all developed land, transportation infrastructure, and human settlements of any size that are not already included in the other categories. Urban trees in gardens, parks, and roadsides should be included in this category, rather than as forest land.

6. Other land

Includes all bare soil, rock and ice, and any unmanaged land that does not fit in the other categories.

There are three methodological approaches for representing land areas and land-use change, which are listed below in order of increasing detail:

Approach 1: Basic land-use data

Approach 1 identifies the total land area and the amount that has been changed for each of the broad land-use categories. This approach may utilise land datasets originally collected for other purposes, such as forestry and agricultural statistics. A number of these datasets may be required to cover all classifications in all regions of the country. Parties should aim to avoid leaving gaps or overlaps in data, by harmonising the existing land use definitions and the LULUCF categories.

Approach 2: Survey of land use and land-use change

Approach 2 expands on approach 1 to provide more detail in land-use change estimations. Assessments will break down the transitions to and from a land-use category into an estimation of how much each of the other categories contributes to its land-use change. This is achieved by estimating the initial and destination land-use categories, and the overall amount of land remaining in each category.

Approach 3: Geographically explicit land use data

Approach 3 utilises spatially explicit data, obtained by sampling geographic points, or by making a complete tally. The target area is split into a number of spatial units, which are then sampled with remote sensing for complete coverage and/or ground surveys for sample grid cells. These grid cells may be distributed evenly throughout the area, or irregularly to focus on where change is most likely. The resulting data can then be mapped using a Geographical Information System (GIS) to record land-use changes spatially.

For each land-use category, the land area and the emission/removals of CO_2 are estimated for the amount

of land remaining, and the amount of land converted into that land use type. Key categories should be assessed in more detail, and include estimates for other significant GHGs. The key categories are defined based on their contribution to the total carbon stock change, and the amount of uncertainty that is present. GHG stock changes are estimated for above and below ground biomass, dead organic matter, and soils. Parties may also estimate the emissions from additional, optional LULUCF activities, such as harvested wood products and lime applications.

As with other UNFCCC sectors, there are three methodological tiers that can be applied to estimate land use and GHG emissions/removals for LULUCF. The tier approach is similar for each land use category, although assumptions, equations and default data may vary between them. The approach used for each tier level is summarised below, using the croplands category as an example:

Tier 1 approach

Tier 1 applies the most basic method in the guidelines, using default emission factors and coarse activity data. The tier 1 approach should only be used for the least significant categories, if possible.

1. Cropland remaining cropland – Includes the net change in the carbon stock of living biomass in perennial woody crops, and soils. Default coefficients can be used to estimate the rates of carbon accumulation and loss. Land area should be estimated from annual or periodic surveys of the woody crops established and harvested/removed. The area estimates are subdivided into climate regions and soil types to match default biomass accumulation and carbon loss rates. International statistics such as FAO databases can be used in the area estimates, but only where national data are not available.
2. Land converted to cropland – Tier 1 assumes that all dominant vegetation is cleared, with the carbon storage becoming zero. The planting of crops will then increase biomass and carbon storage, with the carbon stock change determined by the difference between the original store and the final amount, using default coefficients. Separate estimates of the land area converted to cropland should be made for each land use category and sub-category, which follow the same guidelines as estimating the area for cropland remaining cropland. Default emission factors should be used for liming.

Tier 2 approach

Tier 2 can use the same methodological approach as tier 1, but with country-specific emission factors for important categories. Higher resolution activity data is also required.

1. Cropland remaining cropland – Where possible, country-specific values should be used to determine carbon accumulation and loss rates. Below ground biomass may also be included in carbon stock estimations. Detailed surveys should be made to estimate the area of perennial woody crops, and at a higher spatial resolution. Lime emission factors should be divided into different forms of lime.
2. Land converted to cropland – Country-specific parameters should be used to estimate carbon stock changes from conversion, split into processes like burning and decay. Area estimations should be disaggregated into national climate zones, and at a finer spatial resolution. Lime emission factors should be divided into different forms of lime.

Tier 3 approach

Tier 3 includes the most advanced survey methods, with complete inventories and country-specific models that utilise high-resolution activity data.

1. Cropland remaining cropland – For living biomass and soils, country-specific carbon stock estimates are required for detailed sub-categories (e.g. orchards). Where dynamic models utilising multiple equations or direct measurements may be more accurate, they should be used at a fine spatial scale. Area estimates should be highly disaggregated and divided into the same sub-categories as the carbon store estimations.
2. Land converted to cropland – Country-specific data at a fine spatial scale should be used, using dynamic models or direct measurements. Accurate parameters should be country-defined, instead of using default values. Land use transitions should be disaggregated for the different conditions within a country e.g. climate.

3.2.2 The reporting requirements: timescale, format, quality

Following the adoption of the *GPG-LULUCF* report during COP 9 in 2003[31], a new standardised reporting format was accepted, which was then incorporated into the *UNFCCC reporting guidelines on annual inventories*[32] as a result of decision 14/CP.11[33]. LULUCF follow the same reporting requirements as the UNFCCC, with national inventories submitted annually by each Annex I Party (see section 2.1.1 for details). For the LULUCF sector, Parties provide estimates of the GHG stock change and land area of each category and sub-category, the methodological approach used, and the amount of assumptions and uncertainty present.

3.2.3 Availability and quality of data at a Member State level

The UNFCCC makes Party submissions available to the public online, including CRF tables in Microsoft Excel format and NIRs as PDFs[34]. The most recent submissions (currently April 2010) report on GHG data from the base year up to 2008. The reports are available for all EU Member States except for Cyprus and Malta, as they were not listed as Annex I countries during the last reporting period. The 2010 report has not (at time of writing) been submitted by Hungary, although the 2009 report is available, which has been assessed instead. The 2010 NIRs for Spain and France are not available in English, so only data from the CRF tables can be used for these Member States.

The CRF tables include estimates of the area of each of each land use category, and the amount of land that has been converted from other categories. The availability of this data is summarised for each Member State in Appendix B. Where no area data has been submitted the record is blank, and land use categories that do not occur are indicated with NO (not occurring). The area of forest land, cropland and grasslands remaining the same over the reporting period is available for all of the submissions. Area estimations are available for all land use sub-categories for the Member States France, Germany, Luxembourg, Netherlands and Slovenia. Other Member States have a number of categories which have

[31] United Nations. (2004) Report of the Conference of the Parties on Its Ninth Session, Held at Milan From 1 to 12 December 2003. Available online at http://www.unfccc.int/documentation/decisions/items/3597.php

[32] United Nations (2006) Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11 http://www.unfccc.int/documentation/documents/advanced_search/items/3594.php?rec=j&priref=600003988

[33] United Nations. (2006) Report of the Conference of the Parties on Its Eleventh Session, Held at Montreal From 28 November to 10 December 2005. Available online at http://www.unfccc.int/documentation/decisions/items/3597.php

[34] Available online at http://www.unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5270.php

yet not been estimated, or have been listed as not occurring, particularly for estimations of the amount of land area that has been converted.

The tier levels used by each Member State for estimating GHG emissions and removals are summarised in Appendix C, which was obtained from the NIRs and 2009 Summary Reports[35]. The summary of broad land use categories includes the tiers levels used for all sub-categories and sub-divisions. A number of the submissions did not state if the method followed the approach defined for an IPCC tier, or whether it was compatible with the guidelines, so a country-specific method has been assumed. If the category was not reported by that Party, all tiers are left blank. Most Parties use different tiers for the separate categories, or for sub-categories. A tier 1 approach is used most frequently, and a number of Parties also use a country-specific method. Where parties have used the higher tiers (2 & 3), it is mostly for the forest land, cropland and grassland categories. This follows the guidelines, as these categories are the most often defined as key categories.

The amount of uncertainty estimated for GHG activities and emission factors is summarised for each of the Member States in Appendix D. This has been collated from the most recent NIR submissions available[36]. The amount of detail in the uncertainty analyses varies between Member States, with some dividing the analysis into sub-categories and others as an overall uncertainty value. Some Member States have not yet got a complete system in place to measure uncertainty for the LULUCF sector.

3.2.4 *Member States collecting the best data for policy requirements*

CASE STUDY: CZECH REPUBLIC

This case study takes the majority of its information from the report of the review of the 2009 submission by the Czech Republic[37]. The Czech Republic's 2009 submission includes CRF tables from 1990-2007, and an NIR for the year 2007. Forest land remaining forest land and cropland remaining cropland are designated as key categories from level and trend assessments, according to the tier 1 approach of the guidelines.

The total land area of the Czech Republic was mapped using data collected by the Czech Office for Surveying, Mapping and Cadastre (COSMC). The land-use definitions used by COSMC were matched to IPCC categories to provide an estimate of the area of each land-use category. This method of land area estimation follows approaches 2 and 3 of the guidelines.

The CRF tables are mostly complete, including estimates for the majority of land categories and GHGs. The methods used to estimate carbon stocks and non- CO_2 emissions are consistent with the guidelines, with a tier 2 and 3 approach using country-specific data applied for living biomass. A tier 1 approach is adopted for DOM and soil estimations, using IPCC default methods and emission factors. Data tables are provided for all years, and recalculations have been made for all years from 1990 to apply updated methods to past years.

Uncertainty values for each of the GHG emission estimates have been provided, although this does not include activity data. The IPCC recommends that the Czech Republic aims to use higher tiers for soils and DOM in future submissions, especially for key categories.

CASE STUDY: NETHERLANDS

[35] http://www.unfccc.int/documentation/documents/advanced_search/items/3594.php?data=idr_&such=j&title=&author=&keywords=&symbol=&meeting=&mo_from=&year_from=&mo_to=&year_to=&last_days=&sorted=&dirc=&anf=&seite=1#beg

[36] http://www.unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5270.php

[37] United Nations. (2010) Report of the Individual Review of the Annual Submission of the Czech Republic Submitted in 2009.

This case study takes the majority of its information from the report of the review of the 2009 submission by the Netherlands[38]. The Netherlands 2009 submission includes CRF tables from 1990-2007, and an NIR for the year 2007. Key categories for LULUCF were defined using tier 1 and 2 analyses, with level and trend assessments. CO_2 emissions from forest land remaining forest land and land converted to grassland were identified as key categories.

The methods used to analyse most categories utilised country-specific data and a tier 2 approach. Various forest inventories were utilised, covering around 3,000 sampling plots. Soil carbon was estimated from national soil maps, which were checked by sampling random sites. Land use and change is determined by digitising topographical maps, which were then used in a land-use matrix.

Following the 2007 and 2008 submission, the UNFCCC review recommended that the Netherlands make a number of improvements to their submissions. The expert review team recognised that the majority of these changes had now been implemented in the 2009 submission. Improvements include the heather sub-division now being classed as grassland instead of forest land, greater accuracy of land area calculations and uncertainty estimates, and improved consistency and transparency of forest land converted to other categories.

Further improvements are requested for future submissions, as the Netherlands only reports on CO_2 emissions and removals, although N_2O is also included for soils.

3.2.5 Sustainability of delivery of data

All Annex 1 Parties are required to submit CRF tables from all years between the base year and the current submission year, and an NIR for the LULUCF sector. If a Party does not submit GHG emissions and removals data, they are penalised by not being able to use LULUCF activities to contribute to their emissions targets, providing an incentive for delivery.

The CRF Reporter ensures that the data required for CRF tables is entered in a consistent format that is easy to use. A UNFCCC helpdesk system is in place to provide user support for the software. The UNFCCC secretariat implemented a web-based interface called the UNFCCC Submission Portal in February 2009. This allows Annex I Parties to easily and securely upload submissions, and track their status. These measures should ensure the sustainability of data availability for the future. At the end of the first commitment period in 2012, a different system may be adopted.

3.2.6 Alternative sources of information

The area of forest cover and land change, and carbon stock data is available in the FAO Global Forest Resources Assessment 2005[39]. The data is available in Microsoft Excel format for 1990, 2000 and 2005 for many countries, including all EU Member States.

3.2.7 Developments and progress

Annex 1 Parties aim to implement country-specific emission factors and tier 2 and 3 approaches, with priority given to key categories. The Parties intend to develop the methods for reporting on categories that use tier 1 and non-standard approaches for future submissions.

A UNFCCC expert review team assesses the annual inventory submissions by each Party for quality,

[38] United Nations. (2009) Report of the Individual Review of the Annual Submission of the Netherlands Submitted in 2009. Available online at http://unfccc.int/documentation/documents/advanced_search/items/3594.php?such=j&data=idr_

[39] Food and Agricultural Organization of the United Nations. (2005) Global Forest Resources Assessment 2005. Available online at http://www.fao.org/forestry/fra/fra2005/en/

completion and consistency. Reviewed submissions receive technical feedback and recommendations of ways to improve future submissions.

Frequent Conferences of Parties (COPs) make improvements to the reporting and data requirements, with are continuously updated for the LULUCF sector. Future inventories will also include data for the Member States that have recently joined the EU, including Malta and Cyprus.

3.2.8 Potential synergies of reviewed data with AEIs

AEI indicator	Assessment of requirement/ provision under LULUCF	Units and resolution
AEI 9 – Land use change	Land use change from cropland/ grassland to settlements is reported under the LULUCF requirements and is consistent with this AEI.	*Units:* Km^2 *Tier 1 spatial resolution:* National *Tier 2 spatial resolution:* Climate zones *Tier 2 spatial resolution:* Highly disaggregated to represent different conditions *Temporal resolution:* Annual
AEI 10.1 – Cropping Patterns	Area of broad land use categories (including cropland and grassland) are a reporting requirement and are consistent with this AEI.	*Units:* Km^2 *Tier 1 spatial resolution:* National *Tier 2 spatial resolution:* Climate zones *Tier 2 spatial resolution:* Highly disaggregated to represent different conditions *Temporal resolution:* Annual *Subdivision:* Broad land-use category
AEI 19 – GHG emissions	The emissions of CO_2 from agricultural land are recorded in the LULUCF cropland category. Emissions from other land-uses are also calculated, providing an estimate of the share of agriculture in CO_2 emissions.	*Units:* Kt CO_2e/yr *Spatial resolution:* National *Temporal resolution:* Annual *Subdivision:* broad land use category and sub-category: land remaining the same and land that has been converted from another category.

3.3 Rural Development Policy

In response to the need for better monitoring and evaluation, there is a focus on 'ongoing evaluation' in the programme period 2007-2013: "Member States are required to establish a system of ongoing evaluation for each rural development programme" (Council Regulation No 1698/2005 Article 86). The organisation of evaluation activities on an ongoing basis is intended to ensure better preparation for formal mid-term and ex-post evaluation, notably through improved data collection.

The EU's Common Monitoring and Evaluation Framework (CMEF[40]) consists of a list of common baseline, output, result and impact indicators for ongoing monitoring and evaluation of the RDPs. The CMEF is laid down in a set of documents drawn up by the Commission and agreed with the Member States. These documents are put together in a Handbook, which includes a series of evaluation guidelines and guidance sheets on the common indicators.

3.3.1 The data requirements including their scale and accuracy

Requirements for the evaluation of RDP measures for the programming period 2007-2013 include:

- Monitoring of the set of common indicators (baseline, output, result and impact indicators) in the CMEF, complemented by programme-specific indicators (defined by the individual Member State);
- Answering of a set of Common Evaluation Questions based on Community priorities and objectives is required at defined intervals;
- A close link between "hierarchy of objectives" and "hierarchy of indicators". Assessments of impacts at programme level need to be built up from the outputs and results of individual measures through the "hierarchy of objectives".

The CMEF establishes a limited set of common indicators for each level of the hierarchy of objectives.

Baseline indicators have been developed based largely on data availability. These indicators are required to be monitored and reported. The CMEF identifies 36 objective-related baseline indicators and 23 context-related baseline indicators. The environmental baseline indicators are presented in Table 3 along with the likely sources of data.

[40] The CMEF is available at http://ec.europa.eu/agriculture/rurdev/eval/index_en.htm. The guidance document (the Handbook) of CMEF is available at http://ec.europa.eu/agriculture/rurdev/eval/guidance/document_en.pdf.

Table 3: Common baseline indicators for environmental component of Rural Development Programmes (2007-2013) and data sources[41]

Baseline Indicator	CMEF	Indicator	Measurement	Source	Data Availability
Environ-ment	**C7**	**Land cover**	% area in agricultural / forest / natural / artificial	CORINE Land Cover 2006	Good
	C8	**LFA**	% UAA in non LFA / LFA mountain / other LFA / LFA with specific handicaps	DG AGRI	Unknown
	C9	**Areas of extensive agriculture**	% UAA for extensive arable crops/ grazing	Eurostat (Farm Structure Survey)	Average
	C10	**Natura 2000 area**	% territory under Natura 2000	DG ENV - Natura 2000 Barometer EEA (ETCB)	Good
			% UAA/ forest under Natura 2000	Natura 2000 spatial dataset + Corine Land Cover 2006	Good
	O17	**Biodiversity: Population of farmland birds**	Trends of index of population of farmland birds	BirdLife	Not available for new member states
	O18	**Biodiversity: High Nature Value farmland areas**	UAA of High Nature Value Farmland areas	European Environment Agency/JRC	Not available in ha; sources not defined, but potentially from farm surveys, modelling and scientific research.
	O19	**Biodiversity: Tree species composition**	Distribution of species group by area of FOWL (%coniferous/% broadleaved/%mixed)	MCPFE[42] 2007	Good
	C11	**Biodiversity: Protected forest**	% FOWL protected to conserve biodiversity, landscapes and specific natural elements (MCPFE 4.9, classes 1.1, 1.2, 1.3 & 2)	MCPFE 2007	Unknown
	C12	**Development of forest area**	Average annual increase of forest and other wooded land areas	Global Forest Resources Assessment 2005 (FRA 2005) - FAO Temperate and Boreal Forest Resources Assessment 2000	Good

[41] Source: Statistical and Economic Information for Rural Development in the European Union- Report 2009, available at http://ec.europa.eu/agriculture/agrista/rurdev2009/index_en.htm. Data sources are complied from this report and reports for 2007 and 2008.

[42] MCPFE: The Ministerial Conference on the Protection of Forests in Europe.

Baseline Indicator	CMEF	Indicator	Measurement	Source	Data Availability
				(TBFRA 2000) - UNECE/FAO	
	C13	**Forest ecosystem health**	% trees /conifers/ broadleaved in defoliation classes 2-4	ICP forest - Technical Report 2008,2002	Good
	C14	**Water quality**	% territory designated as Nitrate Vulnerable Zone	DG ENV	Good
	O20	**Water quality: Gross Nutrient Balances**	Surplus of nitrogen/ phosphorous in kg/ha	OECD, Environmental indicators for agriculture Vol.4, 2006	Not available for new member states
	O21	**Water quality: Pollution by nitrates and pesticides**	Annual trends in the concentrations of nitrate/ pesticides in ground and surface waters	European Environment Agency	Not available for some countries, not available at regional level
	C15	**Water use**	% irrigated UAA	Eurostat (Farm Structure Survey)	Good
	C16	**Protective forests concerning primarily soil and water**	FOWL area managed primarily for soil & water protection (MCPFE 5.1 class 3.1)	MCPFE 2007 (2005)	Good
	O22	**Soil: Areas at risk of soil erosion**	Areas at risk of soil erosion (classes of T/ha/year)	JRC Model	Not available for CY, MT, FI, SE
	O23	**Soil: Organic farming**	UAA under organic farming	Eurostat (Farm Structure Survey)	Good
	O24	**Climate change: Production of renewable energy from agriculture and forestry**	Production of renewable energy from agriculture (ktoe)	EurObserER & Eurostat - Energy Statistics, primary sources: EBB &EBIO	Average
			Production of renewable energy from forestry (ktoe)	Eurostat (Energy Statistics)	Good
	O25	**Climate change: UAA devoted to renewable energy**	UAA devoted to energy and biomass crops	DG Agri	Good
	O26	**Climate change: GHG emissions from agriculture**	Agricultural emissions of GHG (ktoe)	Eurostat	Good

Output indicators are used to measure activities directly realised within programmes, which are the first step towards realising the operational objectives of the intervention and are measured in physical or monetary units. A full list of the common output indicators identified by CMEF for Axis 2 measures of the RDP (2007-2013) is presented in Table 4. All should be able to be calculated from scheme monitoring data.

Table 4: Common output indicators for Axis 2 measures of Rural Development Programmes (2007-2013) and data sources[43]

CODE	MEASURE	OUTPUT INDICATORS
211	Natural handicap payments to farmers in mountain areas	• Mountain areas • Number of supported holdings in mountain areas • Supported agricultural land in mountain areas
212	Payments to farmers in areas with handicaps, other than mountain areas	• Number of supported holdings in areas with handicaps, other than mountain areas • Agricultural land area supported in areas with handicaps, other than mountain areas
213	Natura 2000 payments and payments linked to Directive 2000/60/EC (WFD)	• Number of supported holdings in Natura 2000 areas/under WFD • Supported agricultural land under Natura 2000/under WFD
214	Agri-environment payments	• Number of farm holdings and holdings of other land managers receiving support • Total area under agri-environmental support • Physical area under agri-environmental support under this measure • Total Number of contracts • Number of actions related to genetic resources
215	Animal welfare payments	• Number of farm holdings receiving support • Number of animal welfare contracts
216	Non-productive investments	• Number of farm holdings and holdings of other land managers receiving support • Total volume of investments
221	First afforestation of agricultural land	• Number of beneficiaries receiving afforestation aid • Number of ha afforested land
222	First establishment of agroforestry systems on agricultural land	• Number of beneficiaries • Number of ha under new agroforestry systems
223	First afforestation of non-agricultural land	• Number of beneficiaries receiving afforestation aid • Number of ha of afforested land
224	Natura 2000 payments	• Number of forest holdings receiving aid in Natura 2000 area • Supported forest land (ha) in Natura 2000 area
225	Forest-environment payments	• Number of forest holdings receiving support • Total forest area under forest environment support • Physical forest area under forest environment support • Number of contracts
226	Restoring forestry potential and introducing prevention actions	• Number of prevention/restoration actions • Supported area of damaged forests • Total volume of investments
227	Non-productive investments	• Number of supported forest holders • Total volume of investments

Result indicators are used to measure the direct and immediate effects of the intervention. They provide information on changes in, for example, the behaviour, capacity or performance of direct beneficiaries and are measured in physical or monetary terms. A full list of the common result indicators identified by CMEF for Axis 2 of the RDP (2007-2013) is presented in Table 5.

[43] Source: The EU's Common Monitoring and Evaluation Framework (CMEF) Annex 3- Indicator guidance (H- Output Indicators), available at http://ec.europa.eu/agriculture/rurdev/eval/guidance/note_h_en.pdf.

Table 5: Common result indicators for Axis 2 measures of Rural Development Programmes (2007-2013) and data sources[44]

Axis 2 objective	Result indicators	Data sources
Improving the environment and the countryside through land management	Area under successful land management contributing to: • bio diversity and high nature value farming/forestry • water quality • mitigating climate change • soil quality • avoidance of marginalisation and land abandonment	• National/regional statistics; • EUROFARM (cf., Annex 1 to Commission decision 98/377/EC) • EUROSTAT "Les indices de Ruralité et de dévelopement rural" • On-farm observation (interview, sample, case study…) • RDP monitoring data (output indicators)

Impact indicators are used to measure the benefits of the programme beyond the immediate effects on its direct beneficiaries both at the level of the intervention, but also more generally in the programme area. They are linked to the wider objectives of the programme. They are normally expressed in "net" terms, which means subtracting effects that cannot be attributed to the intervention (e.g. double counting, deadweight), and taking into account indirect effects (displacement and multipliers) A full list of the common result indicators identified by CMEF for the RDP (2007-2013) related to Axis 2 is presented in Table 6.

Table 6: Common impact indicators for Axis 2 measures of Rural Development Programmes (2007-2013) and data sources[45]

Impact indicators	Measurement	Related baseline indicators	Data sources
Reversing Biodiversity decline	Change in trend in biodiversity decline as measured by farmland bird species population	• Biodiversity: Population of farmland birds • Biodiversity: High Nature Value farmland areas • Biodiversity: Tree species composition	BirdLife, not available for new member states.
Maintenance of high nature value farming and forestry areas	Changes in high nature value areas	• Biodiversity: Population of farmland birds • Biodiversity: High Nature Value farmland areas • Biodiversity: Tree species composition	Sources not defined, but potentially from farm surveys, modelling and scientific research.
Improvement in water quality	Changes in gross nutrient balance	• Water quality: Gross Nutrient Balances • Water quality: Pollution by nitrates and pesticides	Sources not defined, but potentially from farm surveys, modelling and scientific research
Contribution to combating climate change	Increase in production of renewable energy	• Climate change: Prod. of renewable energy from agriculture and forestry • Climate change: UAA devoted to renewable energy • Climate change: GHG emissions from agriculture	Eurostat Energy Stastistics & EurObserER

[44] Source: The EU's Common Monitoring and Evaluation Framework (CMEF) Annex 3- Indicator guidance (I- Result Indicators), available at http://ec.europa.eu/agriculture/rurdev/eval/guidance/note_i_en.pdf.

[45] Source: The EU's Common Monitoring and Evaluation Framework (CMEF) Annex 3- Indicator guidance (J- Impact Indicators), available at http://ec.europa.eu/agriculture/rurdev/eval/guidance/note_j_en.pdf.

A two-tiered data collection system is needed for effective monitoring and evaluation of rural development programmes at the EU level. The Managing authorities of RDP funds in individual Member States are responsible for collecting data and information on output and results indicators, as well as financial and resource inputs to RDPs. Eurostat assists this process by providing a common dataset structure based on output and result indicators for cross-country comparisons and synthesis. The estimation and quantification of the impact on competitiveness, the environment, and the quality of life that can be attributed to rural development programmes, taking account of deadweight and displacement, should remain with independent evaluators. However, impact cannot be shown without a baseline, for which Eurostat can provide information to show changes and trends for common baseline indicators identified in the CMEF. This should be treated as a priority to ensure the highest relevance of the data provision to current issues in rural development.

3.3.2 The reporting requirements: timescale, format, quality

Based on common monitoring and evaluation framework (CMEF), the reporting requirements for RDP 2007-2013 are as follows:

- Annual progress reports at programme level
- National summary reports on progress in implementation of the national strategy: 2010 – 2012 – 2014
- Commission summary report to the Council and the EP on the progress in implementation of the EU strategy and priorities: 2011 – 2013 – 2015
- Ongoing evaluation: ex-ante (programme)
  ongoing (annual progress report)
  mid-term (2010)
  ex-post (2014)

Reporting requirement for Annual Progress Report:

The progress report is required to be submitted to the Commission by 30 June each year starting from year 2008, with the last progress report due by 30 June 2016. One of the key elements is to report the progress of the programme in relation to the objectives set, based on output and result indictors.

Reporting requirement for Mid-term and Ex-post Evaluation:

The mid-term and ex-post evaluations are required to examine the degree of utilisation of resources, the effectiveness and efficiency of the programming of the EAFRD, its socioeconomic impact and its impact on the Community priorities. This assessment should be based on input, output, result and impact indicators. The evaluations should also cover the goals of the programme and aim to draw on lessons learnt concerning rural development policy. They should identify the factors that contributed to the success or failure of the programmes' implementation and identify best practice. The mid-term evaluation is due in 2010 and the ex-post evaluation is due in 2015.

3.3.3 Availability and quality of data at a Member State level

Evidence from past RDPs

There are several synthesis reports available for the past rural development programmes as well as Reports (2007, 2008, 2009) on Statistical and Economic Information for Rural Development in the

European Union[46], which identify a few difficulties arising from their evaluations:

1) Data availability for evaluation is limited.

Almost every synthesis report of current or previous RDP programmes mentioned that their evaluations suffered from lack of data. Prior to the new RDP programmes (2007-2013), lack of baseline indictors were quoted as one of the difficulties encountered to evaluate the impacts. Even for the new RDP programmes, pointed out by the Synthesis of Ex Ante Evaluation of Rural Development Programmes 2007-2013, data are available only for a very limited number of baseline indicators in the common monitoring and evaluation framework for time series analysis and cross country analysis, of which only three are environmental indictors. Generally the environmental indicators suffer from huge data gaps, both for the new MS and at the regional (i.e. NUTS 2) level.

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In the annual situation reports (Statistical and Economic Information for Rural Development in the European Union, Report 2007, 2008 and 2009), it is indicated that there is a need for a detailed geographical breakdown, especially for the environmental aspects. A related issue with the geographic breakdown is that the evolvement of geographical units over time (for example merge, split between regions and modifications of boundaries) also affects the availability of time series data, which presents difficulties in comparing changes with the baseline situation. This issue may be most pertinent in new MS that are experiencing profound structural economic changes, where the functions of the agricultural sector and rural communities are likely to change rapidly in the coming years.

2) The quality of data varies across member states, making cross country comparisons and aggregation of impact difficult.

Errors, incompleteness of data collection and inconsistencies in interpretation of data have posed difficulties in providing consistent comparisons across MS. It is mentioned by almost every synthesis report of RDP evaluations that the comparability and aggregation at the EU level proved to be difficult or impossible due to the variations in the quality of data across MS.

For example, evidence from the EU synthesis report[47] shows that the annual progress reports for 2007 vary in quality, length and in their information content. Only 11 reports (less than a quarter of the total) are fully in line with the structure proposed in the guidance document. Some reports are highly

[46] http://ec.europa.eu/agriculture/agrista/rurdev2009/index_en.htm; Synthesis of Ex Ante Evaluations of Rural development Programmes 2007-2013, http://ec.europa.eu/agriculture/eval/reports/rurdev/index_en.htm; Development programmes mid-term evaluations (2006), http://ec.europa.eu/agriculture/eval/reports/rdmidterm/index_en.htm; Impact assessment of Rural Development programmes (2005), http://ec.europa.eu/agriculture/eval/reports/rdimpact/index_en.htm; Full synthesis of Rural Study on mainstreaming the LEADER approach (2004), http://ec.europa.eu/agriculture/eval/reports/leader/index_en.htm; Studies on indicators (2005), http://ec.europa.eu/agriculture/publi/reports/indicator_rd/index_en.htm; Synthesis of mid-term evaluations of LEADER+ programmes, http://ec.europa.eu/agriculture/eval/reports/leaderplus/index_en.htm; EU rural development monitoring data - Synthesis report for 2001-2003, http://ec.europa.eu/agriculture/rur/eval/508_en.pdf; EU rural development monitoring data - Synthesis report for 2001, http://ec.europa.eu/agriculture/rur/eval/1482_en.pdf;Agri-environmental indicators, http://ec.europa.eu/agriculture/envir/indicators/index_en.htm; Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0508:FIN:EN:DOC; ARENA project: http://www.eea.europa.eu/projects/irena.

[47] The European Evaluation Network for Rural Development (2009): Synthesis of the Annual Progress Reports for 2007 concerning Ongoing Evaluation

informative and very many are as short as a paragraph. The progress report from Baden-Wurttemberg, Germany is identified by the synthesis report as a good example of an informative progress report.

Evidence from Environmental Indicators in current RDP (2007-2013)

Axis 2 enjoys the lion's share of the RDP budget, which reflects the environmental focus of the RDP programmes (2007-2013). Emphasis should therefore be given to environmental indicators to effectively monitor and evaluate impacts. In this section, we therefore focus on environmental indicators and data sources in Table 3 (baseline environmental indicators) and Table 6 (environmental impact indicators).

There is generally good data coverage for area-based baseline indicators, while there are a few gaps in data availability for some non-area based baseline indicators related to Axis 2. For the environmental impact indicators, apart from data on production of renewable energy, there are significant gaps in data availability. How well the indicator of production of renewable energy can represent the contribution to combating climate change is still an unanswered question.

3.3.4 Member States collecting the best data for policy requirements

As the information on output and result indicators for RDP (2007-2013) are to be reported regularly in the annual progress reports, the focus for this section is the impact indicators, for which data will be needed to compare with the baseline situation (baseline indicators) and to assess the overall impact of the RDP programmes. Again, this section is focused on Axis 2.

A study[48] conducted by the European Evaluation Network for Rural Development provided a useful synthesis of the good practice to measure the impact of the RDP (2007-2013). Information and evidence for this section is drawn from the above mentioned report. There are four impact indicators relating to Axis 2 (Table 6). Examples of good practice are discussed below for each impact indicator.

(1) Impact indicator: Reversing Biodiversity Decline

To estimate the wider impact of the RDP in reversing biodiversity decline, the change in trend in biodiversity is to be measured by the farmland bird species population. The farmland bird indicator (FBI) is intended as a barometer of change for the biodiversity of agricultural landscapes in Europe. Assuming a close link between the selected bird species and the farmland habitat, a negative trend signals that the farm environment is becoming less favourable to birds. Although a selection group of 19 bird species[49] is included in the FBI defined by the European Bird Census Council (EBCC) adopted by CMEF indicator guidance, MS may use an alternative composition of bird species where this is appropriate to the national/regional situation. This alternative is important because the set of species used in the Pan-European indicator is not entirely applicable in all MS. Furthermore, as many countries faced with the short list of 19 "compulsory" farmland birds will say they do not have any, or do not have enough data to

[48] The European Evaluation Network for Rural Development(March 2010). Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

[49] According to the Handbook on CMEF Guidance note G, FBI is an aggregated index of population trend estimates of a selected group of 19 breeding bird species dependent on agricultural land for nesting or feeding. The following farmland bird species are included: Sky Lark (Alauda arvensis), Stone-Curlew (Burhinus oedicnemus), European Goldfinch (Carduelis carduelis), Common Wood Pigeon (Columba palumbus), Yellowhammer (Emberiza citrinella), Common Kestrel (Falco tinnunculus), Crested Lark (Galerida cristata), Barn Swallow (Hirundo rustica), Red-backed Shrike (Lanius collurio), Woodchat Shrike (Lanius senator), Black-tailed Godwit (Limosa limosa), Corn Bunting (Miliaria calandra), Yellow Wagtail (Motacilla flava), Eurasian Tree Sparrow (Passer montanus), Winchat (Saxicola rubetra), European Turtle Dove (Streptopelia turtur), Common Starling (Sturnus vulgaris), Common Whitethroat (Sylvia communis), Northern Lapwing (Vanellus vanellus).

create a meaningful indicator, an official FBI based on a wider list of 36 species[50] from across Europe has been developed.

Data on the population of an individual species are collected annually through surveys. The population counts are carried out by a network of ornithologists (mostly volunteers) coordinated within national schemes. Indices are calculated for each species independently and are weighted equally when combined in the aggregate index using a geometric mean. Aggregated EU indices are calculated using population-dependent weighting factors for each country and species.

The indices are compiled by Statistics Netherlands in conjunction with the Pan- European Common Bird Monitoring scheme (PECBM: a joint project of the European Bird Census Council, the Royal Society for the Protection of Birds, BirdLife International, and Statistics Netherlands).

For the purpose of comparability, the Commission has chosen a common reference year where maximum geographical coverage is provided. FBI is indexed on the year 2000, However, Member States may choose other years where this improves the quality of the analysis.

CASE STUDY: UNITED KINGDOM

An example of good practice for assessing impacts on measure level by combining a multitude of data, like those of FBI, ongoing monitoring and special studies

The UK smoothed farmland bird index of 19 species would appear to provide the information necessary to report against reversing the long-term decline in farmland bird populations. However the problem with just using this information to measure progress against the Impact Indicator is that the populations of these species are determined by many factors. There has been a 48% decline in the index since 1970.

It is generally accepted that multi-faceted agricultural intensification has been the major driver in the long-term decline in farmland bird populations, although the individual factors differ between species and geographically. The index appeared to level off in the late 1990s but has since begun to fall again coincident with widespread AES provision. The reasons for this recent decline are unclear but could relate to a range of farming (e.g. the ending of compulsory set aside in 2007, decline in bare fallow land) and non-farming (e.g. climate/weather affects, increase in predators) related factors. Against this background it is not easy to identify the contribution being made by the RDP measures – the recent declines might have been far more severe in the absence of AES provision. To isolate the effects of the measures from other contextual factors, evaluators' expertise is essential. The interpretation could be easier if the monitoring program include pair-wise comparisons with control sites.

It has to be accepted that it is not yet possible to build up a fully comprehensive and scientifically rigorous picture of the impact of the English RDP on farmland birds. There are, however, a number of the components of this picture. These are as follows:

(a) The results of autecological studies showing a positive response to targeted agri-environmental management by rare and localised species such as stone curlew, cirl bunting and black grouse.

(b) The farmland bird index and the national population data for each of the 19 species that make up the index.

[50] The 36 farmland bird species included are: Sky Lark (Alauda arvensis), Tawny Pipit (Anthus campestris), Meadow Pipit (Anthus pratensis), Stone-Curlew (Burhinus oedicnemus), Greater Short-toed Lark (Calandrella brachydactyla), Common Linnet (Carduelis cannabina), White Stork (Ciconia ciconia), Rook (Corvus frugilegus), Cirl Bunting (Emberiza cirlus), Yellowhammer (Emberiza citrinella), Ortolan Bunting (Emberiza hortulana), Black-headed Bunting (Emberiza melanocephala), Common Kestrel (Falco tinnunculus), Crested Lark (Galerida cristata), Thekla Lark (Galerida theklae), Barn Swallow (Hirundo rustica), Red-backed Shrike (Lanius collurio), Lesser Grey Shrike (Lanius minor), Woodchat Shrike (Lanius senator), Black-tailed Godwit (Limosa limosa), Calandra Lark (Melanocorypha calandra), Corn Bunting (Miliaria calandra), Yellow Wagtail (Motacilla flava), Black-eared Wheatear (Oenanthe hispanica), Eurasian Tree Sparrow (Passer montanus), Grey Partridge (Perdix perdix), Rock Sparrow (Petronia petronia), Whinchat (Saxicola rubetra), Common Stonechat (Saxicola torquata), European Serin (Serinus serinus), European Turtle Dove (Streptopelia turtur), Spotless Starling (Sturnus unicolor), European Starling (Sturnus vulgaris), Common Whitethroat (Sylvia communis), Hoopoe (Upupa epops), Northern Lapwing (Vanellus vanellus).

(c) A wealth of scientific evidence that can be used to construct a 'change of causality' to link output information (the provision of suitable habitat), result information (demonstration of benefit at the option or farm scale) and species population data to provide an estimate of the contribution agri-environment schemes are making to sustaining the populations of the more widespread farmland bird species.

It is suggested that progress towards achieving this indicator might be measured using three parameters:

(a) The farmland bird index

(b) A measurement of the area of habitat being provided under Axis 2 RDP Measures that is known to be of value to the farmland bird species tracked in the index

(c) Direct measurements of the populations of rare and localised farmland bird species known to have benefitted from agri-environmental management.

When reporting these three measurements it would also be necessary to include a short commentary, in particular to explain some of the other factors that may have affected farmland bird populations during the Programme period.

National populations of many widespread farmland birds are already monitored, but it has always proved difficult in the past to relate the observed trends to agri-environmental management. However, by 2013, there will be population data covering more than 7 years of large-scale agri-environment management in England. With this and the data collected from the previous links in the chain, it should be possible to analyse the population data for individual species and to correlate observed population changes against changes in the deployment of agri-environmental management designed to benefit these species. This analysis should then provide, in combination with the data for the rare and localised species, the best possible measurement of the extent to which RDPE has contributed towards the ultimate target of reducing the decline in farmland bird populations.

Data Sources: Geoff Radley, Evidence Team, Natural England quoted in the European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

CASE STUDY: FINLAND

An example of a MS using their own national baseline indicator

Finland has decided to use biodiversity baseline indicator no 17B "Bird indicator based on the ecological grouping of birdlife nesting in farmland". The indicator is defined as the average index of about 40 species and can be ecologically subdivided into species feeding in farmland and breeding in arable areas, field margins, forest areas or farmyards. Ecological grouping helps to identify the impacts in greater detail because species in different groups react to farming work, management and land use differently.

Data sources: RDP for Mainland Finland 2007-2013,

http://www.mmm.fi/en/index/frontpage/rural_areas/ruraldevelopmentprogrammes/strategyandprogramme20072013.html, quoted in the European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

CASE STUDY: AUSTRIA

Example of FBI data used for assessment of impacts on the measure level

Austria has decided to use as much existing FBI information as possible in capturing impacts at measure level because in Austria, AE measures have coverage of approximately 90% of agricultural land. Additional sampling has been set up (both professional counters and volunteers) to achieve big enough sample sizes for all indicator species. The FBI will be subdivided after several aspects (farming type arable/grassland, Natura 2000, LFA, etc) to allow deeper insights – as long as possible due to the sample sizes of the indicator species. This calculation will be done in 2010 for the mid-term evaluation.

Data source: BirdLife Austria, Norbert Teufelbauer, quoted in the European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

CASE STUDY 4: ESTONIA, AUSTRIA & FINLAND

Three examples from three MS, which highlight the need for highly specific approaches when applying the common impact indicator in the different settings

(1) What to do when no data is available – which data would help to evaluate the impact of the measures and what kind of special studies should be carried out? (Estonia)

Monitoring of populations of farmland birds in Estonia has challenges in reflecting general status of farmland biodiversity (baseline situation) and to fit to RDP or measure specific evaluation – for the calculation of FBI only few counting areas are used which also have small coverage of agricultural landscapes.

For capturing the impacts of Estonian AE measures for the RDP 2004–2006 period, a special farmland bird monitoring programme was started in 2005 in the frame of agri-environmental evaluation. Together with other biodiversity data, farmland birds are also monitored for the RDP 2007–2013 period on 66 farms in total, covering different regions (reflecting different soil conditions and agricultural intensities), farm sizes and farm practices (e.g. organic farms and conventional farms). A monitoring sample also consists of reference farms not participating in the agri-environmental scheme. Depending on the region and landscape structure, the composition of bird species may vary quite significantly in Estonia.

Birds are counted annually using the line transect method (0.5-2 km per field). Farmland bird data are analysed together with data for other taxa (especially bumblebees) and landscape.

In addition, the relationship between agricultural production and the possible impact of the agricultural support system on the bird population is studied in one of the pilot areas located in Räpu catchment.

Data source: Agricultural Research Centre, http://pmk.agri.ee/pkt, quoted in the European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

(2) Possibility to combine data from existing common bird monitoring and special measure specific studies (Austria)

For RDP 2000-2006 period, Austria used a special field study to evaluate agri-environmental effects on biodiversity (wildlife species, habitat diversity and landscape). Existing sampling data (e.g.

specific survey conducted in 1998) were used as much as possible to show the impact of the measure over a specific period of time. Ten sites covering two main Austrian landscape types with an area of 1 km^2 each were sampled repeatedly. At these sites, birds; plants and landscape features were mapped again in 2003 using the same method. Similarly, the spatial allocation of agri-environment measures in these sampling plots was documented. Thus an analysis of the impact of the agri-environment measures was possible as a time-based approach as well as a location-based approach. The development of biodiversity elements over a time period of five years was correlated with the applied agri-environment measures and the effect on biodiversity and landscape features was quantified.

Additionally, a simultaneous comparison of the biodiversity status between areas with and without specific agri-environment measures was made. This sophisticated approach responds to species diversity as well as to habitat and landscape diversity. The statistical analyses of the results provide sound information about the impact of the measures. It was concluded that for species diversity and habitat diversity, field surveys were the best method.

Enlargements of the sampling sites and increased numbers of samples are necessary and will certainly enhance the validity of the results. This study (comparison 1998-2003) did not distinguish between the effects of less intensively used land and the effects of the agri-environmental measures. A multivariate approach was not used, i.e. certain 'confounding variables' (e.g. soil productivity) were not taken into account. Therefore, the result that areas with a higher percentage of certain agri-environmental measures are associated with higher bird densities is not conclusive, as agri-environmental net effects were not identified. The association was simply with less productive areas where the uptake of certain measures is higher, because in practice they place fewer restrictions on farming. This 'mistake' is a very common one in evaluation studies.

Data source: E.Schweiger's presentation http://pmk.agri.ee/pkt/CD/index.php?page=2, Comments of Johannes Frühauf – BirdLife Austria, quoted in the European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

(3) Agri-environmental monitoring studies may produce positive side effects by offering baseline data and creating a base for comprehensive farmland biodiversity monitoring (Finland)

The efficiency of Finnish agri-environment support scheme has been studied in the MYTVAS 2 research project (2000–2006). Nature-Mytvas aims to estimate the effects of the supported agri-environmental measures on farmland biodiversity and landscape. It also produces baseline data on the level of biodiversity in ordinary Finnish agricultural areas on several taxa – birds, vascular plants, butterflies, day-active moths and bees. This creates a solid base for long-term monitoring of Finnish farmland biodiversity. Nature-Mytvas is further divided into two major parts: a large-scale species monitoring project conducted on a large group of randomly selected study sites, and several smaller case studies on the biodiversity effects of specific supported measures. MYTVAS3 continues these efforts during 2008-2013.

Data source: http://www.environment.fi/default.asp?contentid=200556&lan=fi&clan=en, quoted in the European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

(2) Maintenance of HNV farming and forestry

HNV farmland refers to farmland characterised by the presence of particular land cover types and patterns (especially semi-natural vegetation and low-intensity crop mosaics) which indicate that this farmland is valuable for nature conservation. The presence of populations of particular wildlife species may also provide this indication. HNV farmland may exist at different scales, from the individual parcel to an entire landscape.

HNV farming system refers to both the land cover (farmland) and the way it is managed for production by particular farming systems and practices. The term implies that the system as a whole (e.g. at farm or even landscape level) is of high nature value, whereas HNV farmland may be limited to only one parcel in an otherwise intensive farming system.

The same interpretation can be used for the terms HNV forest and HNV forestry system. The terms HNV farming and HNV forestry are used in this document to refer to the overall concepts without distinguishing land from management system.

The introduction of the term areas in Guidance note J of the Handbook on CMEF has led to some confusion. The HNV Guidance Document (EENRD, EC, 2008)[51] emphasises that the idea of the indicator is not to designate particular areas or zones as HNV. However, in practice, particular types of HNV farming and forestry may be concentrated in certain zones, and it may be useful to identify approximate zones as a practical basis for establishing appropriate indicators for monitoring tendencies within distinct zones.

The idea of the HNV concept is to contribute to nature conservation by supporting and maintaining the broad types of farming and forestry that favour biodiversity, because of their characteristics. The HNV Guidance Document explains the broad farming and forestry characteristics that are known to be critical for supporting nature value, and which then provide the basis for identifying HNV farming and forestry on the ground.

Three types of HNV farming have been defined:

- Type 1 – Farmland with a high proportion of semi-natural vegetation.
- Type 2 – Farmland with a mosaic of low-intensity agriculture and natural and structural elements, such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers etc.
- Type 3 – Farmland supporting rare species or a high proportion of European or World populations.

The overall challenge for Member States in order to implement this CMEF indicator is to:

- Devise a set of indicators that will provide meaningful information on changes in the extent and in the condition of HNV farmland and forests, and on trends in HNV systems and practices, during the seven years of the Rural Development Programmes.
- Devise a method for assessing to what extent (and how) these changes and trends have been influenced by RD programmes and measures.

[51] HNV Guidance Document on The Application of the High Nature Value Impact Indicator, available at: http://ec.europa.eu/agriculture/rurdev/eval/hnv/guidance_en.pdf.

CASE STUDY: GERMANY

Germany has taken the sampling approach to monitoring HNV farmland. A total of about 1,000 sites, each of 100 ha, are included in the survey. The sites were established originally for monitoring farmland bird species. Additional criteria, based on the HNV farming concept, have been incorporated. The system monitors the condition of relevant land cover elements, but does not monitor farming practices.

Under the applied method, an area or landscape element is classified as "agricultural land of high nature value" when its characteristics are of sufficiently high ecological quality. The assessment is made on the basis of the diversity of botanical species. Land units are allocated to five quality levels on the basis of a list of features, and are only assigned to the HNV farmland category once they have reached a certain minimum quality (Level 3 or higher). To this end, relevant assessment criteria have been drawn up for each land type or landscape element.

The listing of all units and landscape elements to be mapped and assessed, the assessment criteria and the additional mapping instructions are collated in a mapping manual and made available to the cartographers together with an aerial photograph for each sample area. The units are then surveyed on the ground using the technique of trans-sectional field walking. The mapping results entered on the aerial photograph are digitised and centrally collated. This ensures that the data are assessed uniformly at Federal level.

This method makes it possible to observe quantitative changes and also to record qualitative changes within the HNV farmland category. It is also possible to relate the development of HNV farmland to physical regions and regions which are defined according to ecological criteria (e.g. the North German Plain, the Alpine Foothills).

As the selection probability of the individual sample units is known, it is possible to extrapolate the overall quantity, i.e. the overall area of HNV farmland in Germany. Regular data gathering makes it possible to build up a picture of qualitative and quantitative changes in HNV farmland over time. This calculation is also possible for individual HNV farmland types (e.g. meadow orchards, HNV grassland etc.).

The statistically ingenious design of the survey minimises the cost of gathering data in the field and thus reduces the most significant cost factor. Coordination of data gathering across Germany, together with the use of a uniform method, ensures the homogeneity of the gathered data at national level.

The simultaneous use of the survey method for different biodiversity relevant monitoring programmes (including farmland birds and HNV) opens up a number of possibilities for extended utilisation, so that the causes of any desired or harmful developments can be identified quickly, and appropriate management measures taken where required.

Source: The European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

(3) Improvement in water quality

Changes in gross nutrient balance (GNB) is suggested by the CMEF to measure the improvement in water quality. These should be quantitative changes in the estimations of GNB that can be attributed to the intervention once double counting, deadweight, and displacement effects have been taken into account. The GNB indicates potential nutrient losses to the water bodies likely to be detrimental to the quality of water.

The data collection on the different programming levels is supposed to be conducted:

(a) by estimation by the programme evaluator at the level of direct and indirect beneficiaries on the basis of output and result data, survey data and benchmark data and coefficients from similar projects and past evaluations and modelling work (for calculation of double counting, deadweight, displacement).

(b) by cross-checking against the counterfactual situation and contextual trends in the programme area, particularly as regards relevant driving forces, pressures and responses.

(c) by estimation of the contribution to the general trend at programme area level (baseline trend), where feasible/statistically significant compared to other factors.

CASE STUDY: ITALY

"Difference in difference (DiD)" approach

(a) For definition of the unit of reference (UR), in Italy the cadastral sheet (a polygon that is an average of 100 hectares) is used, although for some information more aggregated data (NUTS5 or NUTS4) may be used;

(b) Classification of the territory according to agro-pedology and environmental characteristics (climate, geomorphology, soil, irrigated areas);

(c) Quantification of the agricultural units for crop type, action and for UR;

(d) Quantification of current total agricultural units that include both those conducted with conventional techniques and those following various actions (organic farming, integrated production, etc.);

(e) Definition of technical itineraries for single crop and for the homogeneous areas identified in step 2, both in conventional farms that in farms benefiting from measures. Inputs of mineral N+ manure and their mode of administration, use of pesticides – active periods and doses, grassing for arboriculture, irrigation. This data can come from farm surveys or from interviews with experts (field agronomists, farmers, local technicians, etc.);

(f) Estimation of total inputs of nitrogen and phosphorus (mineral + organic) and pesticides on farms receiving agri-environmental payments and on conventional farms;

(g) Estimation of surplus of nitrogen and phosphorus by nitrogen and phosphorus balance at farm level;

(h) Estimation of input and total surplus of nitrogen and phosphorus and pesticides in the investigated territory or farmland level through the results of Sections c, d, e, f and g;

(i) Quantification of indicators for estimating the effects of environmental measures on the input and on the surplus:

– Variation in total input of nitrogen, phosphorus and pesticides (kg and %) induced by any single measure;

– Variation in surplus of nitrogen and phosphorus (kg and %) induced by any single measure.

Challenges/limitations

(a) Difficulty in knowing the levels of use of minerals and organic fertilizers (input) for each farm: asking this information directly from the farmer has not always been appropriate, as farmers are reluctant to give too detailed information on their farm practices. However, well-designed questionnaires can succeed in obtaining more reliable information;

(b) The transition from micro to macro level is very complicated, due to a lack of information from

non-beneficiaries (unrepresentative sample). In the latter case, context data should be used but it often does not have the proper territorial (i.e. scale) level or is not updated. There is the need to work on a smaller scale of detail than NUTS4, because the regional farmland is very different with regard to landscape, agricultural practices, morphology, soil, climate, etc.;

(c) There is an agreement to share the methodology, for example using the same coefficients for the calculation of the surplus of nitrogen; but it is by far more difficult to harmonize the basic data for the analysis. In Italy there are regions with detailed data available, while in other regions data is practically absent.

Source: The European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

CASE STUDY: ESTONIA

Quality indicators in the RDP

There are 3 water quality indicators in the RDP of Estonia:

(a) Quality of the drainage water.

Drained fields with different environment support schemes are selected for the monitoring of drainage water quality. Water samples from the drainage system and discharge are collected and the concentrations of NO_3-, NH_4+, P, K and S measured four times per month. On the basis of plant nutrient concentration in the drainage water and the discharge, the leaching of every plant nutrient is calculated (kg/ha/year). On the same test fields, the total nutrient balance is calculated to compare the influence of different environment support schemes on the usage of fertilizers.

(b) Gross nutrient balance.

Data is collected annually from 2004 from approximately 120 agricultural enterprises. Monitoring companies and farmers are chosen from different Agri Environment Support (AES) scheme types: supporting Organic Farming (OF), Environmentally Friendly Production Scheme (EPS) and Environmentally Friendly Management Scheme (EMS). Farms are stratified by type of farming and by size. GNB is aggregated at farm level and calculated 01.January – 31.December (corresponding to the economical accounting period).

(c) Pesticide use

During the pesticide use study, data is collected from the Environmentally Friendly Production (EPS) and Environmentally Friendly Management (EMS) manufacturers. Pesticide use and number of pesticide treatments are aggregated at farm level and calculated 01.January – 31.December. The following data is collected during monitoring:

Cultivated cereals – type, treated and non-treated ha, yield (t/ha); Pesticide treatments –number of treatments, cereal type, ha, seed dressing (name, dose), herbicide (name, dose), fungicide (name, dose), insecticide (name, dose).

Source: The European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

(4) Contribution to combating climate change

The common impact indicator for climate change is defined in Guidance note J of the Handbook on CMEF as the "Increase in production of renewable energy", measured in units of ktoe (kilotonnes of oil equivalent). The indicator is defined as "quantitative and qualitative change in the production of renewable energy that can be attributed to the intervention once double counting, deadweight, and displacement effects have been taken into account".

CASE STUDY: NETHERLANDS, AUSTRIA & SPAIN

Assessment of climate change impact

Netherlands and Austria both provide a wider interpretation of the evaluation approach by considering how a broader suite of practices that can be attached to programme measures in other axes (1,2 & 3) deliver climate change impacts.

The Austrian example demonstrates how to evaluate the displaced emissions from support to investment in agricultural biomass plants for electricity generation and heating. The impact of such energy measures are straightforward to evaluate in terms of KTOe by using specific assumptions about energy displaced. The savings are estimated from an assumed proportion of farm households assumed to substitute this generation technology for at least 50% of current generation. Additionality can be gauged by using a stratified sample of adopters to ascertain the true effect of the support. The Austrian example also highlights how a range of policy-related agri-environmental measures can be associated with practices that affect nitrogen use (thus its manufacture emissions and its loss from application) and methane from livestock. These impacts can only be reflected in terms of CO_2e, which by implication is what Austria intends to report alongside KTOe.

The Dutch approach is similar, looking beyond Axis 2 and also considering how to measure impacts in terms of the more representative indicator CO_2e. The Dutch highlight the links to information contained in national greenhouse gas inventories collected for IPCC purposes. For example, IPCC Tier 1 data provides standard coefficients that can be used to quantify impacts of quantitative changes in stocking rates or nitrogen application on CO_2e. The national inventory contains sufficient information to be useful for highlighting the impacts of a range of agricultural, land use and forestry practices, but the Dutch contribution also highlights the challenge in isolating RD programme support from other CC interventions.

Spain: An approach that adheres rigorously to the CMEF interpretation of biofuel production and the KTOe indicator.

The approach combines a quantitative land use forecast (i.e. useable agricultural area) with qualitative interviews to evaluate a limited number of Axis 2 measures. The quantitative analysis considers the likely area to be recorded under miscellaneous biofuels. Interviews are used to understand the different crop choices and the extent to which these are likely to be used as substitutes for fossil fuels.

1. Assessment of the quantitative change in the production of renewable energy

In order to estimate the increase in production of potential renewable energy, the following sources have been taken into account:

- Energy crops: cereals, beetroot, sunflower, sweet stalk corn, energy grass.

- Residues from agriculture: roots, leaves, straw, non-usable fruits, pruning residues.

- Purpose-grown energy crops from forestry: poplars, eucalyptus, willow, acacia.

- Residues from forestry: pruning residues.

a) Identification of related measures:

According to the indicator description provided in the CMEF, the indicator addresses the following measures, 214, 216, 221, 222, 223, 224, 225, 226 and 227. To quantify the indicator, only the measures included in the evaluated RDP should be considered.

b) Assessment of the "positive impact area":

Based on the output indicators of supported land area or UAA related to the selected measures mentioned above, the positive impact area (SPP) covered by each measure and/or commitment is calculated. This area is defined as the land on which biomass for energy is expected to be produced. It is estimated using coefficients to define the degree of influence of each measure and/or commitment on the indicator, within the context of the evaluated RDP (coefficient P1 for measure 1, P2 for measure 2, etc.). In order to avoid double-counting, overlapping between different measures and/or commitments has been taken into account, using weighing coefficients, as in the example that follows:

ST_1: Area supported by measure 1

ST_2: Area supported by measure 2

s_{12}: overlapping % of measures 1 and 2. $s_{12} = (ST_1 * ST_2)/(ST_1 + ST_2)^2$

Thus, the area covered only by measure 1 is estimated as $S_1 = (1 - S_{12}) * ST_1$, and the area covered by both measures 1 and 2 is calculated as $S_{12} = s_{12} * (ST_1 + ST_2)$. In the cases of overlapping measures, the coefficients which define the degree of influence of each measure are estimated as $P_{12} = 1 - [(1 - P_1) * (1 - P_2)]$.Finally, the total area of positive impact for I7 indicator is the sum of SPP =Σ(Si * Pi).

c) Assessment of the potential biomass for energy production:

Once the expected SPP is estimated, next step is to determine the yield, in terms of biomass for energy production. For this purpose, different energy crop utilization coefficients are used, depending on the type of crop or residue expected to be produced under each measure. Depending on the source of the biomass, different calorific values are used to estimate the potential renewable energy kept within the kilograms of expected biomass. Finally, the potential renewable energy is transformed into KTOe.

2. Assessment of the qualitative change in the production of renewable energy

The qualitative aspects considered to be related with the potential production of renewable energy are the following:

- Type of carbon sink, in terms of type of source (agriculture/forestry, purpose-grown crops/residues) and crop and/or tree species
- Type of actions, in terms of preventive actions (e.g. reducing forest fires), restoring actions (after fires and/or other disasters) and increasing actions
- Type of area/habitat supported, (mountain/handicap/normal areas, Natura2000/ WFD/ Special protected areas)
- Degree of use of the potential renewable energy produced within the RDP

In order to gather the information required to assess these aspects, case studies will be carried out among the recipients of the selected measures and/or commitments.

Source: The European Evaluation Network for Rural Development (March 2010) Working Paper: Approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors. Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development.

3.3.5 Sustainability of delivery of data

Data is required to provide information on the progress in achieving RDP objectives annually by MS, on the basis of progress towards output and result indicators. Mid-term evaluation and ex-post evaluation are also scheduled at the mid point and end of the programme period to provide a more comprehensive assessment of the effectiveness of RDPs in terms of impact. Although there are EU guidance documents available for these evaluations, a common indicators framework and report templates, MS do not necessarily follow closely with the guidelines and data quality varies. Thus, while data will continue to be available as MS seek funding through this programme, completeness and quality may be variable.

In terms of policy change, there is currently a debate and consultation on how to support rural development beyond 2013. It is recognised that provision of public goods from EU agriculture should be the core of including the future RDPs, in response to the growing awareness of environmental concerns and the importance of natural resources and ecosystems in providing services which benefit society. This was recognised in the CAP Health-Check in additional rates of modulation to be focused on 'new challenges', (climate change, renewable energy, water management, biodiversity and dairy sector restructuring). This potential change towards more environmentally focussed RDPs emphasises the needs for a better monitoring and evaluation system of environmental impacts. This may require greater emphasis on collection of environmental data for RDPs in future.

3.3.6 Alternative sources of information

For the RDP programme-specific output and result indicators, data is collected primarily by the project/programme monitoring team as well as the input and financial data. However, for many baseline and impact indicators, data comes from a variety of sources and may only be supplemented by RDP evaluation surveys e.g. for impact indicators. These may be more relevant to some of the AEI.

3.3.7 Developments and progress

Additional guidance is being made available to MS in terms of common methodologies available to calculate more complex indicators such as impact indicators. However, these are unlikely to be followed exhaustively and it may be necessary to develop proxy indicators and more simple methods in order to achieve a complete and consistent dataset.

3.3.8 Potential synergies of reviewed data with AEIs

AEI indicator	Assessment of requirement/ provision under the RDP	Units and resolution
AEI 1 – Agri-Environmental commitments	• Physical area under AE commitment is a reporting requirement of Axis 2, as is total UAA as a baseline indicator. These data are consistent with the parameters 'Share of area under AE commitments/total UAA' and 'Area under AE commitments (per category). • Supported agricultural/ forest land under N2K are required for Measures 213 and 224, and where available are consistent with the parameters 'Area under AE commitments within N2K sites'. • Number of holdings under AE commitment is a reporting requirement of Axis 2, providing	• *Units*: Ha *Spatial resolution*: National *Temporal resolution*: Annual *Subdivision*: Measure • *Units*: Ha *Spatial resolution*: National *Temporal resolution*: Annual *Subdivision*: Measure • *Units*: Number *Spatial resolution*: National

AEI indicator	Assessment of requirement/ provision under the RDP	Units and resolution
	information for the parameter 'Share of agricultural holdings with AE commitments'. • Total expenditure for AE schemes, total RDP expenditure and total UAA are reporting requirements, providing data consistent with the parameter 'Share of total expenditure for AE payments' and 'AE payments/UAA'.	*Temporal resolution*: Annual *Subdivision*: Measure • *Units*: Euros *Spatial resolution*: National *Temporal resolution*: Annual *Subdivision*: Axis
AEI 2 – Agricultural areas under Natura 2000	• The agricultural area under Natura 2000 sites is a baseline indicator, as is total UAA, consistent with the parameter 'Share of UAA under N2K'. • Rural development expenditure is reported annually, and Natura 2000 payments are included in the measure 'Natura 2000 payments and payments linked to Directive 2000/60/EC (WFD)', but not applicable in all MS.	• *Units*: Ha *Spatial resolution*: National *Temporal* resolution: Varies • *Units*: Euros *Spatial resolution*: National *Temporal resolution*: Annual
AEI 3 – Farmers' training level and use of environmental farm advisory services	• The number of farmers using environmental farm advisory services is an output indicator of Measure 114 and is consistent with the main indicator. • The share of farmers with practical experience only, basic or full agricultural training is a baseline indicator for Axis 1, consistent with the parameter 'Share of farmers having practical experience, basic training and full agricultural training'.	• *Units*: Number *Spatial resolution*: National *Temporal resolution*: Annual • *Units*: % *Spatial resolution*: National *Temporal resolution*: varies
AEI 4 – Area under organic farming	• The area under organic farming is a baseline indicator for areas that have received some form of support from RDP funding.	*Units*: Ha *Spatial resolution*: National *Temporal resolution*: varies
AEI 7 – Irrigation	• Water use (irrigated area) is measured as an RDP baseline indicator, consistent with the parameter 'Irrigated area/ total UAA'.	*Units*: % UAA *Spatial resolution*: National *Temporal resolution*: varies
AEI 10.1 – Cropping patterns	• The portion of the UAA used for extensive arable crops and grazing is a baseline indicator.	*Units*: % UAA *Spatial resolution*: National *Temporal resolution*: varies
AEI 11.1 – Soil Cover	• The forested and wooded land area managed primarily for soil and water protection is a baseline indicator.	*Units*: Ha *Spatial resolution*: National *Temporal resolution*: varies
AEI 12 – Intensification/ Extensification	• Areas of extensive agriculture are required as a baseline indicator, having a weak link to the main AEI.	*Units*: % UAA *Spatial resolution*: National *Temporal resolution*: varies
AEI 14 – Risk of land abandonment	• The parameter 'Farms with farmer aged 55 years' can be determined from the baseline indicator 'Age structure'. • The FNVA/AWU per farm is included in the calculations for the impact indicator 'Economic growth'.	• *Units*: Ratio *Spatial resolution*: National *Temporal resolution*: varies • *Units*: Purchasing Power Standard *Spatial resolution*: National *Temporal resolution*: programme period

AEI indicator	Assessment of requirement/ provision under the RDP	Units and resolution
AEI 15 – Gross nitrogen balance	• Required for the baseline indicator 'Water Quality: Gross nutrient balances' and the impact indicator 'Improvement in water quality'.	*Units*: Surplus of N in Kg/ha *Spatial resolution*: National *Temporal resolution*: varies
AEI 16 – Risk of pollution by phosphorous	• Required for the baseline indicator 'Water Quality: Gross nutrient balances' and the impact indicator 'Improvement in water quality'.	*Units*: Surplus of P in Kg/ha *Spatial resolution*: National *Temporal resolution*: varies
AEI 19 – GHG emissions	• Required for baseline indicator 'Climate change: GHG emissions from agriculture.	*Units*: Ktoe *Spatial resolution*: National *Temporal resolution*: annual
AEI 21 – Soil erosion	• Required for baseline indicator 'Soil: Areas at risk of soil erosion'.	*Units*: Classes of T/ha/yr *Spatial resolution*: National *Temporal resolution*: varies
AEI 22 – Genetic diversity	• Under an output indicator of measure 214, MS should report on the number of livestock units for commitments relating to the conservation of local breeds in danger of being lost to farming. Where applicable to a MS, the number of actions relating to the preservation of genetic resources (crop and animal) should be provided under a separate output indicator.	*Units*: LUs/ number of actions *Spatial resolution*: National *Temporal resolution*: Annual
AEI 23 – High nature value farmland	• Required for the baseline indicator 'Biodiversity: High Nature Value Farmland areas' and impact indicator 'Maintenance of high nature value farming and forestry areas'. Not well developed.	*Units*: Ha *Spatial resolution*: National *Temporal resolution*: varies
AEI 24 – Production of renewable energy	• Required for the baseline indicators 'Climate change: production of renewable energy from agriculture and forestry' and 'Climate change: UAA devoted to renewable energy'. Also impact indicator 'Contribution to combating climate change'. No information on total energy production required.	*Units*: Ktoe & Ha *Spatial resolution*: National *Temporal resolution*: varies *Subdivision:* agriculture and forestry
AEI 25 – Population of farmland birds	• Required for baseline indicator 'Biodiversity: population of farmland birds'.	*Units*: Trends in population index *Spatial resolution*: National *Temporal resolution*: varies
AEI 27.1 – Water quality – Nitrate pollution	• Main AEI is required for baseline indicator 'Water quality: pollution by nitrates and pesticides'.	*Units*: Annual trends (mg/L NO_3) *Spatial resolution*: National *Temporal resolution*: varies
AEI 27.2 – Water quality – Pesticide pollution	• Main AEI is required for baseline indicator 'Water quality: pollution by nitrates and pesticides'.	*Units*: Annual trends (µg/L) *Spatial resolution*: National *Temporal resolution*: varies
AEI 28 – Landscape – state and diversity	• The AEI data requirements are loosely linked to Axis 2 and 3 payments in the RDP.	*Units*: number of commitments/ expenditure *Spatial resolution*: National *Temporal resolution*: annual *Subdivision:* Measure

3.4 Water Framework Directive

3.4.1 The data requirements including their scale and accuracy

Article 4(1) of the Water Framework Directive (WFD) commits Member States to achieve good status in all bodies of surface water and groundwater by 2015. In order to do this, each MS must first undertake an environmental analysis, or characterisation, of each river basin district under Article 5(1). A review of the existing pressures and impacts of human activities on the status of its water bodies is also required. Following pressure and impact analysis and prior to drawing up river basin management plans (RBMP), Article 8 requires that MS establish monitoring programmes to establish a coherent and comprehensive overview of water status within each river basin district. These monitoring programmes were to be operational by December 2006.

Characterisation

Each surface water body should be categorised as a river, a lake, transitional water (e.g. estuaries) or coastal water. Due to differences in features and pressures within different sections of a water body, MS identify separate sections of water bodies at a suitable scale to manage the objectives of the directive. Similarly, groundwater bodies are designated based on their geology and pressures.

Surface water bodies should be further characterised by type. The typology for rivers is given in Table 7 as an example.

Table 7: An example (for rivers) of the typology used for characterisation of surface water bodies under WFD

Fixed Typology	Descriptors
Ecoregion	One of 25 shown on a map in Annex XI of directive
Altitude	High: >800m Mid: 200 to 800m Low: <200m
Size based on catchment area	Small: 10 to 100 km^2 Medium: >100 to 1,000 km^2 Large: >1,000 to 10,000 km^2 Very large: >10,000 km^2
Geology	Calcareous Siliceous Organic

Member States are required to submit to the Commission GIS maps of the geographical location of the types consistent with the degree of differentiation specified.

Characterisation of surface water bodies enables reference conditions to be set for good ecological status by establishing type-specific hydromorphological, physicochemical and biological values expected when there is no anthropogenic influence. Type-specific reference conditions are to be defined by MS based on measurements or modelling, or a combination of the two. If this is not possible, expert judgement may be used.

The location and boundaries of groundwater bodies should be defined, and characterised by the type of overlying strata as well as their pressures (see section 2.4.1.2). Those groundwater bodies that have directly dependent surface water or terrestrial ecosystems should be identified. Those identified as at risk should be further characterised by the type of geology, hydrogeology, soils, and land-uses, along with other specific factors such as rate of recharge and chemical composition.

Identification of pressures and assessment of impacts

The WFD requires MS to identify any anthropogenic pressures on surface water bodies that may impact on water quality. These include significant point source pollution, significant diffuse source pollution, significant water abstractions, significant water flow regulation, significant morphological alterations, and land-use patterns.

Once the pressures have been identified, an assessment should be made of the susceptibility of each surface water body to these pressures, and hence the likelihood of them failing to achieve the environmental quality objectives. This assessment should make use of existing monitoring data where available, or can use a modelling approach.

For groundwaters, an initial characterisation is required to assess their uses and sensitivity to pressures. Pressures include point sources of pollution, diffuse sources of pollution, abstraction, and artificial recharge. For groundwater bodies that cross MS boundaries or are considered at risk following initial characterisation, further information such as the locations of abstraction and discharge points, rates of abstraction and discharge, the chemical composition of discharges, and the land-use in the catchment including pollution inputs and modifications to water routing is required.

The Directive requires the pressures and impacts analysis to identify water bodies as either 'at risk' or 'not at risk' of failing to achieve the environmental quality objectives. These classifications can then be sub-divided by, for example, the main pressure types to assist in implementing the follow-up steps and to increase transparency when reporting results.

Special protection

Under Article 6 of the WFD, MS are required to keep a register and maps of all bodies of water that have been designated as requiring special protection. These include;

1. waters used for the abstraction of drinking water under article 7
2. areas designated for the protection of economically significant aquatic species
3. waters designated as recreational waters[52]
4. nutrient-sensitive areas[53] (e.g. Nitrate Vulnerable Zones)
5. areas designated for the protection of habitats or species where water quality is an important factor in their protection[54] (e.g. some Natura 2000 sites)

Monitoring

Article 7 and Annex V of the directive address the monitoring requirements, which are used by MS to classify the ecological status of each water body on a five-class scale – high, good, moderate, poor and bad. The classification is based on the magnitude of the deviation from the physico-chemical, hydromorphological and biological reference values for that type of water body under minimal

[52] Under Directive 76/160/EEC

[53] Under Directives 91/676/EEC or 91/271/EEC

[54] Under Directives 92/43/EEC or 79/409/EEC

anthropogenic influence.

Monitoring allows MS to assess the effectiveness of the measures implemented to achieve good status, and the progress towards this target. A common approach to monitoring water quality across MS is specified by the directive, however it is left to the individual MS to decide on the best methodology to use based on existing approaches and local circumstances.

In 2001, the Commission and the Member States agreed upon an informal programme of cooperation to develop a unified approach to address the challenges of WFD implementation, known as the Common Implementation Strategy (CIS)[55]. A number of technical guidance documents have since been produced, two of which are relevant to monitoring[56].

The directive required monitoring programmes to be in place by December 2006.

There are three types of monitoring specified:

1. *Long-term surveillance monitoring*, the purpose of which is to provide a broad understanding of the health of water bodies and tracks slow changes;
2. *Operational monitoring*, which focuses on the main pressures of water bodies that do not already have good status;
3. *Investigative monitoring*, which is carried out when a MS needs further information that cannot be obtained from (2) – for example from pollution accidents.

More in-depth monitoring is required for water bodies that are protected for drinking water, or for natural habitats and species.

Surface water monitoring

Monitoring for surface waters should cover the ecological and chemical status of natural water bodies. Biological quality elements are used to assess ecological status, supported by hydromorphological, chemical and physico-chemical quality elements. Biological elements are measurements of the composition and abundance of four community types – phytoplankton; other aquatic flora; benthic invertebrate fauna; fish fauna – for each category of water body. Supporting hydromorphological elements are – hydrological regime; river continuity; morphological conditions; and tidal regime. Supporting chemical and physico-chemical elements include general measurements such as transparency, thermal conditions, oxygenation conditions, salinity, acidification status and nutrient conditions; as well as pollution by priority and other substances. Estimates of the level of confidence and precision of the data are to be provided in the river basin management plans. Chemical status (good or bad) is defined by compliance with the quality standards set for chemical substances at European level.

A surface water monitoring network should be established with the aim of providing a consistent and complete picture of the ecological and chemical status of water bodies within a river basin. The monitoring programme should be designed following pressure and impact analysis to determine the type and frequency of monitoring required.

The selection of surveillance monitoring sites should be based on criteria in the directive relating to the importance of the water body. Generally, all quality elements and pollutants should be monitored at sites for at least one year during the six-year RBMP. For operational monitoring, the quality elements that should be measured depend upon the pressures and impacts on the water body. Monitoring frequency is

[55] Available at http://ec.europa.eu/environment/water/water-framework/objectives/pdf/strategy.pdf

[56] Guidance Document No 7: Monitoring under the Water Framework Dirctive (2004)
Guidance Document No 15: Guidance on Groundwater Monitoring (2006)

to be chosen by MS, but minimum frequencies are provided in Annex V of the WFD as a guide, and range from continuous to every 6 years depending on the quality element and the type of water body.

Groundwater monitoring

Monitoring for groundwaters should cover the chemical and the quantitative status of the water bodies. Good chemical status is achieved if the concentrations of pollutants do not exceed the quality standards set by other relevant Community legislation[57], and if conductivity measurements do not indicate any infiltration of saltwater or other harmful substances. Quantitative status relates to groundwater level. Good quantitative status is attained if abstraction does not exceed the available groundwater resource; that is what is left once the needs of the connected ecosystems have been accounted for.

A groundwater monitoring network should be established with the aim of providing a comprehensive overview of groundwater chemical status, an accurate assessment of quantitative status, and identification of any long-term upward trends in pollution.

Under surveillance monitoring, MS should monitor at least the core parameters – oxygen content; pH; conductivity; nitrate; ammonium – at least once during the six-year planning cycle. Additional parameters should be measured if deemed necessary following the pressures and impacts assessment. An operational monitoring programme should be established following the results of the surveillance monitoring, and should be targeted at those water bodies at risk of failing to meet the environmental objectives. This should take place at a frequency of at least once a year, and maybe more depending on the pollutant.

Additional requirements for protected areas

The purpose of additional monitoring in protected areas is to assess compliance with environmental objectives under the relevant Community legislation. Surface water bodies protected for abstraction of drinking water under the EU Drinking Water Directive[58] must be monitored for all priority and other substances discharged in quantities that could affect their status. Monitoring frequency is dependent on the size of the community served. Water bodies in Natura 2000 areas must be included in operation monitoring networks if their status is less than good, and should continue to be monitored until they satisfy the water-related requirements of their legislation.

Intercalibration

Due to the different methodological approaches adopted by MS for assessing ecological status, an intercalibration exercise is required to ensure that the classification system is consistent and comparable across MS. The intercalibration exercise is facilitated by the Commission's Joint Research Centre, and carried out by research consortiums such as WISER[59] using a network of intercalibration sites. MS must translate the results of the intercalibration exercise into their national classification systems to set boundaries between high and good, and good and moderate status. The first results were published in 2008, however the intercalibration process is still ongoing.

3.4.2 The reporting requirements: timescale, format, quality

The implementation timescale of the WFD is as follows;

- **December 2003**: transposition of the WFD into national law.

[57] Groundwater Daughter Directive 2006/118/EC in accordance with Article 17 WFD

[58] Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption

[59] http://www.wiser.eu

- **June 2004:** Identification of river basins and set up of administrative arrangements (Article 3 report). The contents of the report are specified in Annex I and include the geographical coverage of the river basin districts, details of the competent authority, and the form of the international relationship for international river basin districts. For Article 3, reporting was based on river basins and river basin districts at the Member State level.
- **March 2005**: Pressure and impact analysis of river basins and economic analysis of water uses (Article 5 report). The process and the results of the analysis should be transparent, comprehensible and all data and information used in the analysis should be made available to the public. The analysis will help develop a targeted monitoring network, but is not a classification of the status of water bodies. A gap analysis explaining missing or incomplete data should also be carried out. Reporting was at the individual RBD level.
- **March 2007**: Establishment of monitoring programmes for assessment of water status by December 2006 (Article 8), with a reporting deadline of March 2007. The Article 8 report should have been submitted electronically through the Water Information System for Europe (WISE) using the REPORTNET facility of the European Environment Agency. Reporting was based on an individual RBD but it was possible to report for a part of an RBD and specify the reporting level to clarify what was being reported.
- **December 2008**: Publication of draft river basin management plans for public consultation (Article 14)
- **March 2010**: Reporting of final river basin management plans (Article 13) including programme of measures and register of protected areas.
- **December 2012**: Programme of measures operational at the latest (Article 11). Report on progress in implementation of programme of measures required within 3 years of publication of the RBMPs.
- **December 2015**: Achievement of good status for surface and groundwater (Article 4) and first update of the river basin management plan. Interim report on implementation of programme of measures.

As part of the reporting requirements, MS are required to provide summary text for each RBD detailing their methodologies used for delineating water bodies (Article 3); pressure and impact analysis (Article 5); determining the quality elements and class boundaries; establishment of groundwater threshold values; combining QEs to define the final status class; and assessing groundwater chemical and quantitative status. Summary text for monitoring programmes is also requested, covering the methodology used for selecting sites for monitoring; selecting the monitoring frequencies for each QE; and the sampling and analysis.

Article 18 of the Directive requires the Commission to publish reports on the implementation of the Directive and submit them to the European Parliament and the Council. The Commission carries out compliance checking to ensure the regulations are being implemented in the MS. This involves the use of compliance indicators, the information required for which are part of the reporting requirements for MS.

The EC (DG Environment, Joint Research Centre and Eurostat) is currently developing an electronic data and information system on water (WISE) to help streamline the reporting exercise. Guidance documents for reporting under WFD have been produced, along with guidance on electronic submission. The public portal for WISE[60] has been available since March 2007, and compiles all water-related data and information collected at EU level.

[60] http://water.europa.eu

No legally binding reporting formats have been developed, since they would result in many MS being non-compliant with the Directive, and would lack flexibility if any improvements or adaptations were introduced. In order to increase the comparability of reports across MS, guidance documents use the format of Reporting sheets (Table 8), which are not legally binding but are a voluntary commitment by MS to submit this information to WISE. These have recently been consolidated into an integrated guidance document[61] on reporting on EU water policies under WISE. There has also been a review of the Article 3, 5 and 13 schemas for reporting to simplify their structures and reduce duplication to help MS meet their reporting obligations under WFD.

Table 8: Reporting sheets involved in the WFD reporting process for 2010, which have been consolidated in the combined guidance

Reporting sheets	
CA1	Competent Authority
RBD1	River Basin District
SWB1	Identification of surface water bodies, artificial water bodies and HMWB
SWB2	Typology of Surface Water Bodies
SWPI1	Summary of Pressure Types Causing Water Bodies to Fail to Reach Good Status
SWPI2	Identification of Surface Water Bodies at Risk
SWPI3	Significant Point Source Pollution of Surface Waters
SWPI4	Significant Diffuse Source Pollution of Surface Waters
SWPI5	Significant Water Abstractions from Surface Waters
SWPI6	Significant Water Flow Regulations and Morphological Alterations
SWPI7	Other Pressures on Surface Waters Not Covered by Other Reporting Sheets
SWPI8	Summary Assessment of the Impacts on Surface Water Bodies
SWPI9	Uncertainties and Data Gaps
RPA1	Register of protected areas
GWB1	Identification/Delineation of groundwater bodies
GWPI1	Summary of pressure types causing groundwater bodies to fail to reach good status
GWPI2	Identification of Ground Water Bodies at Risk
GWPI3	Relevant Point Source Pollution to Groundwaters
GWPI4	Relevant Diffuse Source Pollution in Groundwater
GWPI5	Relevant Groundwater Abstractions
GWPI6	Relevant Artificial Groundwater Recharge
GWPI7	Relevant Saltwater or Other Intrusion
GWPI8	Other Pressures on Groundwaters not covered by Other Reporting Sheets
GWPI9	Summary Assessment of the Human Impacts on Groundwater Bodies
GWPI10	Further characterisation – Summary Information
GWPI11	Uncertainties and Data Gaps
GIS	Geographical Information Requirements and Water Body Attributes
GWD1	Reporting requirements for the Ground Water Directive

The data reporting requirements under each reporting stage are detailed in the following sections.

[61] Common Implementation Strategy for the Water Framework Directive (2000/60/EC) Technical Report – 2009 - 029

Reporting requirements for Article 3 (identification)

For each **river basin district** (RBD), the following GIS and attribute data are required;

- The RBD boundaries
- Sub-unit boundaries
- The main rivers within the RBDs with a catchment area of ≥500km2 and their lengths
- The lakes assigned to the RBDs and their areas
- Transitional waters relating to the main rivers in the RBD and their areas
- Coastal waters that have been assigned to the RBDs and their areas
- Transboundary groundwaters that have been assigned to the RBDs.

Reporting requirements for Article 5 (characterisation, pressure & impact assessment)

A separate summary report is required for each RBD.

For each **surface water body** type in the RBD, a shapefile/GML is required with the boundaries of the water body catchments, to include following attributes;

- Water body code & name
- Centroid
- Size at 1:250,000 scale
- Significant point source discharges - type, point location, and whether or not the water body is affected
- Significant water abstractions - type, point location, and whether or not the water body is affected
- Water flow regulations and morphological alterations - type and whether or not the water body is affected
- Significant saltwater or other intrusion - whether or not the water body is affected
- Other pressures - type and whether or not the water body is affected
- Impacts – type identified
- Protected areas – whether water body is within or overlapping a protected area, and the type of protected area

For each **groundwater body** (GWB) in the RBD, a shapefile/GML is required with the boundaries of the GWB or groups of GWBs >100km^2, to include following attributes if available;

- Water body code & name
- Centroid
- Layered (Y/N)
- Average depth to groundwater body (m)
- Average thickness of groundwater body (m)
- Assignment to a depth range (0-20m, 20-50m, 50-200m, >200m)
- Directly dependent aquatic ecosystems (Y/N)

- Directly dependent terrestrial ecosystems (Y/N)
- Geological formation – aquifer type
- Type of vertical orientation of GWB
- Volume of aquifer (m3)
- Relevant point source discharges to groundwater – type and point location
- Relevant diffuse source pollution to GWB – type and whether or not water body is affected
- Relevant abstractions from groundwater – type, point location and whether or not water body is affected
- Relevant artificial recharge of groundwater - type and whether or not water body is affected
- Significant saltwater or other intrusion - whether or not water body is affected
- Other pressures - type and whether or not water body is affected
- Impacts – type identified
- Protected areas – whether water body is within or overlapping a protected area, and the type of protected area

Key pressures present in the RBD likely to cause water bodies to be of less than good status should be reported. The specific data required to be reported for each **sub-unit or RBD** are;

- The number of water bodies at risk of failing to reach good status as a result of each pressure type (point sources, diffuse sources, abstractions etc.) for each water body category. The reporting categories are: 1a – At Risk; 1b – Probably At Risk; 2a – Probably Not At Risk; and 2b – Not At Risk.
- The number of significant/relevant point sources
- Loads (monitored, calculated or estimated) of pollutants discharged to surface waters
- Number of significant/relevant abstractions and volumes abstracted per year or in different seasons by category of abstraction
- Water balance (for groundwater)
- Number of relevant recharges and volumes recharged by category of recharge

Reporting requirements for Article 8 (monitoring programmes)

For each surveillance and operational **monitoring programme** and for each **surface water category**, the following data are required;

- Intended start date
- Total number of monitoring sites and expected monitoring frequency for each QE
- List of Priority Substances and other substances discharged in significant quantities to be monitored
- The status/potential class boundaries for each relevant QE (an example is provided in Table 9)

Table 9: Example of the monitoring programme information requirements for surface water bodies

Water category	QE	National method	National type	Type description	Reporting units	Reference conditions
Rivers	Dissolved oxygen	In-situ measure	Type R1; R2 etc.	Small, high altitude, low alkaline	5-percentile mg O_2/L	9
	Macro-inverts	GREB			EQR	1

High-Good boundary	Good-Moderate boundary	Moderate-Poor boundary	Poor – bad boundary	Does boundary reflect result of intercalibration exercise?	Can MS implement QE at this stage?
7.5	6				
0.86	0.65			Yes	

Whilst the intercalibration exercise was carried out to ensure consistency in the definitions of high and good ecological status across MS, the information in the example above is requested to ascertain whether or not MS have applied the results of the intercalibration to their national data. The information is also needed in order for the EC to review the completeness of the data, i.e. if class boundaries have been defined for all waterbody types and quality elements.

For each surveillance and operational **monitoring programme** for **groundwaters**, the following data are required;

- Intended start date
- Total number of monitoring sites
- Total number of protected areas used for drinking water abstraction for which there are groundwater monitoring sites associated
- List of parameters (mainly level and pollutants) expected to be monitored

The following information on the **classification** used for **groundwater** bodies should be reported for each **RBD**;

- The Threshold Values (TV) established in accordance with Article 3 of the Groundwater Directive
- The TVs established for nitrates and pesticides
- The starting point for trend reversal (% of TV)

For each **surface water monitoring site**, the following data are required;

- Unique ID
- Link to code(s) of WBs reported under Article 5
- Site grid reference
- Surveillance or operational monitoring site, or both
- Whether or not site located in a protected area – type
- Whether site is part of the intercalibration network

- Whether site is part of existing international monitoring networks

For each **groundwater monitoring site**, the following data are required;

- Unique ID
- Link to code(s) of GWBs reported under Article 5
- Site grid reference
- Type of monitoring site – well or spring
- Quantitative or chemical monitoring site or both
- Use of monitoring site – drinking water supply; industrial supply etc.
- Whether site is part of existing international monitoring networks
- Sampling depth

No specific monitoring results at monitoring site level are required at present.

Reporting requirements for River Basin Management Plans

For each **RBD/sub-unit**, data are required to enable maps of **surface water status** to be produced;

1. Ecological status class of natural water bodies, and on which Biological quality elements the assessment is based
2. Ecological potential class for heavily modified water bodies
3. Status for protected areas and reasons for failure (if not reported under other Directives)
4. Achievement/exceedance of EQS for heavy metals out of a list of Priority Substances
5. Achievement/exceedance of EQS for pesticides out of a list of Priority Substances
6. Achievement/exceedance of EQS for industrial pollutants out of a list of Priority Substances
7. Achievement/exceedance of EQS for other pollutants out of a list of Priority Substances
8. Achievement/exceedance of EQS for other pollutants

Data to enable the following **groundwater-related** maps to be produced at RBD level will be required;

- Quantitative status of groundwater bodies (good or poor)
- Chemical status of groundwater bodies (good or poor)
- Achievement/exceedance of standard for nitrates
- Achievement/exceedance of standard for pesticides
- Achievement/exceedance of threshold values set by MS for other pollutants
- Groundwater bodies with environmentally significant and sustained upward trend in pollutant concentrations and groundwater bodies in which trends have been reversed

MS should also provide information on any missing data for quality elements and a qualitative indication of the confidence in the status class (low to high). Monitoring data should be provided at the monitoring site level for reports produced when monitoring is operational.

3.4.3 Availability and quality of data at a Member State level

Under Articles 3 & 5

A communication document from the Commission to the European Parliament and the Council[62] and the accompanying working document[63] provide a summary of progress of Member States' implementation of the WFD under Articles 3 & 5. The Commission developed a methodology for assessing the performance of MS against the requirements of the Directive from their reports using a set of performance indicators.

Implementation of Article 3 resulted in the establishment of 110 RBDs across the EU, 40 of which are international. The submission of data was largely satisfactory, and most MS have provided GIS data. Under Article 5 reporting, more than 70,000 surface water bodies were defined, of which an average of 40% were identified as being at risk of failing to achieve the environmental objectives by 2015. No risk assessments were reported for Finland, Sweden, Greece and Italy, whilst the Slovakian risk assessment did not cover all surface water bodies. Overall, the result of risk assessment was inconclusive for around 30% of surface water bodies. An average of 30% of groundwater bodies in the EU were identified as being at risk. No risk assessments were reported by Finland, Greece and Italy for groundwater bodies, whilst Germany, Sweden, France and Lithuania did not provide sufficient data. Overall 45% of groundwater bodies had insufficient data for conclusive risk assessment.

Only 12 MS reported information on the relative importance of different pressures and impacts for surface waters, and only five provided complete information on the main pressures. From the information available, it was concluded that point source pollution, diffuse source pollution and water flow regulations/morphological alterations are the most significant pressures on surface waters. Availability of information on priority chemical substances varies considerably between MS and is often very incomplete. Levels of EQS are very variable, and inventories of significant pollutants and their loads are often not provided. For groundwaters, quantitative pressures are a particular problem in MS that are highly dependent on groundwater for water abstraction.

The results of the average performance indicator ranges for analyses of characteristics; pressures, impacts and risk assessment for surface waters and groundwaters, of each RBD as assessed by the EC are compared in Appendix E. The MS scoring most highly for the completeness and quality of Article 5 analyses include Austria, Belgium, Cyprus, Czech Republic, Luxembourg, The Netherlands and Slovakia. Those scoring poorly include Finland, Greece and Italy.

Under Article 8

A second communication document from the Commission[64] and the accompanying working document[65] provide a review of MS' implementation of Article 8. The information submitted in MS monitoring reports was analysed for completeness and clarity by the use of compliance indicators. These were used to enable a harmonised comparison of implementation efforts and results across MS. The key issues that were addressed were:

1. Whether or not the objectives of WFD been taken into account in the design of the monitoring programme

[62] Towards sustainable water management in the European Union – First stage in the implementation of the Water Framework Directive 2000/60/EC. COM(2007) 128 final

[63] SEC(2007) 362

[64] Report from the Commission to the European Parliament and the Council in accordance with article 18.3 of the Water Framework Directive 2000/60/EC on programmes for monitoring of water status. COM(2009) 156 final

[65] SEC(2009) 415

2. Whether or not the monitoring programmes are comprehensive
3. Whether or not methods are available for the assessment of water status
4. Which quality elements are used for the assessment of water status
5. The frequency of monitoring.

At the time of the assessment, Greece had not reported and Malta had not reported on its surface water monitoring programmes. 24 MS reported electronically through WISE. Poland reported electronically but not in the agreed format. Malta reported on paper only, and Romania reported too late into WISE. The quality of information in the reports varied enormously, with some reliant on secondary reports that were not always available.

Data on the number of monitoring stations overall, and the number per 1000 km2 are shown in Appendix E. The latter gives a crude overview of monitoring effort, although this will also be dependent on number of quality elements measured and the frequency of monitoring. Also, countries with a larger number of river basins will require more monitoring stations to achieve the same level of confidence, and countries with a high number of water bodies at risk of failing the environmental objectives would require more monitoring stations. Nevertheless, the UK and Ireland have a significantly higher monitoring station density than other MS, and Finland, significantly lower. There are also large disparities in the relative number of surveillance to operational monitoring sites, suggesting that interpretation of the WFD requirements differs across MS.

Annex V of the WFD requires surveillance monitoring to be carried out for parameters indicative of all biological quality elements. The percentages of surveillance monitoring sites at which all relevant biological QEs are measured are shown for each MS in Appendix E. It was not possible to extract the necessary information from the reports of Denmark, Ireland and Latvia, and Finland did not report the water bodies in which the monitoring sites are located. Italy did not indicate which quality elements are monitored at their sites. Only Bulgaria, Czech Republic and Luxembourg were monitoring all biological QEs across their surveillance monitoring network at this time. Most MS are monitoring more frequently than the minimum 6 year cycle required by the WFD for surveillance monitoring.

For surface water bodies assessed as ‘at risk’, operational monitoring is required under WFD. The percentages of ‘at risk’ water bodies that were included in operational monitoring by MS are shown in Appendix E. This provides a crude assessment of the degree to which operational monitoring programmes are based on the results of the risk assessment. The WFD allows grouping of similar water bodies from which a sample can be drawn, and the status of those not monitored inferred from this sample, therefore it is not a requirement for this value to be near 100%. The more water bodies that are monitored however, the greater the confidence in the estimate of the status results. There is generally a lack of information in reports on the level of confidence and precision of the monitoring results, therefore it is difficult to assess the adequacy of those monitoring programmes for which a lower proportion of ‘at risk’ water bodies are being monitored.

The stage of development of methods for the assessment of ecological status varies considerably between MS; in many cases no information was available in the report. No MS provided complete information on the level of confidence and precision of the methods developed.

The numbers of quantitative and chemical groundwater monitoring stations per 1000 km2 land area per MS are shown in Appendix E. Some stations are used for both. This indicates a large degree of variation between MS, but the size of the country and the dependency on groundwater abstraction will greatly affect these figures. Nevertheless, a harmonised approach to groundwater monitoring seems to have been applied across RBDs. MS reports indicate that the vast majority of RBDs will be subject to quantitative

monitoring and chemical surveillance monitoring every year for the first planning cycle.

It was inferred from the RBD reports that the quality elements selected for surveillance monitoring fully met the requirements of the WFD, although a few are not detailed enough to be conclusive – Portugal, Hungary, Latvia and Luxembourg for example do not include monitoring of specific pollutants. The percentages of groundwater bodies included in chemical operational monitoring for each MS are given in Appendix E. In most RBDs where it occurs, operational monitoring covers all core parameters and specific pollutants. France and Portugal only monitor nitrates among the core parameters.

River Basin Management Plans

Reporting of final RBMPs was due in March 2010. At the time of writing, 15 MS had adopted their RBPMs by the deadline, three were awaiting decisions from the consultations. For the remaining nine, consultations were still ongoing (Appendix E). A number of international RBDs have published RBMPs, including Danube, Rhine, Elbe, Ems, Meuse and Scheldt. The current situation, along with web-links to the available RBMPs, is available through WISE[66].

The European Environment Agency have recently (May 2010) published databases on the status and quality of water bodies across Europe, which incorporate data collected annually through WISE, including data reported for WFD. Quality control documentation is provided with these datasets. There are three datasets publicly available via WISE. 'Waterbase – Lakes' contains data on nutrients and organic matter, pressure data for the upstream catchments and physical characteristics of the lake monitoring stations. 'Waterbase – Rivers' contains data on nutrients and organic matter, pressure data for the upstream catchments and physical characteristics of the river monitoring stations. 'Waterbase – Groundwater' contains data on physical characteristics and pressures of the groundwater bodies, chemical quality data on selected nutrients and hazardous substances, characteristics of sampling sites and data on saltwater intrusions.

3.4.4 Member States collecting the best data for policy requirements

The Article 8 reports of Austria, Czech Republic and Hungary are cited as examples of good practice in the 2009 report from the EC to the European Parliament, in that they show a clear approach to the development of WFD monitoring programmes. The reports from Ireland and the United Kingdom show that a significant monitoring effort has been made to ensure high confidence in the results. Austria and Czech Republic have been chosen for case studies due to their consistent quality and completeness of reporting and data collection.

[66] http://ec.europa.eu/environment/water/participation/map_mc/map.htm

CASE STUDY: AUSTRIA

Austria is situated in three river basin districts, Danube, Rhine and Elbe, all of which are international. The numbers of water bodies in each RBD are shown in Table 10. The number of river water bodies only includes those with catchments larger than 100km2. The numbers of monitoring stations in each RBD by type are shown in Table 11.

Table 10: Austrian river basin districts and number of water bodies

RBD	Surface (km^2)	% National territory	Number of river water bodies	Number of lake water bodies	Number of transitional water bodies	Number of coastal water bodies	Number of groundwater bodies
Danube	80565	96	863	55	0	0	128
Rhine	2365	3	57	5	0	0	7
Elbe	921	1	20	2	0	0	1
Austria	**83851**	**100**	**940**	**62**	**0**	**0**	**136**

Table 11: Numbers of surveillance, operational and quantitative monitoring stations in Austrian RBDs

RBD	Rivers		Lakes		Transitional waters		Coastal waters		Groundwaters		
	Surv	Op	Surv	Op	Surv	Op	Surv	Op	Surv	Op	Quant
Danube	69	451	32	1	-	-	-	-	1926	247	3050
Rhine	7	32	1	0	-	-	-	-	72	0	302
Elbe	0	14	0	0	-	-	-	-	14	0	7
Total	**76**	**497**	**33**	**1**	**-**	**-**	**-**	**-**	**2012**	**247**	**3359**
Total number of stations	**550**		**33**		**-**		**-**		**2012**		**3359**

Austria has established surveillance, operational and investigative monitoring programmes for surface waters, with specific sub-programmes for rivers and lakes. Surveillance monitoring is carried out in the first year of the 6-year monitoring cycle and repeated over the following five years for a selection of quality elements. More than 90% of water resources are covered by surveillance monitoring. Operational monitoring covers rivers with catchments larger than 100km2. Monitoring of smaller river catchments is expected to start in December 2010 (1500 additional sites estimated). The pressure and impact analysis has informed the selection of operational monitoring sites.

Austria has provided complete information on methods for assessment of biological quality elements for surface water where relevant, and justifies a lack of method where absent. Qualitative estimates of the expected level of confidence for each method are provided. The WFD intercalibration results have been correctly applied to the national methods to establish class boundaries. All quality elements are monitored at higher than the minimum required frequency, with the exception of phytoplankton in rivers and macroinvertebrates in lakes, which are not measured.

Austria has established surveillance, operational and quantitative monitoring programmes for

groundwaters. There are three sub-programmes for quantitative assessment and two sub-programmes for surveillance monitoring, the latter being set up to monitor long-term trends. The criteria for selection of sites are listed, with pressure and impact analysis informing the selection of surveillance monitoring sites. Operational monitoring has only been set up for the Danube RBD at present.

All core parameters for groundwater monitoring are listed in the report. Monitoring is to be carried out every year for the first cycle, at monthly intervals, or daily for stations with an automatic data logger.

International river basin management plans have now been published and adopted on 30th March 2010 for the Danube, Rhine and Elbe. This required international cooperation, with a nominated body co-ordinating the development of each plan. For the Danube for example, the co-ordinating body is the International Commission for the Protection of the Danube River (ICPDR)[67]. The Danube RBMP focuses on the main transboundary water management issues, including a joint programme of measures. The plan also includes;

- A description of the significant pressures
- An overview of the monitoring networks
- An assessment of the ecological and chemical status
- A final designation of Heavily Modified Water Bodies
- An overview on exemption according to the WFD
- An economic analysis of water uses
- A brief overview of water quantity issues and climate change
- An outline of public consultation and participation
- An inventory of protected areas

In summary, Austria had a clear concept for developing the monitoring programmes following WFD requirements, which they presented clearly in a report of good quality. They have also successfully achieved international coordination in their international RBDs.

CASE STUDY: CZECH REPUBLIC

Czech Republic is also situated in three river basin districts, Danube, Oder and Elbe, all of which are international. The numbers of water bodies in each RBD are shown in Table 12. The numbers of monitoring stations in each RBD by type are shown in Table 13.

[67] http://www.icpdr.org/icpdr-pages/river_basin_management.htm

Table 12: Czech river basin districts and number of water bodies

RBD	Surface (km^2)	% National territory	Number of river water bodies	Number of lake water bodies	Number of transitional water bodies	Number of coastal water bodies	Number of groundwater bodies
Elbe	49933	63	600	50	0	0	97
Danube	21688	28	301	17	0	0	40
Oder	7246	9	127	8	0	0	24
Austria	**78867**	**100**	**1028**	**75**	**0**	**0**	**161**

Table 13: Numbers of surveillance, operational and quantitative monitoring stations in Czech RBDs

RBD	Rivers		Lakes		Transitional waters		Coastal waters		Groundwaters		
	Surv	Op	Surv	Op	Surv	Op	Surv	Op	Surv	Op	Quant
Elbe	67	528	16	41	-	-	-	-	333	333	451
Danube	32	137	6	22	-	-	-	-	104	104	156
Oder	12	170	5	13	-	-	-	-	25	25	63
Total	**111**	**835**	**27**	**76**	**-**	**-**	**-**	**-**	**462**	**462**	**670**
Total number of stations	**885**		**76**		**-**		**-**		**462**		**670**

The Czech Republic has applied the same methodologies and standards to all three of their RBDs for surface water monitoring. They have specific programmes for operational, surveillance and investigative monitoring, based on WFD objectives and national Water Law. For surveillance and operational monitoring, there are sub-programmes for rivers and lakes. The applied criteria are consistent with WFD guidance, and the validation of the pressure and impact analysis is included in the objectives. Site selection for the surveillance monitoring network was influenced by meeting at least one of the WFD selection criteria, but no reference sites were included. Operational monitoring is based on existing programmes, upgraded to meet the aims of WFD and other commitments.

A thorough description of the methods and standards used for biological quality elements is provided in the report, although no information of confidence levels is included. Methods are available for the assessment of all biological quality elements for rivers and lakes. The results of the WFD intercalibration exercise have not been incorporated into national methods or parameters. Both surveillance and operational monitoring of surface waters is conducted once every three years, with 1 to 7 samples collected per quality element. Physico-chemical parameters and priority substances are measured once every year in operational monitoring.

Groundwater monitoring networks underwent reconstruction and were operational in 2008. The Article 8 report was based on the original network. For chemical monitoring, all stations were reported to be both surveillance and operational. The design of the network considered the impacts of point and diffuse sources of pollution. Higher densities of monitoring sites were set up in areas where contamination of groundwater may be an issue. The chemical monitoring includes all core parameters, and any others related to the identified pressures. Quantitative monitoring will be carried out annually, operational monitoring every second year, and surveillance monitoring every third year.

RBMPs for the Oder, Danube and Elbe have been adopted, but those for the Oder and Elbe are not publicly available in English.

In summary, the Czech Republic have a clear concept for developing monitoring programmes following WFD requirements, reported clearly and with good quality. Methods for the assessment of ecological status are available for all quality elements. On the negative side, the frequency of monitoring is not much above the minimum requirement, and additional monitoring of protected areas is not apparent.

3.4.5 Sustainability of delivery of data

The WFD is structured in three management cycles; the first ending in 2015 when environmental objectives for RBDs should have been met. There are then a further two six-year cycles, the second cycle ending in 2021 and the third in 2027. At the beginning of each of these management cycles, a new (or updated) river basin management plan is submitted to the EC and monitoring of water bodies (including reporting on progress against objectives) is to continue. The end of the third cycle is the final deadline for meeting the objectives of the WFD. As MS improve their monitoring networks and become more familiar with the requirements of the WFD, the quality and quantity of data should improve out to 2027. Beyond this date, there is no provision in place to continue monitoring and reporting under WFD, however it is likely that some level of monitoring will continue.

3.4.6 Alternative sources of information

A number of other EU Directives are directly relevant to the WFD These include the Nitrates Directive and the Groundwater Directive, which have many common monitoring sites; also the Bathing Water, Drinking Water; Urban Wastewater Treatment; Integrated Pollution Prevention & Control; and Sewage Sludge Directives. The WFD regards implementation of these other directives as a minimum requirement, and measures to implement them must be included in RBMPs. WISE provides a means of integrating and accessing water quality and quantity data for river basins across the EU from all relevant sources.

3.4.7 Developments and progress

Intercalibration is an important part of the WFD, but is also a very complex scientific and technical exercise. The first results of the intercalibration exercise were delivered in 2007, but much work remains to be done. Member States have agreed to work to fill the gaps; for example intercalibration of transitional waters, which have particularly complex ecosystems.

With regards international RBDs, cooperation is variable. For some large IRBDs, the neighbouring MS have been successful in coordinating their efforts to produce a single shared RBMP for the IRBD, cooperating in designing a monitoring framework, sharing data and reporting results. For others, this cooperation is lacking and needs to be addressed in the coming years.

The Common Implementation Strategy (CIS) for the WFD was initiated in 2001 as a way for MS to work together to implement core water law. The deliverables of CIS were incorporated to a large extent in the Article 5 & 8 reports; however there are still a number of issues to be addressed. In the first years of the implementation of the first RBMPs, there is a need to simplify the process and focus on activities that are directly relevant to the WFD and its daughter Directives. There is also a requirement for better dissemination of practical implementation. Details of principles for the period 2010-2012 are now available in an EC report on the work programme[68].

[68] Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Work Programme 2010-2012: Supporting the implementation of the first river basin management plans.

3.4.8 Potential synergies of reviewed data with AEIs

AEI indicator	Assessment of requirement/ provision under the WFD	Units and resolution
AEI 7 - Irrigation	Locations of abstraction points and rates of abstraction are required for pressures and impacts assessment, for which knowledge of irrigable/ irrigated areas is needed. This may provide some data for the AEI parameters 'Irrigable areas' and 'Irrigated areas'.	*Units:* Volume abstracted per year/ season *Spatial resolution:* sub-unit or RBD *Temporal resolution:* every 6 years *Subdivision:* category of abstraction
AEI 15 – Gross nitrogen balance	The N balance surplus is a commonly used indicator for identifying areas vulnerable to nutrient pollution in the pressures and impacts analysis.	*Units:* Kg N/ha/yr *Spatial resolution:* Water body catchment *Temporal resolution:* every 6 years
AEI 16 – Risk of pollution by phosphorous	The P balance surplus is a commonly used indicator for identifying areas vulnerable to nutrient pollution in the pressures and impacts analysis.	*Units:* Kg P/ha/yr *Spatial resolution:* Water body catchment *Temporal resolution:* every 6 years
AEI 20 – Water abstraction	Significant water abstractions from each surface water and groundwater body by type are required to be identified.	*Units:* Volume abstracted per year/ season *Spatial resolution:* sub-unit or RBD *Temporal resolution:* every 6 years *Subdivision:* category of abstraction
AEI 27.1 – Water quality – Nitrate pollution	The measured concentrations of nitrate in ground and surface waters are to be reported under the WFD	*Units:* mg/L *Spatial resolution:* monitoring site *Temporal resolution:* continuous to every 6 years *Subdivision:* water body category & monitoring programme type
AEI 27.2 – Water quality – Pesticide pollution	The measured concentrations of pesticides in ground and surface waters are to be reported under the WFD	*Units:* µg/L *Spatial resolution:* monitoring site *Temporal resolution:* continuous to every 6 years *Subdivision:* water body category & monitoring programme type

3.5 Nitrates Directive

3.5.1 The data requirements including their scale and accuracy

Articles 3-6 of the Nitrates Directive set out the compliance requirements to be fulfilled by Member States in order to reduce nitrate pollution. Article 10 requires each Member State to submit a national level report on progress they have made. Implementation methods are decided by each Member State but must include analysis of water quality, assessment of action programme impacts, and cyclic revision of designated vulnerable zones and action programmes[69]. Member States are obliged to set up sampling stations at all major rivers, groundwaters, lakes, dams, coastal and marine waters, these must be analysed for nitrogen content and eutrophication status in order to identify NVZ.

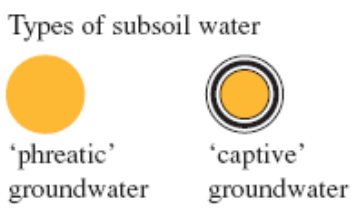
Identification criteria

Annex 1 of the Nitrates Directive outlines the criteria that should be used to identify polluted and threatened waters. This requires sampling data on the nitrate concentration and trophic status of waters. Polluted surface freshwaters are those that exceed nitrate concentrations of 50mg NO3-/l as set out in Directive 75/440/EEC concerning the quality of surface water intended for the abstraction of drinking water. Accordingly, polluted groundwater is that which contains over 50mg NO3-/l. Waters with an increasing trend in nitrate concentrations are perceived as threatened. Other water bodies, lakes and coastal zones are deemed polluted or threatened if they are, or could become, eutrophic. All land draining into polluted or threatened water had to be designated as NVZ within two years of notification of the Directive. Member States must provide maps detailing the location of NVZ and any revisions.

Spatial data requirements

Annex V declares that Member States must provide maps for a) identified polluted waters including which Annex I criteria was used for identification and b) the location of the designated vulnerable zones, including changes since the previous report. Guidelines on spatial data presentation are provided in the document, *EEC, DG environment document (2000); Status and trends of aquatic environment and agricultural practices: Development guide for Member States' Report*[70]. For example, it is preferable that national level maps are provided at a scale of 1:1 000 000, and each zone at a scale of 1:250 000. A common code of classification is described along with colour coding recommendations. Recommendations for groundwater classification are shown below, whereby if nitrate concentrations are above 50 mg/l they should be highlighted in red.

0–24	green
25–39	yellow
40–50	orange
≥ 50	red



[69] 1st implementation report (2000). Available at http://ec.europa.eu/environment/water/water-nitrates/report.html

[70] Available at http://www.zm.gov.lv/doc_upl/950799_binnenwerk_en(2).pdf).

Monitoring

Water quality

In accordance with Article 6, Member States must create and implement suitable monitoring programmes which assess nitrate concentrations at selected ground and surface water sites. The monitoring programme must be carried out at least every 4 years. A common procedure for measuring nitrate concentrations must be used to enable exchange of information. Accordingly measurements of freshwaters, coastal waters and marine waters must be carried out in agreement with Article 4a (3) of Council Decision 77/795/EEC (22 June 1977) on establishing a common procedure for the exchange of information on the quality of surface fresh water in the Community[71]. Member states must submit nitrate concentrations for both ground and surface waters, and information on trophic status of surface waters including the eutrophication parameters that were used. The recommended frequency for nutrient monitoring is to take samples on a monthly basis, at a minimum. Guidance also suggests increasing station density in and around polluted waters[72]. Information from each individual sampling point must be submitted, rather than an amalgamation of results. Monitoring requirements vary slightly depending on whether the Member State has allocated specific vulnerable zones or decided on a whole territory approach.

Nitrogen application

Record of fertiliser and manure applications are required in order to keep within the restrictions. Substances containing nitrogen must be measured using the method explained in Commission Directive 77/535/EEC (amended by Commission Directive 95/8/EC)[73] on the approximation of the laws of Member States relating to methods of sampling and analysis for fertilizers (e.g. methods of analysis for trace elements at a concentration greater than 10%).

Other

Member States are required to explain the physical and environmental characteristics of the waters and land, their understanding of the behaviour of nitrogen compounds in both water and soils, and the existing understanding of the impact of actions taken. The Directive does not set out specific details of these data requirements as they will vary between Member States but information on livestock numbers, soil crop cover in winter, land use and land management, soil characteristics and fertiliser consumption are all relevant.

Action Programmes

Member States are required to submit details of action programmes in accordance with Annex II Codes of good agricultural practice. In order to assess the impact of the action programme measures Member States will need to gain information on the following elements as recommended in "*EEC, DG environment document (2000); Status and trends of aquatic environment and agricultural practices: Development guide for Member States' Report"*[74].

- Total number of farmers, and farmers with livestock
- Total land (km^2)
- Agricultural land (km^2)

[71] Council Decision 77/795/EEC http://eur-lex.europa.eu/LexUriServ/site/en/consleg/1977/D/01977D0795-20040501-en.pdf

[72] European Environment Agency, Working group D Reporting Activity of State of the Environment Reporting. Available at http://eea.eionet.europa.eu/Public/irc/eionet-circle/water/library?l=/wise_reporting_2009/reporting_feb2009pdf/_EN_1.0_&a=d

[73] Commission Directive 95/8/EC http://faolex.fao.org/docs/texts/eur18994.doc

- Agricultural land available for application of manure (km^2)
- Permanent pasture
- Permanent crops
- Annual contribution of mineral and organic forms of N (Kg N/ha)
- Annual use of mineral and organic N (kilotonnes)
- Nitrogen discharge into the environment from agriculture, urban wastewater and industry.
- Date of publication and revision of codes of good agricultural practice
- Information regarding codes of good agricultural practice
  - periods of spreading
  - spreading on sloping soils
  - soaked, frozen, snow covered soils
  - proximity of water courses
  - effluent storage works
  - limitation and splitting of mineral and organic nitrogen inputs
  - methods of spreading
  - crop rotations and crop maintenance
  - vegetation cover
  - fertilisation plans and spreading records
  - irrigation relating runoff and leaching
- Estimation of farmers who voluntarily apply the code.

Dataset tables

Data and information regarding NVZ identification, measurement methods, monitoring procedures, codes of good agricultural practice and action programmes measures should be submitted to the EC. The informal development guide was prepared by the Commission in 2000 to facilitate preparation of Member States' reports but more recently the EC published the *"Dataset specification for evaluation of water quality under the Nitrates Directive, EEA, version: February 2008"* on the technical specifications for the central data storage facility, the Data Dictionary. This provides an overview of dataset tables required[75]

[74] Available at http://www.zm.gov.lv/doc_upl/950799_binnenwerk_en(2).pdf).

[75] Available at http://dd.eionet.europa.eu/dataset.jsp?mode=view&ds_idf=NiD

Table 14: Overview of the dataset specification for evaluation of water quality under the Nitrates Directive

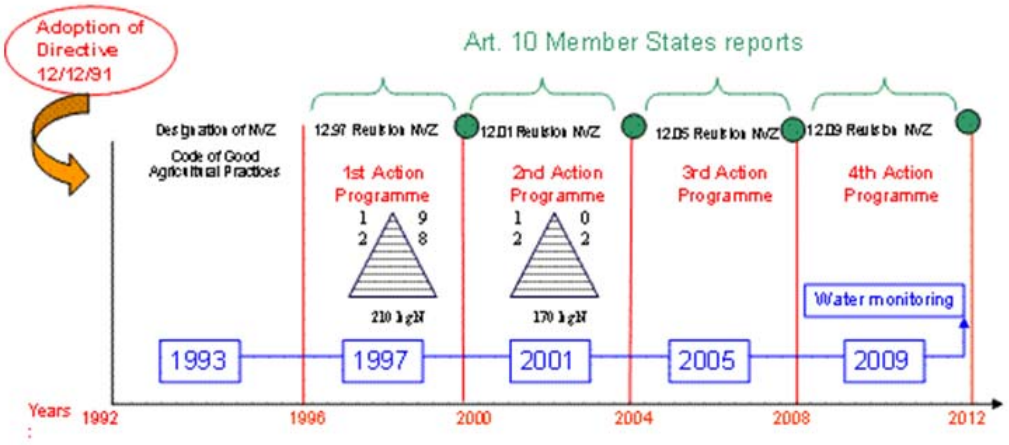
2. Overview of **Evaluation of water quality under the Nitrates Directive.** dataset tables

Name	Definition	Short description
1. List of groundwater monitoring stations	Detailed information on the characteristics of the groundwater monitoring stations	Information on the groundwater monitoring stations used to report water quality data under the Nitrates Directive.
2. NO3 concentrations in groundwater	NO3 concentrations measured in each groundwater monitoring station.	NO3 values for each groundwater monitoring station
3. List of surface monitoring stations	Detailed information on the properties of the surface water monitoring stations.	Information on the surface water monitoring stations used to report water quality data under the Nitrates Directive.
4. NO3 concentrations in surface water	NO3 concentrations measured in each surface water monitoring station.	NO3 values for each surface water monitoring station
5. Eutrophication parameters in surface water	Eutrophication parameters measured in each surface water monitoring station.	
6. Trophic state of surfacewater	Trophic state in each surface water monitoring station.	Trophic state in each surface water monitoring station.
7. Designated Nitrate Vulnerable Zones GIS boundaries	Attribute data referring to geographical data sets of NVZ areas are requested to update the NVZ database hosted by JRC.	Geographical information on the Designated Nitrate Vulnerable Zones
8. Potential Vulnerable Zones GIS boundaries	Attribute data referring to geographical data sets of potential Vulnerable Zones are requested to update the NVZ database hosted by JRC	Geographical information on Potential Vulnerable Zones
9. WTA - Whole territory approach	Information on legal acts if MS have whole territory approach	Information on legal acts if MS have whole territory approach
9a. Risk areas WTA - GIS boundaries (optional)	Geographical data set of the Risk areas if MS have Whole Territory Approach (WTA)	Geographical information on Risk areas for countries with Whole Territory Approach (WTA)

3.5.2 The reporting requirements: timescale, format, quality

After the adoption of the Nitrates Directive, the first 4 years required designation of NVZ and establishment of codes of good agricultural practices. The implementation of action programmes then began in 1996, along with the four year reporting process. During the first action programme, Member States could allow manure with up to 210 kg N per ha. The timescale of procedures is set out below[76]. For most Member States the next report is due in June 2012.

[76] Taken from http://ec.europa.eu/environment/water/water-nitrates/index_en.html



Article 10 of the Nitrates Directive requires member states to submit a report to the commission every four years. The report must provide information about the implementation of relevant measures in accordance with Annex V. This process allows the Commission to assess policy effectiveness, to compare status and trends, and to check for compliance.

The report must consist of 4 main chapters:

1. A statement of the preventative measures taken, in relation to Article 4, such as codes of good agricultural practice and training for farmers.
2. A map highlighting polluted waters and those at threat from pollution and the criteria by which they were identified (according to Annex 1). A second map that highlights the designated vulnerable zones should also be provided. This should highlight any boundary revisions.
3. A summary of monitoring results including reasoning behind designations and revisions of NVZ.
4. A summary of the action programmes created in response to Article 5, including assumptions on the timescale of recovery and related uncertainty.

Geographical data on selected NVZ should be provided in shapefile or e00 format. For whole territory allocations, it is optional to supply geographic information on risk areas. GIS guidelines are provided by the EC[77]. Member states also provide geo-referenced water quality data which allows the EC to produce aggregated maps on nitrate and trophic status of European waters. These maps are published in the staff working document[78].

The water quality data is submitted using a generic table format including parameters such as start and end sampling date, number of samples, unit of measurement and average annual value. Each record in the table must have a unique ID consisting of a combination of Country code, National station code and Station type, to guarantee that duplicates don't exist in the database. Data should be supplied in XML, Excel or tab-separated ASCII text format. Templates for formatting and collating the data could be downloaded from the ReportNet data dictionary since July 2008. An example is provided below.

[77] Available on http://eionet.europa.eu/gis/

[78] Commission staff working document {COM(2010) 47}.
Available at http://ec.europa.eu/environment/water/water-nitrates/index_en.html

CountryCode	ND_NatStatCode	ND_BeginDate	ND_EndDate	ND_MeasUnit	ND_NoOfSamples	ND_AvgAnnValue
DE	30390001	2007-01-01	2007-12-31	mg/l NO3	2	129.5

In accordance with Article 11, the Commission then use the information to publish summary reports within 6 months of receiving the reports from Member States. The information is communicated to the European Parliament and the Council. It may also be used to inform the general public. The report for the period 2000-2003[79] deals with EU-15 but summarises progress on implementation by new Member States. The report for the period 2004-2007[80] deals with data submitted by EU-27 but also makes some comparisons between the EU-15. The summary reports are accompanied by staff working documents with aggregated maps, tables and graphs. The most recent report also provided a description of links with other EU policies including the Water Framework Directive (WFD) and the Groundwater Directive. The previous summary reports for 2000-2003 and 2004-2007 are available on the EC web page[81]. The Nitrates directive is currently in its 5th reporting stage (post 2008).

3.5.3 Availability and quality of data at a Member State level

Data availability

The most recent reports, submitted in 2008/2009, cover the 4th reporting period (2004-2007). This was the first time that all 27 EU Member States submitted reports including Romania and Bulgaria who joined the EU in 2007 and so were not actually obliged to submit. Also, although Norway is a non-Member State, the Nitrates Directive is being implemented and reports were submitted in 2004 and 2008. The recent data and reports can be accessed on the European Environment Agency's EIONET Data Repository[82] however some of the information is inaccessible. Information on average annual nitrate concentrations has been provided by all Member States but not all members have reported on marine water quality.

Data Quality

Groundwater

There are a total of 31,000 groundwater sampling sites in the EU-27. Numbers and densities of monitoring stations inside and outside NVZs by MS are detailed in Appendix F. Belgium, Malta and Denmark have the highest density of groundwater sampling sites whilst Sweden, Finland and Lithuania have the lowest density. The majority of Member States have provided groundwater data from different depths, from 0-5cm to 30cm. Only a few Member States have given information on monitoring frequency. E.g. Belgium, France, Slovenia and Slovakia take measurements 4 times per year and the Netherlands measure once a year. Trend analysis was provided by most Member States that had submitted previous reports.

Surface water

There are 27,000 surface water sampling sites in the EU-27. Numbers and densities of monitoring stations inside and outside NVZs by MS are detailed in Appendix F. Belgium, Malta and the United Kingdom

[79] Report from the commission to the council and the European parliament (for the period 2000-2003). Brussels, 19.3.2007. Available at http://ec.europa.eu/environment/water/water-nitrates/index_en.html

[80] Report from the commission to the council and the European parliament (for the period 2004-2007). Brussels, 9.2.2010. Available at http://ec.europa.eu/environment/water/water-nitrates/index_en.html

[81] http://ec.europa.eu/environment/water/water-nitrates/index_en.html

[82] EINOET Central Data Repository http://cdr.eionet.europa.eu/searchdataflow

have the highest density of sampling sites, and Finland has the lowest. Monitoring frequency ranges from 7.4 times a year (in Romania) to 26 times a years for some locations in Germany. Where applicable, Member States should have monitoring sites in marine waters but not all relevant Member States have reported on marine water quality. It is difficult to compare trophic status of surface waters as Member States have used different methods of assessment. There has been an increase in sampling stations which is implicative of improved monitoring structure throughout the EU.

3.5.4 Member States collecting the best data for policy requirements

CASE STUDY: UNITED KINGDOM

The UK has designated 94410 km2 of its land as NVZ and holds 7988 surface water monitoring stations; the largest amount in the EU. This is the second highest density of freshwater monitoring sites with 32.6 monitoring points per 1000 km2, over half being situated within NVZ areas. The UK also has 3061 groundwater monitoring sites. A majority of these sites form a regular monitoring network with "frequent" sampling[83]. The action programmes applied in the UK cover all measures outlined in Annex II including storage requirements, detailed rules on closed periods, application techniques and standards based on vicinity of water courses and provision of a calculated balance system to limit fertiliser use.

3.5.5 Sustainability of delivery of data

The frequency of data collection varies between Member States but monitoring programmes must be repeated and updated at least every four years. The cyclic nature of the reporting process should ensure regular delivery of data and provide the capacity for trend analysis. A number of Member States are integrating monitoring stations to meet requirements under both the Nitrates Directive and the WFD[84]. Data from the 4th reporting period highlighted that in 10 Member States 50% of monitoring stations were used for both databases.

3.5.6 Alternative sources of information

The EC Water Information System for Europe (WISE)[85] provides geographically mapped information on water issues at a Europe wide scale.

3.5.7 Developments and progress

Six years after the adoption of the Nitrates Directive most Member states had failed to implement it. In 1997 infringement procedures were taken against 13 out of the 15 MS. Following this delay all Member States have created comprehensive monitoring schemes, designated vulnerable zones, and implemented action programmes. The WFD has included aspects of the Nitrates Directive in its provisions, for example NVZ have become protected zones. As the Nitrates Directive is a key to protecting waters from agriculture, it will play an important role in the WFD. Action programmes under the Nitrates Directive will need to be integrated into River Basin Management Plans.

[83] Report available on the EIONET data repository http://cdr.eionet.europa.eu/gb/eu/nid/envsuqgew

[84] Water Framework Directive (2000/60/EC) http://ec.europa.eu/environment/water/water-framework/index_en.html

[85] http://water.europa.eu/en/welcome

3.5.8 Potential synergies of reviewed data with AEIs

AEI indicator	Assessment of requirement/ provision under the ND	Units and resolution
AEI 1 – Agri-Environmental commitments	The land area under NVZ mandatory action programme commitments is reported for the ND.	*Units:* Ha *Spatial resolution:* National *Temporal resolution:* every 4 years
AEI 5 – Mineral fertiliser consumption	The annual contribution of mineral and organic forms of N are required as part of Action Programmes. Application rates are recorded by some Member States.	*Units:* Kt or Kg/ Ha *Spatial resolution:* National *Temporal resolution:* every 4 years
AEI 10.1 – Cropping patterns	The area of permanent pasture and permanent crops, plus total agricultural land, are required as part of Action Programmes.	*Units:* Ha *Spatial resolution:* National *Temporal resolution:* every 4 years
AEI 10.2 – Livestock patterns	MS are not explicitly required to collect data on livestock numbers, but they are necessary for the calculation of manure storage capacity.	*Units:* Numbers *Spatial resolution:* National *Temporal resolution:* every 4 years *Subdivision:* broad livestock category
AEI 11.1 – Soil cover	Soil crop cover in winter is not a specific requirement, but MS are encouraged to collect these data.	*Units:* Ha *Spatial resolution:* National *Temporal resolution:* every 4 years
AEI 11.3 – Manure storage	The type of storage used for farm manure and slurry are data required as part of action programmes. Information regarding manure application techniques may be provided by some MS.	*Units:* % *Spatial resolution:* National *Temporal resolution:* every 4 years *Subdivision:* manure storage system/ application technique
AEI 15 – Gross nitrogen balance	The action programmes should contain rules relating to the limitation of the land application of fertilizers based on a balance between the foreseeable nitrogen requirements of the crops, and the nitrogen supply to the crops from the soil and fertilization. This should therefore be calculated at farm level.	*Units:* Kg N/ha/yr *Spatial resolution:* Farm *Temporal resolution:* every 4 years
AEI 16 – Risk of pollution by phosphorous	Some Member States report data on total phosphorous and orthophosphate as eutrophication parameters.	*Units:* Kg P *Spatial resolution:* Farm *Temporal resolution:* every 4 years
AEI 26 – Soil quality	Soil characteristics are reported under the ND requirements for some MS, and may provide similar information to these parameters.	*Units:* unknown *Spatial resolution:* National *Temporal resolution:* every 4 years
AEI 27.1 – Water quality – Nitrate pollution	The concentrations of nitrate in ground and surface waters are reported under the ND requirements.	*Units:* mg/L *Spatial resolution:* water body monitoring site *Temporal resolution:* every 4 years *Subdivision:* water body type

3.6 National Emissions Ceiling Directive

The directive requires all 27 Member States of the European Union to report information annually concerning emissions and projections for four main air pollutants: sulphur dioxide (SO_2), nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs) and ammonia (NH_3).

3.6.1 The data requirements including their scale and accuracy

Articles 2, 6, 7 and 8 of the National Emission Ceilings Directive (NECD) set forth the requirements for the EU-27 Member States concerning their national inventories, projections and programmes. As specified in the directive, Member States were required to prepare and annually update national total emissions and emission projections for 2010 for the pollutants SO_2, NO_X , NMVOC, and NH_3. In addition, by 31 December each year, the MS should report to the European Commission and EEA their national emission inventories and emission projections for the year 2010; final emissions data should be submitted for the previous year but one, and provisional emissions data for the previous year. Anticipated significant changes in the geographical distribution of national emissions are also to be indicated.

To help ensure that information on emissions reported by Member States is consistent and harmonised, NECD further proposed that the MS establish emission inventories using the methodologies agreed upon by the Convention on Long-range Transboundary Air Pollution (LRTAP Convention). Furthermore (Annex III, NECD), in preparing these inventories and projections, MS should use the latest version of the EMEP/CORINAIR Emission Inventory Guidebook (i.e. EMEP/EEA, 2007). Within this approach, guidance was adapted from the Intergovernmental Panel on Climate Change (IPCC) 2006 Good Practice Guidance (IPCC, 2006). However, since inventory reports or explanatory information is not mandatory under NECD, a consequence is that the transparency of the submitted data is rather limited.

The EMEP/CORINAIR Guidebook provides comprehensive guidance for the estimation of emissions from all relevant source sectors, but also allows some flexibility. Member States may use national or international methodologies to estimate emissions and projections other than those recommended, as long as such methods are considered to be more representative of the national situation and are compatible with the Guidebook. When using alternative methods, details of the chosen alternative method are required. To comply with the requirement for consistency in inventories, any time-series data provided pursuant to the NECD should be calculated in a consistent manner. Where methods are revised, these amended methods should be applied to the other years of the inventory and new estimates for these years should be compiled and reported.

The source sector relevant to the AEIs is the agriculture sector. The main source of ammonia emissions in Europe is volatization from livestock excreta, but may also be emitted from the application of N-fertilizers, from fertilized crops and from stubble burning. Soils and crops are a net sink for most NO_X compounds, however NO may be released from soils during the mineralisation and subsequent nitrification of N from organic matter. NMVOCs are emitted from the excreta of livestock, and are considered at all stages, from animal housing through manure storage to spreading onto agricultural land.

In the **EMEP/CORINAIR Guidebook**, there are several subgroups applicable to emissions of NO_X, NMVOCs and NH_3:

10 01- Cultures with fertilizers & 10 02 - cultures without fertilizers

These subgroups incorporate all emissions arising from agricultural crops or their supporting soils. For subgroup 10 02, this includes unintentional fertilization only, whilst for subgroup 10 01, intentional fertilization is also included.

Intentional fertilization comprises applications of;

- Synthetic (mineral) fertilizer
- Natural inorganic fertilizer
- Organic manure (farmyard manure)
- Compost (from municipal solid waste or sewage sludge)

Unintentional fertilization comprises;

- Biological nitrogen fixation
- Manure excreted by grazing animals
- N input from atmospheric deposition resulting from NO_X and NH_3 emissions from agricultural crops and soils
- Crop residue application

Activity data required for subgroup 10 01 include the annual consumption of major N-fertilizer types for arable and grassland; the amounts and N concentrations of crop residues returned to the soil by crop type; the amounts of N deposited by animals whilst grazing by livestock type, and the area of organic soils (histosols) under cultivation. Activity data required for subgroup 10 02 include the area of legumes cultivated by crop type; the area of unfertilized grassland grazed by livestock, and an estimate of N deposited in excreta during grazing by livestock type. Information on atmospheric deposition to soils is also required.

10 03 - field burning of stubble, straw etc.

This covers all emissions originating from the burning of agricultural vegetation wastes, and includes NO_X, NMVOC and NH_3 emissions; the former estimated using methods proposed in the IPCC Guidelines, and the latter two using methodology described under forest fires. The relevant activity data are the amount (dry weight) of waste or crop residue combusted. In the simple methodology, a dry weight of straw from cereal crops of 5 tonnes per ha is assumed.

10 05 and 10 09 - manure management regarding organic and nitrogen compounds

These subgroups cover emissions of all gaseous carbon nitrogen species (including NH_3) from animal husbandry (manure management). A tool to estimate the order of magnitude of NMVOC emissions from stored manure is also provided in the EMP/CORINAIR guidelines. For NH_3, calculations include emissions from grazing animals and emissions from manure and slurry applied to soil and crops. The activity data required for these subgroups include animal numbers in relevant sub-categories, the excretion of volatile solids as a function of animal performance and feed, and the frequency distribution of the respective manure management systems.

3.6.2 The reporting requirements: timescale, format, quality

Under Article 7 of NECD, the European Commission (EC) assisted by EEA, shall, in cooperation with the MSs and on the basis of the information provided by them, establish inventories and projections for the relevant pollutants. Whilst there is no mandatory requirement for provision of inventory reports/explanatory information, the inventories and projections are made publicly available[86].

Member States were obliged to report their updated national programmes for progressive reduction of

[86] Data submitted by MSs under NECD is available through EEA data service at: http://www.dataservice.eea.europa.eu/dataservice

national emissions of the four pollutants to the European Commission by 2006. The reported national programmes should have included information on policies, adopted and envisaged, and quantified estimates of the effect of these policies and measures on emissions of those pollutants in 2010. A detailed evaluation of the reported NECD programmes was performed in 2007 for the European Commission. It analysed projections and programmes submitted by the Member States and the measures they planned to implement (AEA Technology, 2007).

Preparation of the aggregated EC NECD inventory involves several stages:

- Member States provide the data;
- EC and the European Environment Agency (EEA) receive the data;
- EEA via the European Topic Centre on Air and Climate Change (ETC/ACC) compiles the data and prepares the inventory data and report;
- EEA and EC disseminate the results (including draft NECD status report to the MSs;
- Final MS NECD inventory required by December 31.

For reporting purposes, EU MSs are requested to make use of the EEA Eionet ReportNet Central Data Repository (CDR).

3.6.3 Availability and quality of data at a Member State level

In the 2008 reporting round, 22 of the 27 Member States submitted their national inventories of SO_2, NO_X, NMVOC, and NH_3 to the Commission, on or before the reporting deadline of 31 December 2008. Greece, Malta and Poland delivered their inventories between 1 January and 28 February 2009, Spain submitting on 12 March 2009 and Luxembourg, by 17 April 2009. Eight MSs provided additional or revised data between 1 January and 5 May 2009. In the previous year, 18 MSs reported by the required deadline and eight reported at least some data by May 2008. Thus timeliness and completeness of reporting has improved compared to the previous reporting round.

In the 2008 reporting, all 27 Member States provided the mandatory information on final emissions for the year 2006 and preliminary emission data for 2007. The 2010 projections were not submitted by France. Ten MSs (Austria, Bulgaria, Czech Republic, Estonia, Finland, Lithuania, Malta, Portugal and Romania) did not revise their reported projections in 2008.

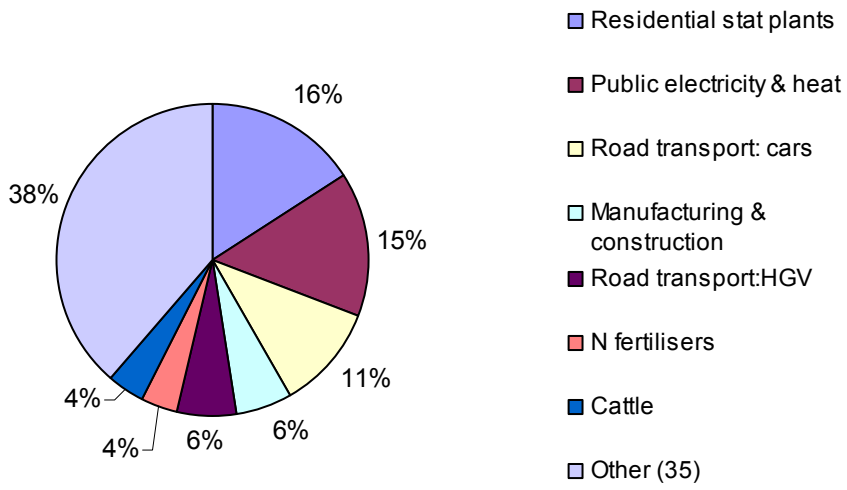
As no gap-filling procedures are in place with respect to NECD reporting, compilation of complete EU-27 trends are not possible for as long as any countries have not reported their complete emission inventories; this compilation is required if a comparison with the EU-27 ceilings (as defined in NECD Annex 1 and 2) is to be made.

3.6.4 Member States collecting the best data for policy requirements

The recent "European Community emission inventory report 1990–2007" (EEA, 2009)[87], under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP) provides important data on emissions of all the NECD pollutants and recent trends. The top seven key categories of air pollutant emissions are shown in Figure 1. Agriculture (cattle and N fertilisers) features in only two of the top seven emission categories.

[87] EEA Technical Report No 8/2009, Copenhagen.

Figure 1: Air pollutant sources of NO_X, CO, NMVOC, SOx, PM10, PM2.5 in EU-27, 2007



Source: EEA, 2009[85]

Detailed emission profile data are available for all Member States, via the EEA website[88], although explanatory information is lacking because of the absence of a requirement under NECD for inventory reports. Taking the examples of Denmark, Spain and UK for NO_X, energy use and supply is responsible for 55-60% of emissions, road transport 30-39%, other transport 4-11%, with agriculture reported only by Spain (at 2%). Energy use and supply, similarly, is accredited with 17-50% NMVOC emissions, road transport 9-20% and "other sources", 27-52%. The situation is very different with NH_3, where agriculture is responsible for the great majority of emissions (91-97%) and road transport (2-3%) and industry (2-4%) the only other significant sources reported in Denmark, Spain and UK.

It appears, from the consistency and completeness of data received from the MS, that emission estimates for NO_X, NMVOCs and SO_2 are likely to be soundly based, since these pollutants are associated primarily with the human population and activity. Emission sources are predominantly from energy use, transport and industry, for which many data are widely and easily available.

Ammonia emissions (predominantly from agriculture) are much more difficult to estimate, mostly arising from diffuse sources, which are often poorly characterised and difficult to measure. Therefore, many of these estimates and the inventories to which they contribute are associated with considerable uncertainty (Webb *et al.*, 2009)[89]. For those countries for which uncertainty analyses are available, results indicate the estimates may be accurate to within ±20%; however, for other inventories created using simple emission factors (EFs), uncertainties could be much greater, perhaps in the region of ±100%. An analysis of the sensitivity of the UK NH_3 emission inventory identified farm activity data as the inputs to which the output was generally most sensitive; for example, information on cattle diets, especially those predominantly based on grass, was considered to be particularly uncertain.

[88] See: http://www.eea.europa.eu/themes/air/nec-directive-member-state-country-profiles/nec-directive-member-state-country-profiles

[89] Webb. J., Hutchings, N.J., Bittman, S. et al. (2009). Reliability of ammonia emission estimates and abatement efficiencies. In "Atmospheric Ammonia", eds. Sutton, Reis and Baker, Springer Science & Business Media B.V. 2009, pp 423-431.

3.6.5 Sustainability of delivery of data

Based on the consistency and completeness of data received from the MS in recent years on emission estimates for NO_X, NMVOCs and SO_2 within annually submitted inventories, future delivery of these data from MS seems likely to be achieved. It seems clear, however, that some improvement in both the structure and quality of input data for NH_3 inventories will be necessary, to facilitate the future delivery and application of the latter.

3.6.6 Alternative sources of information

Guidance on possible sources of country-specific data relevant for inventory compilation is provided in the EMEP/CORINAIR Emission Inventory Guidebook. The following sources are proposed:

- National Statistics Agencies (NSAs). For EU countries, activity data are available from **Eurostat** and, in particular, enhanced versions of the Farm Structure Survey (FSS) and Survey of Agricultural Production Methods (SAPM), are planned for implementation across the EU, during 2010 or 2011;
- Sectoral experts, stakeholder organisations;
- Other country national experts;
- Emission Factor Databases (including the USA Environmental Protection Agency's (EPA's) AP 42, Compilation of Air Pollutant Emission Factors http://www.epa.gov/ttn/chief/ap42/);
- International experts;
- International organisations publishing statistics; e.g. United Nations, Eurostat or the International Energy Agency, Organisation for Economic Co-operation and Development (OECD) and the International Monetary Fund (IMF), which maintains international activity as well as economic data;
- Reference libraries (national libraries);
- Scientific and technical articles in environmental books, journals and reports;
- Universities;
- Web search for organisations and specialists;
- Inventory reports from other parties.

In general, national data are considered preferable to international data, not only because of direct relevance, but also because national data are more likely to be up-to-date.

3.6.7 Developments and progress

The EMEP/CORINAIR Guidebook provides guidance for the estimation of emissions from all relevant source sectors. It also allows the Member States to use national or international methodologies to estimate emissions and projections other than those recommended in the Guidebook, as long as such methods are considered to be more representative of the national situation and are compatible with the Guidebook. When using alternative methods, it is important that a description of the chosen alternative method is provided. To comply with the requirement for consistency in inventories, any time-series data provided pursuant to the NECD should be calculated in a consistent manner. Where methods are revised, these amended methods should be applied to the other years of the inventory and new estimates for these years should be compiled and reported.

Data collection is an integral part of developing and updating an inventory. Formalised data collection activities should be established, adapted to countries' national circumstances, and reviewed periodically as a part of implementing good practice. In most cases generating new source data will be limited by the resources available and prioritisation will be needed, taking account of the results of key category analysis. Data collection procedures are necessary for finding and processing existing data, (i.e. data that are compiled and stored for other statistical uses than the inventory), as well as for generating new data by surveys or measurement campaigns. Other activities include maintaining data flows, improving estimates, generating estimates for new categories and/or replacing existing data sources when those currently used are no longer available.

Principals of methodology proposed within the EMEP/CORINAIR Guidebook regarding data collection include:

- Focus on the collection of data needed to improve estimates of the largest key categories, which have the greatest potential to change or have the greatest uncertainty;
- Choose data collection procedures that iteratively improve the quality of the inventory in line with the data quality objectives;
- Put in place data collection activities (resource prioritisation, planning, implementation, documentation, etc.) that lead to a continuous improvement of the data sets used in the inventory;
- Collect data/information at a level of detail appropriate to the method used;
- Review data collection activities and methodological needs on a regular basis, to guide progressive, and efficient, inventory improvement;
- Introduce agreements with data suppliers to support consistent and continuing information flows.

Throughout the data collection activities the inventory compiler should maintain QA/QC records about the data collected according to the guidance provided in the EMEP/EEA inventory guidebook. While collecting data it is also good practice to be aware of future data collection needs.

Regarding the uncertainties associated with national NH_3 inventories, it is worth noting that the future requirements of CLRTP for inventory submission, to include an informative report, will also require an uncertainty analysis. At the UNECE international workshop on "Atmospheric Ammonia" (Edinburgh Workshop) (Sutton et al, 2009) an expert group, considering the reliability of ammonia emission estimates, recommended an approach be made to the European Commission to fund a collaborative project, in concert with Eurostat, to harmonise approaches for the collection of key activity data from the livestock sector. The importance of reliable livestock activity data has already been outlined, for use not only within inventories, but also to assist consideration of abatement measures and in determining, more accurately, other impacts of livestock production on the environment.

3.6.8 Potential synergies of reviewed data with AEIs

AEI indicator	Assessment of requirement/ provision under the NECD	Units and resolution
AEI 5 – Mineral fertiliser consumption	The volumes and rates of N fertiliser use (including the formulation) are reported for the NECD.	*Units:* Kt and Kg/ha *Spatial resolution:* National *Temporal resolution:* Annual
AEI 10.1 – Cropping patterns	Calculation of emissions from soils, crop residue burning and rice cultivation require activity data on cropping patterns.	*Units:* Ha *Spatial resolution:* National *Temporal resolution:* Annual *Subdivision:* Crop type
AEI 10.2 – Livestock patterns	The numbers of livestock by category are reported for the NECD. The data methodology and detail vary between Member States.	*Units:* Number *Spatial resolution:* National *Temporal resolution:* Annual *Subdivision:* Broad category or sub-category (depending on Tier level used)
AEI 11.3 – Manure storage	Calculation of emissions from manure management requires activity data on the frequency distribution of the respective manure management systems.	*Units:* % *Spatial resolution:* National *Temporal resolution:* Annual *Subdivision:* Manure management system
AEI 18 – Ammonia emissions	Ammonia emissions from agriculture are reported under the NECD requirements.	*Units:* Kt/yr *Spatial resolution:* National *Temporal resolution:* Annual *Subdivision:* Source

3.7 Framework Directive on the sustainable use of pesticides

3.7.1 The data requirements including their scale and accuracy

Directive 2009/128/EC was published on 24 November 2009 and Member States must bring in legislation to implement the directive by 14 December 2011. The Directive covers aspects of the usage of pesticides such as operator training, testing of equipment and aerial spraying, and disposal of pesticides. There is also a requirement for harmonised risk indicators, although these are still being developed.

Regulation 1185/2009 was published on 10 December 2009 and came into force on 30 December 2009. The main requirement of the regulation is for all Member States to collect statistical information on sales and usage of plant protection products. The current regulation focuses on agricultural uses, but it may be extended to include biocides. The key aspects are the collection of statistics on:

- Annual amounts of pesticides (plant protection products and biocides) placed on the market
- Annual amounts of pesticides used in agriculture

Sales Data

Sales data are relatively easy and cheap to collect, so can be provided more regularly and across all crops. The requirement is for the annual weight in kilograms of all active substances identified in Annex III of the Regulation. The information is required to be collected under certain major groups and categories of products:

- Fungicides and bactericides
- Herbicides, haulm destructors and moss killers
- Insecticides and acaricides
- Molluscicides
- Plant growth regulators
- Other plant protection products including nematicides, rodenticides

There are limitations to sales data. Sales data does not provide direct information on usage by crop, which is required in order to assess the risk, although an expert assessment can be made. The reference period for sales data is a calendar year, and applications during that year may differ from those predicted from sales data due to weather, or changes in cropping. For example, poor autumn weather conditions could lead to delays in herbicide application into the New Year, resulting in a perceived increase in pesticide use in that year, whereas in reality there is no change. Sales data can also be affected by cross border movement or stocks of unused pesticides.

Usage Data

The usage data requirements under the statistics Regulation are quite limited and allows for regional variation. For use data, the Member State can select representative crops to be covered and a one-year reference period within a 5-year reporting period. The reference period can be different for each crop.

The key pieces of information to be collected on pesticides in Annex III of the Regulation are:

- The quantity in kilograms of each substance used on each crop
- The area in hectares treated with each substance

The way the statistics are collected and the method of surveying is not prescriptive, allowing Member States to target the appropriate crops for their region. There are however definitive lists of active substances and crops, and requirements for the level of detail.

Risk Indicators

The Sustainable Use Directive requires that Member States adopt harmonised risk indicators for pesticides, although these are still under development. Risk indicators were identified in the Harmonised environmental Indicators for predicting pesticide Risk (HAIR) programme. The HAIR project was funded by the EU under the 6th Environment Action Programme. It aims to integrate information on the use, emissions and environmental fate of pesticides to help assess the overall risk. The output from the project was a set of harmonised environmental and human health risk indicators in a software package and user manual, which is to be used to predict environmental fate and exposure for aquatic and terrestrial organisms, groundwater, the general public, and spray operators. It includes databases on pesticide use, agricultural practice, land use, soil properties, hydrology, climate, ecotoxicological and humantoxicity data[90]. Alternatively, Member States are allowed to develop their own risk indicators.

The provision of accurate usage data is a vital input into the programme. The risk evaluation can be made at different resolutions and will be dependent on the level of detail provided. Pesticide consumption is a key indicator, along with pesticide characteristics, soils, application etc. The pesticide consumption data for HAIR needs to include certain features such as applications date, crop, active substance, rate, area treated, number of applications, mitigation measures etc. and these are the basis for the requirements for the usage data. The usage data requirements under the statistics Regulation are quite limited compared to what might be required for the full range of risk indicators.

Usage practices

The usage phase is regarded as a key factor in managing risks of pesticides. The Sustainable Use Directive sets out requirements for the usage phase of pesticides. This includes requirements for:

- spray operator training
- training of those selling pesticides
- equipment testing
- disposal practices
- use of integrated pest management techniques

Individual Member States must set out implementing legislation by 14 December 2011 and report on compliance on a regular basis. These could be used as indicators.

[90] http://www.rivm.nl/rvs/risbeoor/Modellen/HAIR.jsp (February 2010)

3.7.2 The reporting requirements: timescale, format, quality

Under the Statistics regulation, the first year of sales data is required for 2011, with delivery in 2012, and for pesticide use, a representative selection of crops for one year during the period 2010-2014 with delivery by 2016.

The aim of the regulation is to harmonize the provision of statistics on pesticide use across the EU in order to measure the progress towards the objectives of the Thematic Strategy on Pesticides.

Implementing legislation of the Sustainable Use Directive must be in place by 14 December 2011 with reporting of progress at intervals after that. There is no indication of the format of the information.

3.7.3 Availability and quality of data at a Member State level

Up to December 2009 there were no mandatory requirements for the provision of pesticide statistics to the EU by Member States, although several have collected data on a regular basis (Table 15). However there is no common methodology so the comparability and collation of the results is limited.

Pesticides **sales** data has been collected by many, but not all, Member States in recent years. Exceptions include Malta and Cyprus where pesticide usage is relatively low.

The United Kingdom, Denmark, Germany and Finland have the most comprehensive pesticide usage data collection systems that have been running for the longest time, with data on active substances by crop going back 20-30 years in some cases.

Other Member States have only recently started surveying pesticide **usage**, for example Ireland began in 2003, whilst some are currently developing programmes in order to meet the requirements of the Statistics regulation.

Table 15: Pesticide data collection from Member States

	Resolution	Sales	Usage	Date	Rate/crop	By Active
Austria	NUTS 0	Yes	-		-	-
Belgium	-	Yes	Yes		Yes	Yes
Bulgaria	Not known	Not known	Not known		Not known	Not known
Cyprus	Not known	Not known	Not known		Not known	
Czech republic	-	No	No	Statistics Regulation	No	No
Denmark	NUTS1 - DK	Yes	Yes	1981	Yes	Yes
Estonia	Not known	Not known	Not known		Not known	Not known
Finland	NUTS1	Yes	No (2013)	1990	No (2013)	Yes
France	Not known	Yes	Not known		Not known	Not known
Germany	NUTS 0	Yes	Yes	1980	Yes	Yes
Greece	Not known	Not known	Not known		Not known	Not known
Hungary	NUTS1	Yes	No	Statistics Regulation	No	No
Ireland	Not known	Yes	Yes	2003	Yes	Yes
Italy	NUTS 1 and 2	Yes	No	1996	No	No
Latvia	NUTS 1	Yes	No	Statistics Regulation	No	No
Lithuania	2	Yes	No	Statistics Regulation	No	No
Luxembourg	Not known	Not known	Not known		Not known	Not known
Malta	Not known	Not known	Not known		Not known	Not known
Netherlands	Not known	Yes	Yes		Yes	Yes
Poland	Not known	Not known	Not known	Statistics Regulation	Not known	Not known
Portugal	Not known	Not known	Not known		Not known	Not known
Romania	NUTS 3	No	No	Statistics Regulation	No	NO
Slovakia	Not known	Not known	Not known		Not known	Not known
Slovenia	Not known	Not known	Not known		Not known	Not known
Spain	NUTS 0 y 2	Yes	Yes	2004	No	No
Sweden	Not known	Not known	Not known		Not known	Not known
United Kingdom	NUTS 1	Yes	Yes	1970	Yes	Yes

From DIREDATE survey returns
From other sources

3.7.4 Member States collecting the best data for policy requirements

CASE STUDY: UNITED KINGDOM

Sales data: The UK sales data is provided by the Crop Protection Association[91].

Usage data: The United Kingdom have collected detailed pesticide usage information since 1965[92], co-ordinated and funded by the Chemicals Regulation Directorate. The introduction of the Food and Environment Protection Act in 1985 required post registration monitoring of pesticides and a fixed programme of surveys was introduced in 1990.

Statistics programme: The programme requires surveys of arable crops every two years and all other crops every 4 years. Other crops include grassland and fodder, outdoor vegetables, orchard and fruit stores, soft fruit, hops, mushrooms, protected crops, outdoor bulbs and flowers and hardy nursery stock. Data is also compiled for farm grain stores, commercial grain stores, potato stores, sheep dip and aerial spraying as well as rodenticide use on arable and grassland farms and by local authorities.

Methodology: The data is collected by a team of experienced surveyors who visit holdings to collect the information. Farm holdings are selected at random, stratified by holding size and region. The information is collected on a field by field basis for each crop and raised to give national estimates of usage.

Data availability: The pesticide usage reports are available from the Chemicals Regulation Directorate or summary statistics through an online data base http://pusstats.csl.gov.uk/. The reports and summary information are widely used by the industry and Government.

Indicators:

The pesticide sales and usage surveys are only one method of monitoring pesticides. The UK Government takes the view that the greatest risk occurs at the point of use, and if pesticides are not applied in a responsible way, this may undermine the risk assessment process. As a result, the UK Government set up a Pesticide Forum in 1999 to encourage the responsible use of pesticides with specific objectives under communication, monitoring and knowledge transfer http://www.pesticides.gov.uk/pesticides_forum.asp?id=1318. Under monitoring, the key objective was to look at how to effectively monitor all impacts from pesticides including use of indicators (Table 16). The Pesticide Forum established an indicators sub-group in 2000, which publish an annual report on pesticide indicators[93]. The UK Government intend to continue to use their own indicators for pesticides, but may use HAIR as an initial assessment to identify issues.

Pesticide consumption as measured by the statistics regulation is only one indicator of the risks of pesticides. Other indicators are tabulated below.

[91] http://www.cropprotection.org.uk/content/Home.asp

[92] http://www.fera.defra.gov.uk/plants/pesticideUsage/fullReports.cfm

[93] Pesticide Forum (2008) The 2008 report on the impacts and sustainable use of pesticides http://www.pesticides.gov.uk/uploadedfiles/E-publisher_Pesticides_Forum/Pesticides_forum_annual_report_2008.html

Table 16: Other pesticides risks indicators

Headline indicator	Core Indicator	Data source
Pesticide use	Pesticide sales	Crop Protection Association
	Cropped area	Defra June Survey
	Pesticide average input per crop kgas/crop and kgas/ha	CRD Pesticide Usage Survey
	Fungicide, Herbicide and Insecticide use – number of products and total doses of as/ha	CRD Pesticide Usage Survey
User Practice	National sprayer testing scheme	Voluntary Initiative
	National register of spray operators	NRoSO
	BASIS professional register	BASIS
	Crop Protection Management Plans	Voluntary Initiative
	Cross-compliance checks, legislative breaches	Rural Payment Agency
Protecting Human health	Pesticide Incident Appraisal Panel (PIAP)	Health and Safety Executive PIAP report
	Maximum Residue Levels	Pesticide Residue Committee reports
Availability of products and techniques	Number of biopesticides available to users	Chemicals regulation directorate
Protecting water	Pesticides in surface water	Environment Agency
	Top 9 pesticides in surface waters Pesticides in ground water	Environment Agency Environment Agency
	Number of substantiated pollution incidents	Environment Agency
Protecting biodiversity	Population of selected farmland bird species	British Trust for Ornithology
	Pesticide poisoning incidents investigated by Wildlife Incident Investigation Scheme (WIIS)	WIIS
	Arable field margins	UK arable field margin steering group
Best Practice in Amenity Use	Not applicable to this project	
Best Practice in amateur use	Not applicable to this project	

Usage practices:

The UK is well advanced in many aspects of implementing the requirements of the Sustainable Use Directive. There are already National Action Plans for water, biodiversity, amenity, amateur use, pesticide availability and human health. There is a voluntary system of training for professional advice when selling and/or advising on the use of pesticides. There is already a legal requirement for all spray operators to have a Certificate of Competence in spray applications, although there is an exemption for some older operators that will no longer be sustainable. There are currently voluntary arrangements for testing of spray equipment, aided by a national campaign, the Voluntary Initiative (www.voluntaryinitiative.org.uk), and the requirement for equipment testing under arable crop assurance schemes, resulting in a high proportion of the arable area sprayed by trained operators and tested equipment.

Pesticide disposal practices are covered in Waste Regulations of 2005 and supported by campaigns by the Voluntary Initiative.

CASE STUDY: POLAND

The Central Statistical Office (GUS) of the Ministry of Agriculture and Rural Development are responsible for collecting pesticide data. Poland started to collect information on pesticide sales and usage in 2002 in preparation for its accession to the European Union in 2004.

The first full set of pesticide sales data was available from 2005, where 974 chemicals were covered with information from 198 producers and importers. Information is collected on pesticide name, formulation, amount sold and amount in stock. The information is sourced confidentially from agrochemical producers and importers who submit data electronically. The information from the surveys is aggregated by active substance and chemical class and used to calculate the mean pesticide use in kilograms of active substance per hectare (kg ai /ha).

A comparison of sales and usage data in 2005 indicated that there was a difference in the headline figures of kg ai /ha, therefore in 2006 GUS established a working group to review the data collection process for usage and sales data. The working group identified key areas where the usage statistics would change with the introduction of the Statistics Regulation:

- Selecting a representative sample of farms – a move from quota sampling to random sampling
- Choosing crops to be surveyed – in 2007 beet, orchard and cereals were surveyed
- Adjusting cycles of data collection
- Reporting to Eurostat
- Data aggregation within the information system

Questions

- Will they develop their own pesticide risk indicators?
- Do they intend to exceed the requirements of the statistics regulation?

3.7.5 Sustainability of delivery of data

The basic requirements for sales data and usage statistics under the Sustainable Use Directive and the Statistics regulations are a minimum expected level and are likely to be achieved by all Member States. The provision of additional information and indicators are less reliable given the variations in states.

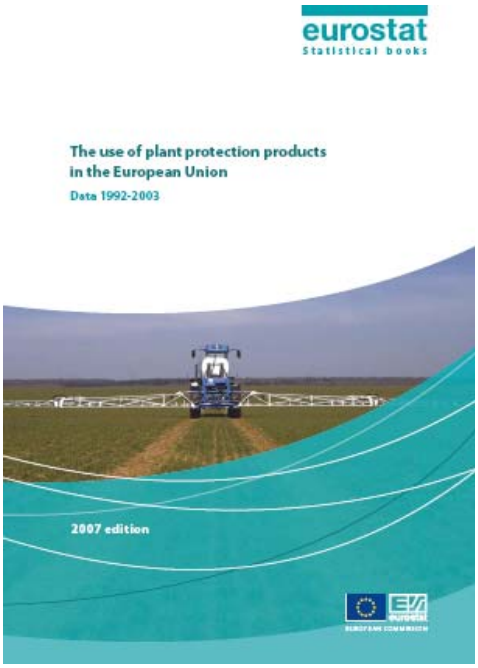
3.7.6 Alternative sources of information

Data collection by Eurostat

The most recent official Eurostat publication on pesticide usage in the EU, is the 2007 report, 'The use of plant protection products in the European Union', covering the period 1992-2003. This report was commissioned by the European Commission to produce meaningful and accurate information on the consumption and use patterns of plant protection products in order to understand the risks to human health and the environment, and for measuring progress towards the objectives of the Thematic Strategy.

The report was compiled by the European Crop Protection Association (ECPA) and provides statistical information on the estimated consumption of pesticides by:

- Member State
- Treated crops
- Chemical class – herbicide, insecticide, fungicide, other
- Active substance (where confidentiality rules allow).



Information on **use** of plant protection products by Member States for the main crop classes – beets, cereal, citrus, fodder, grapes, horticulture, maize, oilseeds, potatoes, top fruit, vegetable, industrial crops, non-crop and unspecified crops – is provided. The information was based on submissions from ECPA's full member companies – BASF, Bayer Cropscience, Dow AgroSciences, DuPont, Monsanto and Syngenta – who provided data on their own products and estimates for their competitors. These six companies are estimated to dominate 80-90% of the European crop protection market. The information collection methodology varied considerably between companies but included farmer surveys, external industry research including sales data, produce studies, industry expert opinion and internal company analysis.

Data was collected from 23 Member States. Good information was available from 18 of these, with less comprehensive information from Estonia, Latvia, Lithuania, Slovakia and Slovenia. No information was available from Cyprus or Malta.

There are some acknowledged limitations of the data provided by ECPA including:

- Farmer panels, which are considered the most accurate, are not carried out for all crops, or in all countries.
- Farmer panels are reliant on the farmers' understanding, with some lack of clarity over formulations.
- Internal and industry expert opinion are likely to vary from actual usage.
- ECPA member companies only represent 80-90% of total usage. Adjustments are made for other products but there are some gaps.

The limitations are evident when ECPA data is compared with data from Member States, showing some large variation. This is due to inclusion of different categories of pesticide and groupings of crops.

3.7.7 Developments and progress

Most Member states have been involved in pesticide statistics pilot studies under two EU programmes - TAPAS[94] from 1992-1999 for the EU-15, and PHARE[95] programme from 2002 for new Member States.

There is a Working Group on Pesticide Statistics with members from each of the Member States[96], which has met annually since 2005. This working group aims to share best practice on the collection of pesticide statistics and adoption of risk indicators under the Framework Directive or the Sustainable Use Directive, and in the context of agri-environment indicators.

[94] TAPAS – Technical Action Plan for Agricultural Statistics
http://circa.europa.eu/Public/irc/dsis/agrienv/library?l=/indicators_pesticides/tapas_pesticides&vm=detailed&sb=Title

[95] http://circa.europa.eu/Public/irc/dsis/agrienv/library?l=/indicators_pesticides/phare_pesticide&vm=detailed&sb=Title

[96] http://circa.europa.eu/Public/irc/dsis/agrienv/library?l=/indicators_pesticides/continuation_pesticides/pesticidestatisticsexper/_EN_1.0_&a=d

At the most recent meeting in Poland in October 2009[97], it was restated that the collection of pesticide usage and sales data under the Regulation 1185/2009 will be vital for the calculation of the HAIR project indicators.

Some key questions were raised about the output of the HAIR indicators:

- The indicators are based on the assumption that all mandatory measures, such as buffer zones, are applied everywhere. It currently cannot accommodate different levels of adoption of mitigation measures.
- The indicators are not a tool to quantify risks but mainly to indicate trends or express differences in time, between regions or between different practices.
- There is not currently sufficient clarity between hazard and risk, and this is vital for the final interpretation by the public and policy makers.
- Some indicators were likely to be abandoned as they were insufficiently developed.

Aside from the HAIR project, Member States are developing their own pesticide risk indicators at a national level:

- Denmark developed a tool to evaluate environmental contamination based on the distance between fields and natural elements such as water bodies.
- Belgium developed a holistic approach based on driving forces, pressures, state, impact and response.
- Germany developed a system based on sales data and application patterns from field use survey data.
- UK are using a mix of indicators such as pesticide usage, user practice (poisoning incidents) and monitoring (water and foodstuffs)

All agreed that the information required by the statistics regulation is a cornerstone for calculating risk indicators. Key concerns are:

- Quality assurance
- Definition of statistical concepts
- Preparation of data
- Transmission formats
- Data collection methodology
- Accuracy of data at different geographic levels

It is also important to note that monitoring of national strategies will require more data and information than those requested by the Statistics Regulation. This is particularly relevant to monitoring farmer application practice, which is not required under the regulation.

In the development of risk indicators the main considerations are:

- Risk indicators should be about risk not hazard
- HAIR risk indicators are to be based on those with good information already available
- Eurostat is to ask EFSA to build a pesticide properties database

[97] http://www.circa.europa.eu/Public/irc/dsis/agrienv/library?l=/indicators_pesticides/continuation_pesticides/20090914_poznan&vm=detailed&sb=Title

- Interpretation of risk indicators and use for agri-environment or sustainable development monitoring needs further discussion
- Member States should be allowed to develop additional indicators
- Indicator models based on the nature and type of active could lead to changes in use with no change in risk, unless the practice of users is taken into account

3.7.8 Potential synergies of reviewed data with AEIs

AEI indicator	Assessment of requirement/ provision under the FDSUP	Units and resolution
AEI 6 – Consumption of pesticides	The Statistics Regulation will provide data from all Member States on the consumption, and usage by main crops in those regions. There are currently working groups to aid the development of statistic collection and ensure robust data.	*Units:* Kg and Kg/ha *Spatial resolution:* National *Temporal resolution:* every 5 years *Subdivision:* Active substance; crop
AEI 10.1 – Cropping patterns	The Statistics Regulation includes cropping areas as part of the usage evaluation.	*Units:* Ha *Spatial resolution:* National *Temporal resolution:* every 5 years *Subdivision:* crop
AEI 11.1 – Soil cover	Calculations of pesticide applications to particular crops will require temporal information on cropping.	*Units:* Time period *Spatial resolution:* National *Temporal resolution:* every 5 years *Subdivision:* crop
AEI 17 – Pesticide risk	Not provided under the Statistics Regulation but the information will be used in the EU HAIR programme which aims to evaluate pesticide risk but there are some limitations due to data requirements.	*Units:* Risk indicators *Spatial resolution:* National *Temporal resolution:* not yet defined *Subdivision:* Active substance

3.8 Birds & Habitat Directive

The data requirements including their scale and accuracy

3.8.1 The data requirements including their scale and accuracy

Site Designation

Natura 2000 sites are designated by completing a *Standard Data Form*[98]. The data required by the form includes the following details:

- Identification data, including the site type, a proposed site code, the name of the site, and the date of designation.
- Location data, including coordinates (latitude, longitude), surface area (hectares), site length, altitude, and the NUTS and biogeographical regions.
- The habitat and species types present on the site, and cover/population details. Site assessments are made for each habitat/species to rank the feature for a number of categories (e.g. conservation status, population, representativity) where A is the highest rank, and C/D the lowest.
- A description of the site characteristics, quality, importance, vulnerability, ownership and history.
- The protection status and relationship with Corine biotope sites.
- The impacts and management measures present at the site.
- Maps, slides and photographic material.

Birds Directive

Article 12 of the Birds Directive requires each MS to submit a composite report on the progress they have made with meeting the main aims of the Directive. The implementation of the Birds Directive is decided by each Member State, so no standard method for monitoring bird populations and collecting data is proposed by the Directive. As the data will vary between each MS, the report template is supplied in a questionnaire format. This is completed at a national level as text responses, which include the measures that have been taken to support the Directive, and what has changed since the last report. If applicable/available, summary data and statistics should be included in the responses. The fields present in the most recently completed assessment (2002-2004)[99] are reproduced below in Table 17. The report includes the following details:

- A list of the species from each Annex of the Directive present in the Member State territory.
- The measures taken to protect the habitats and bird species within designated SPAs.
- The research and education efforts in place to benefit and promote bird conservation.
- The legislation that has been developed.

[98] European Commission. 1994 Standard Data Form. Available online at http://ec.europa.eu/environment/nature/legislation/habitatsdirective

[99] European Commission. Report to the Commission on the implementation of Directive 79/409/EEC on the conservation of wild birds. Available online at http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm

Table 17: The questionnaire Member States are required to complete by Article 12 of the Birds Directive

Birds Directive Questionnaire	
Section	**Field**
1. Species	
1.1.	Species covered by the Directive
2. Protection of habitats	
2.1.	State of progress for the classification of Special Protected Areas
2.2.	Targeted measures drawn up per SPA
2.3.	Actions undertaken outside SPAs
2.4.	Targeted measures taken for bird habitats in wider countryside
3. Protection of species	
3.1.	General system of protection
3.2.	Hunting & capture of bird species
3.3.	Means, arrangements or methods used for the large-scale or non-selective capture or killing of birds
3.4.	Synthesis of derogations from provisions of Articles 5, 6, 7 and 8
3.5.	Authorization of sale of bird species referred to in Annex III/2
3.6.	Introduction of species of birds which do not occur naturally in the wild state in the EU
4. Encouragement of research and any work required as a basis for the protection, management and use of the population of all bird species referred to in Art. 1	
4.1.	Research efforts completed or ongoing
4.2.	Education, information and communication in relation to bird protection
5. Legal texts	
5.1.	Texts of the main provisions of national law adopted in the field governed by the Directive
6. Other information	
6.1.	Other complementary information relevant to the conservation of wild birds

Habitats Directive

Article 17 of the Habitats Directive requires all MS to report on the progress made with establishing SAC sites, and to provide monitoring data on the conservation status of habitats listed in Annex I, and species listed in Annexes II, IV and V. The first report to include conservation status was for the period 2001-2006, which used a standard data collection and reporting format, as defined in EC guidance documents[100,101,102].

Reports are produced at a national level, and for each of the biogeographical regions present within a MS. There are seven terrestrial and four marine biogeographical regions recognised, which are determined based on climate, altitude and geology. Marine regions are defined as areas which are permanently covered by seawater. Where a MS contains two or more biogeographical regions, separate reports are required for each. The required assessment for a species or habitat covers its whole distribution within a MS, not just the sites of the Natura 2000 network (although an optional Natura 2000 assessment can also be made).

[100] European Commission, 2006 Explanatory Notes & Guidelines, available online at http://circa.europa.eu/Public/irc/env/monnat/library?l=/habitats_reporting/reporting_2001-2007/guidlines_reporting&vm=detailed&sb=Title

[101] European Commission, 2005 DocHab-04-03/03 rev.3, available online at http://circa.europa.eu/Public/irc/env/monnat/library?l=/habitats_reporting/reporting_2001-2007/reporting_framework&vm=detailed&sb=Title

[102] European Commission, Appendix 1 - Annexes of DocHab-04-03/03 rev.3

The guidelines include five Annexes outlining the reporting format, which requires three sections to be submitted, a General Report (Annex A), and conservation status assessments for each species (Annex B) and habitat (Annex D) present in the MS.

General Report (Annex A)

The general report contains a summary of progress establishing and enforcing the Habitats Directive, including the legislation in place, the number of SCIs and SACs present in each biogeographical region, the total surface area of SCIs and SACs, and the conservation measures applied to the habitats and species listed in the Directive.

Conservation Status Reports (Annexes B & D)

A conservation status assessment report is required for every species (Annex B) and habitat (Annex D) present in the MS territory. Each report must include a national-level summary, followed by a more detailed regional section, which should be completed for each of the biogeographical regions in which a species or habitat occurs. Maps outlining the distribution of the habitat or species are required at a national and biogeographical level in a standard GIS format as vector or raster grids, preferably at a 10 x 10 km resolution. If there is insufficient data to produce a 10 x 10 km grid, a larger alternative can be used (e.g. 50 x 50 km). The format of the data required for these sections is outlined in Table 18.

Table 18: Data requirements for Annexes B (species) & D (habitats) of the Habitats Directive.

The standard data requirements are similar for both Annexes; differences for Annex D are shown in red.

Annex B/ D	
Data	**Data format & description**
National Level	
Species/ Habitat code	Species code as used in Standard Data Forms, e.g. S1303
Member State	2 digit ISO country code e.g. ES
Biogeographic regions concerned within the MS	Codes for each of the biogeographic regions present e.g. ALP
Range	Range within the country concerned
Map	A GIS map file in vector or grid format, together with relevant metadata
Biogeographic level (complete for each biogeographic region concerned)	
Biogeographic region	Code for the biogeographic region e.g. ALP
Published sources	If the data present is from published sources, a list of bibliographic references or links to Internet site(s)
Range	
Surface area	Total surface area of the range within biogeographical region concerned (km²)
Date	Date (or period) when the range surface area was determined
Quality of data concerning range	3 = good 2 = moderate 1 = poor
Range trend	0 = stable + xx% = net increase by xx% − xx% = net loss by xx% If known provide magnitude of change in km²

Annex B/ D	
Data	**Data format & description**
Trend-Period	Dates of beginning & end of the period for which the trend has been reported
Reasons for reported trend	Assumed main reasons for change of range where known 0 = unknown 1 = improved knowledge/more accurate data 2 = climate change 3 = direct human influence (restoration, deterioration, destruction) 4 = indirect anthropo(zoo)genic influence 5 = natural processes 6 = other (specified)
Population/ Area covered by habitat	
Distribution map	Presence/absence, as a GIS based map in vector or grid format
Population size estimation/ Surface area	Total population in biogeographic region (data or best estimate), and units used (e.g. individuals, breeding pairs etc)/ Area covered by habitat within the range in the biogeographic region (km^2)
Date of estimation	Date (or period) when the population size/ surface area was determined
Method used	3 = from complete inventory/ ground-based survey 2 = extrapolation from sampling/ remote sensing 1 = based on expert opinion
Quality of data	3 = good 2 = moderate 1 = poor
Trend	0 = stable + xx% = net increase by xx% − xx% = net loss by xx%
Population trend magnitude	If known, the magnitude of change in population size/ area size
Trend-Period	Dates of beginning & end of the period for which the trend has been reported
Reasons for reported trend	Assumed main reasons for change of populations where known 0 = unknown 1 = improved knowledge/more accurate data 2 = climate change 3 = direct human influence (restoration, deterioration, destruction) 4 = indirect anthropo(zoo)genic influence 5 = natural processes 6 = other (specify)
Justification of % thresholds for trends	If a threshold of 1% increase/decrease has not been used to determine the trend, justification is given here
Main pressures	A list of main pressures impacting on the species/ habitat in the past or at the moment (past/present impacts), using codes from Appendix E to the Standard Data Forms to 2nd or 3rd level e.g. 160 - General Forestry management
Threats	Threats affecting long term viability of the species/ habitat (as above)
Habitat for the species (Annex B only)	
Habitat for the species	*Description of habitat use*
Area estimation	*Estimate of area (km²)*
Date of estimation	*Date (or period) when habitat surface area was determined*

Annex B/ D	
Data	**Data format & description**
Quality of data	*3 = good* *2 = moderate* *1 = poor*
Trend	*0 = stable* *+ = net increase* *− = net loss*
Trend-Period	*Give dates of beginning & end of the period for which the trend has been reported*
Reasons for reported trend	*Assumed main reasons for change of species habitat where known* *0 = unknown* *1 = improved knowledge/more accurate data* *2 = climate change* *3 = direct human influence (restoration, deterioration, destruction)* *4 = indirect anthropo(zoo)genic influence* *5 = natural processes* *6 = other (specify)*
Future prospects (Annex B only)	
Future prospects	*Is the species viable in the long term?* *1 = good prospects* *2 = poor prospects* *3 = bad prospects*
Complementary information	
Favourable reference range	Range (km²) and vector or grid map if feasible
Favourable reference population/ area	Number of individuals or other relevant surrogate/ Area
Suitable Habitat for the species	Area of suitable habitat which the species could potentially occupy (km²)
Other relevant information	Additional notes, if required
Conclusions (assessment of conservation status - see Annex C/E)	
Range	Favourable (FV) / Inadequate (U1) / Bad (U2) / Unknown (XX)
Population/ Area	Favourable (FV) / Inadequate (U1) / Bad (U2) / Unknown (XX)
Habitat for the species/ Specific structures & functions	Favourable (FV) / Inadequate (U1) / Bad (U2) / Unknown (XX)
Future prospects	Favourable (FV) / Inadequate (U1) / Bad (U2) / Unknown (XX)
Overall assessment	Favourable (FV) / Inadequate (U1) / Bad (U2) / Unknown (XX)

The conservation status reports include the following sub-sections:

Range (species and habitats)

Range is defined in the EC guidelines as 'the area of which a species or habitat is usually to be found'[103]. This should be the actual range of the feature at the end of the six-year reporting period. The range may be discontinuous, with the feature present in a number of separate locations. This can be determined by the number of empty 10 km grid squares between the two ranges, with a gap of 4-5 or more indicating two separate ranges. Expert judgement may be required to assess the range where gaps may be due to

[103] European Commission, 2006 Explanatory Notes & Guidelines, available online at http://www.circa.europa.eu/Public/irc/env/monnat/library?l=/habitats_reporting/reporting_2001-2007/guidlines_reporting&vm=detailed&sb=Title

limited data, or to adjust for migratory species and areas known to be ecologically unsuitable for the species/habitat.

Population (species)

Member states are encouraged to undertake surveys for species where there is a lack of information on the current population size and distribution. If no national inventory is available, European Atlases may be used to provide some of this data. Population sizes should be estimated as accurately as is possible, including the minimum and maximum estimates, and the units used. The overall trend of change in population size is also required, taken from an interval suitable for the biology of that species to account for natural fluctuations. If available, a trend over the full six year reporting period is preferred. To avoid double counting of mobile populations (particularly marine species), information should be shared between adjacent MS as required.

Area (habitats), Suitable Habitat (species)

MS can use previously existing habitat inventories, reinterpreting them to match Annex I habitat classes with the aid of other sources such as soil or geological maps. If there is no previous habitat map available, the range may be modelled from other sources, including climate data, species distributions, and topographical maps. The typical species of a habitat will also need to be stated, which includes all species important to that habitat, not just those included in the Habitat Directive.

Future Prospects (species)

This aims to determine if the species is likely to be viable in the long term, achieved by integrating information on pressures, threats, population trends and population structure. For example, if the population contains mostly non-reproducing mature individuals with no young or reproducing adults the 'future prospects' for that population are likely to be poor or bad[104].

Overall conservation status (species and habitats)

All habitats and species in the Habitats Directive must be assessed for 'Favourable Conservation Status'. Monitoring data, such as range, population size and structure, the amount of available habitat for a species and the vulnerability of the typical species in a habitat are assessed across the entire biogeographical region that the feature occupies within a MS. To evaluate the conservation status, these values are then compared to Favourable Reference Values (FRV), which estimate the range and area for habitats, and range and population size for species, required to achieve Favourable Conservation Status. If the FRV cannot be calculated, it may be set as 'greater than present value' when it is clear that the range, area or population size is currently insufficient.

Using the monitoring data collected and the FRV evaluation, the vulnerability of each of the four categories should be assessed, and an overall conservation status determined. There are three classes of conservation status, which are colour-coded for use in tables, charts and maps:

- Favourable (green): The habitat or species is expected to survive without any change to current management or policies.
- Unfavourable-Inadequate (amber): The habitat or species requires a change in management or policy to reduce the threat of extinction or extirpation.
- Unfavourable-Bad (red): The habitat or species has a high danger of extinction or extirpation.

[104] European Commission, 2006 Explanatory Notes & Guidelines, available online at http://www.circa.europa.eu/Public/irc/env/monnat/library?l=/habitats_reporting/reporting_2001-2007/guidlines_reporting&vm=detailed&sb=Title

In some cases, there may not be sufficient data to assess the conservation status. Expert opinion can be used to make the assessment, if available. Otherwise, the habitat or species must be listed as 'Unknown' (grey). To indicate an improvement or deterioration in status, '+' or '-' may be also included with the assessed category. Conservation status is determined using matrices provided in Annex C (for species) and Annex E (for habitats).

3.8.2 The reporting requirements: timescale, format, quality

Birds Directive

Under article 12 of the Directive, MS are required to prepare a composite national-level report of the measures taken to implement the Directive every 3 years. An initial draft report is sent to the Commission, which is assessed for quality and completion, and changes requested if needed. When the reports have been approved, the final versions are submitted and collated by the EC to produce a summary report. MS may also apply for derogations to appeal for licences to hunt or capture certain species for cultural, economic or health reasons, which are submitted annually.

Habitats Directive

Under Article 17 of the Habitats Directive, MS are required to submit a national report on the progress with implementing the Directive to an agreed format every six years. These national reports are then summarised by the EC to produce an EU composite report[105]. The first reports, for the period 1994-2000, focussed on the progress made with establishing the designated conservation areas. The second report for the period 2001-2006 was the first to provide data for conservation status, and was completed in late 2008. National reports were transmitted using a web based IT tool (Reportnet), developed by the European Environment Agency (EEA), with a deadline of June 2007. Only three Member States achieved this deadline, with all national reports received by March 2008. Received reports were then checked for data quality and completeness by the European Topic Centre on Biological Diversity (ETC/BD), and if required, a request for making amendments was made before a final resubmission.

3.8.3 Availability and quality of data at a Member State level

Birds Directive

Data Availability

The most recent summary report available is for the period 2002-2004. All of the MS responded to the questionnaire supplied, although not for all of the questions presented. The questionnaire answers provide a summary of the data collected by each MS, although there does not appear to be any of the raw data immediately available from the EC, which includes bird species lists. In some cases, the current inventory may be available directly from the MS (as is the case for the UK). Alternatively, other information sources may be used to provide this data (see section 3.4.).

Data Quality

Many of the responses provided to the EC Questionnaire were brief or incomplete answers. In some cases data was given for certain sites rather than nationally, or was classed as 'no change from previous report'. The species lists submitted included full inventories or checklists of protected species, which did not

[105] European Commission. 2009 Report from the Commission to the Council and the European Parliament. Available online at http://www.eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52009DC0358:EN:NOT

always include just the birds listed in the Annexes of the Directive. In many cases, species numbers were not split into the separate Annexes as was requested, or were entered into the wrong Annex. The Member State responses are available in the document Report to the Commission on the implementation of Directive 79/409/EEC on the *conservation of wild birds*[106]. Appendix G lists the questions each Member State provided responses for.

Habitats Directive

Data Availability

The first report on conservation status for the period 2001-2006 included feedback from all 25 MS, (before Bulgaria and Romania joined the EU). Data was often collected and presented differently between MS, which was processed by the ETC/BD to address any issues, and to request amendments if required. The reports from Malta and Spain were received too late for corrections to be made.

The final MS reports and data are available in a number of formats. Raw data is stored online in the Central Data Repository (CDR)[107;] processed at a Member State level for individual species[108] and habitats[109;] or at an overall species[110] and habitat level[111]. Raw data is also made available in a Microsoft Access database and as GIS data, which consists of separate layers for habitats and species distribution in 10km grids (or equivalent) for all MS[112]. Summaries for each of the MS are available at a biogeographical level, including some basic site statistics for the overall conservation status of habitats and species, and the amount of uncertainty present[113].

Data Quality

A summary of the data quality evaluation made by the EC is available in the document Data Completeness, Quality and Coherence[114]. Most of the data used to assess conservation status was primarily collected for another purpose and was not strictly for the 2001-2006 period specified. In other cases, the data was not provided or was recorded as 'unknown'. Overall, the conservation status of 18% of habitats and 31% of species were classed as 'unknown' or 'not assessed'. The majority of 'unknown' classifications were from countries in southern Europe, with Cyprus, Greece, Spain and Portugal having 50% or more species classed as 'unknown'. Marine habitats and species, and bats, were the most lacking in data in most Member States. From the National Summaries of each MS, the overall uncertainty in data for each MS was extracted to give a breakdown of the quality of data available (Appendix H). The estimation of 'trend' by many of the MS was not made for a number of their species or habitats, particularly for species (the highest is 86%).

[106] European Commission. Report to the Commission on the implementation of Directive 79/409/EEC on the conservation of wild birds. Available online at http://ec.europa.eu/environment/nature/knowledge/rep_birds/index_en.htm

[107] Accessed at http://circa.europa.eu/Public/irc/env/monnat/library?l=/habitats_reporting/reporting_2001-2007/ms-reports_2001-2006&vm=detailed&sb=Title

[108] Accessed at http://biodiversity.eionet.europa.eu/article17/speciesreport

[109] Accessed at http://biodiversity.eionet.europa.eu/article17/habitatsreport/?group=&country=&region=

[110] Accessed at http://biodiversity.eionet.europa.eu/article17/speciesprogress

[111] Accessed at http://biodiversity.eionet.europa.eu/article17/habitatsprogress

[112] Accessed at http://www.eea.europa.eu/data-and-maps/data/article-17-database-habitats-directive-92-43-eec

[113] Accessed at http://circa.europa.eu/Public/irc/env/monnat/library?l=/habitats_reporting/reporting_2001-2007/ms-reports_summaries&vm=detailed&sb=Title

[114] European Commission. 2007 Data Completeness, Quality and Coherence, available online at http://biodiversity.eionet.europa.eu/article17

3.8.4 Member States collecting the best data for policy requirements

BIRDS DIRECTIVE CASE STUDY – UK

The Joint Nature Conservation Committee (JNCC) conducted a full UK SPA Review, based on data from the first half of the 1990s[115]. This includes detailed data for every species and site present under the Birds Directive at the time of the review, and the methodology used for site selection and monitoring.

National level breeding and wintering population estimates for Annex I and migratory bird species were collated from previous assessments for Great Britain and Ireland separately. These values were used to estimate the proportion of the total population at potential SPA sites. SPA sites were designated if they contained a minimum population threshold, usually 1% of the national population. For each of the final SPAs, a site account has been made, which includes the location of the site (map and grid references); the area (ha); the species present on the site; the population size and proportion, and a site description. A report is also available for each of the species that have at least one SPA selected. This includes the biological, legal and conservation status, the population size and proportion on each site, the total population size, structure and trends, the global and national distribution, the protection measures taken, and the criteria used to select SPAs for that species. To provide the most recent data, an updated list of the SPA sites in the UK is also available online, and copies of the original Standard Data Form, including species and habitat lists, conservation issues and management measures for each site.

HABITATS DIRECTIVE CASE STUDY – CZECH REPUBLIC

For the Habitats Directive, the Czech Republic has submitted a report with little uncertainty in the data. The basis of this case study comes from the documents *Data Completeness, Quality and Coherence*[116] and *Nation Summary: Czech Republic*[117]. For the majority of assessed categories, the Czech Republic had one of the lowest amounts of missing data reported. Many MS had a high amount of uncertainty in their trend estimation, which was much lower in the Czech Republic assessment, with all habitats including a trend assessment, and a maximum of 17% uncertainty for species.

The Czech Republic has been more thorough in recording the typical species found in a habitat with an average of 38 species per habitat, whilst some of the other MS only reported a few species, or did not record any at all. From EC quality checks made on the conservation status assessments provided, there were a low number which were identified as being ‘unknown’ or ‘unexpected’ conclusions.

The Czech Republic has been identified as providing good quality maps for each of the habitats and species present. The mapping is at a high resolution with detailed field mapping of the distribution, with some individual polygons as small as a hectare. Maps for some of the other Member States are at a lower resolution, and overestimate the distribution of the feature. The Czech Republic is the only Member State that has mapped a range and distribution that matches the Natura 2000 sites designated for habitats and species. It is also one of only three MS that had no QA/QC issues with the species maps.

[115] JNCC. SPA Review, Available online at http://www.jncc.gov.uk/page-2970

[116] European Commission. 2007 Data Completeness, Quality and Coherence, available online at http://biodiversity.eionet.europa.eu/article17

[117] European Commission. 2008 Article 17 Report – National Summary: Czech Republic, available online at http://circa.europa.eu/Public/irc/env/monnat/library?l=/habitats_reporting/reporting_2001-2007/ms-reports_summaries&vm=detailed&sb=Title

3.8.5 Sustainability of delivery of data

Birds Directive

MS are required to submit reports every three years, which details the species present from each Annex of the Birds Directive, the SPAs designated for them, and the conservation measures in place. In the most recent report available, a number of MS had only partially completed the questionnaire, or did not follow a standard format. This suggests that data delivery is currently not being performed in a sustainable manner. An Expert Group meeting has suggested improvements to the data collection process for the next reporting period that may improve data sustainability[118].

Habitats Directive

The Habitats Directive requires continuous monitoring of the condition of species and habitats within each MS, with results being updated every six years. An online reporting system is in place to allow data to be submitted at the end of each reporting period. This system ensures that data is sustainable, and presented using a standard format. All data is then made available to the public online via the CDR system.

3.8.6 Alternative sources of information

BirdLife International provides factsheets for Important Bird Areas (IBAs) in Europe, chosen based on similar criteria to SPAs using IUCN Red List data[119]. This includes the location, area, land-use and threats to each site. A species list is provided, which contains an estimation of the population size for breeding, passage and wintering species. For many individual species, there is also a summary of the population size and trend in each European MS available[120].

3.8.7 Developments and progress

To improve and develop the reporting system, an Expert Group meets to discuss the current reporting of Natura 2000, and suggest strategies for the future[121]. The Expert Group has identified a need for data to be systematically monitored, collated, assessed and reported. The priority for future reports will be to produce data that is more harmonised between the MS. The Expert Group aims to improve the clarity of the data requirements and specifications, and how best to assess, assemble and present data. Electronic data management and reporting systems are being developed further to help achieve this.

To improve the reporting of the Birds Directive, a Bird Reporting System has been proposed. This involves cooperation between the EU reporting and other established data collection. In collaboration with BirdLife International, a peer-reviewed dataset will be collated that can be used for NGO conservation assessments and for MS Birds Directive reporting.

The Habitats Directive 2007 report was the first assessment of conservation status, and as such cannot yet provide a full estimate of trends. The next reporting period is for 2007-2012, which will include more detail for population, area and range trends, and the threats and pressures present. Standardisation of data such as population units will allow for more in-depth assessments, and improvements in developing

[118] European Commission. 2010 Streamlining and modernising the reporting tasks under the Habitats and Birds Directives. Available online at http://circa.europa.eu/Public/irc/env/monnat/home

[119] Accessed at http://www.birdlife.org/datazone/sites/index.html?action=SitHTMFind.asp&INam=&Reg=7

[120] Accessed at http://www.birdlife.org/datazone/species/index.html

[121] European Commission. 2010 Streamlining and modernising the reporting tasks under the Habitats and Birds Directives. Available online at http://circa.europa.eu/Public/irc/env/monnat/home

species and habitat inventories should occur over time, reducing the amount of uncertainty in the data. The next report also aims to include more details on management strategies and their effects on improving conservation. The 2013 report will also include data for the newer EU MS, Romania and Bulgaria.

3.8.8 Potential synergies of reviewed data with AEIs

AEI indicator	Assessment of requirement/ provision under the BHD	Units and resolution
AEI 2 – Agricultural areas under Natura 2000	• Areas of Natura 2000 sites are required, however not restricted to UAA. • The area covered by each priority habitat and the main pressures impacting it are required. An optional N2K assessment can be made, but the mandatory requirements are across the whole territory.	• *Units:* Ha *Spatial resolution: N2K* site *Temporal resolution:* every 6 years • *Units:* Ha *Spatial resolution:* Biogeographic region *Temporal resolution:* every 6 years *Subdivision:* Priority habitat
AEI 23 – High Nature Value Farmland	Areas of farmland can be determined as having high nature value in terms of habitats and bird species from BHD sites.	*Units:* Ha *Spatial resolution:* Biogeographic region *Temporal resolution:* every 6 years *Subdivision:* Habitat
AEI 25 – Population of farmland birds	The Birds Directive requires data on bird species listed in the annexes to the Directive that are present in the MS territory, although this is not consistently gathered/ reported across MS.	*Units:* Number of species/ population counts *Spatial resolution:* National *Temporal resolution:* every 3 years

3.9 EU Strategy for Sustainable Development (EU SDS)

3.9.1 The data requirements including their scale and accuracy

The EU SDS is arranged into a framework of ten central themes, which was designed to provide a clear structure that has relevance for political decision making. Each theme is also further divided into a number of sub-themes, which organise the indicators to reflect the operational objectives and actions of the EU SDS. The ten main themes of the EU SDS are:

- Socio-economic development;
- Climate change and energy;
- Sustainable transport;
- Sustainable consumption and production;
- Natural resources;
- Public health;
- Social inclusion,
- Demographic changes;
- Global partnership;
- Good governance.

The SDIs are structured in three levels, enabling distinction between the SDS hierarchy of key challenges, overall objectives, operational objectives, and actions; whilst also being applicable to different kinds of user needs. The three levels of SDIs are complemented with contextual indicators to provide background data and are outlined below:

- **Headline Indicators (First Level):** These indicators monitor the overall objectives of the strategy. They are widely used, with a high communicative and educational value, and are available for most member EU states for a period of five years;
- **Second Level Indicators:** These indicators are related to the operational objectives of the strategy. Within the individual sub-themes these are lead indicators. They are robust and are available for a time frame of at least three years;
- **Third Level indicators:** These indicators are purely based on actions described in the strategy or focussed on issues, which are useful for analysing progress towards the set SDS aims;
- **Contextual Indicators:** These indicators do not monitor a particular SDS objective or they are not policy responsive. Their purpose is to provide supportive background information.

There are currently over 100 SDIs in total, each of which relates to one of the themes or sub-themes of the EU SDS. The structure of the indicator set within each theme is shown in Appendix I. Those with relevance to agri-environment indicators are highlighted in bold.

Most data to compile the set of indicators come from Eurostat statistical data collected through the European Statistical System (ESS)[122]. However, in order to cover the wide range of issues related to sustainable development, other data sources such as European Commission services and the European

[122] Available online at http://epp.eurostat.ec.europa.eu/portal/page/portal/about_eurostat/european_framework/ESS

Environment Agency have been considered. Each SDI requires different data collection methods, which may be adapted from the existing reporting methods of other policies. The data collection requirements for a selection of SDIs that could potentially be compatible with agri-environmental indicators are outlined below.

1. Final energy consumption by sector (level 3)

This indicator is calculated as the sum of energy supplied to final users from all sources. The energy units are transformed into the equivalent amount in 1,000 tonnes of oil (ktoe), allowing for aggregation and comparison between sectors. Energy consumption is measured for each of the sectors agriculture; transport; industry; households; services; and other sectors.

Energy use data is collected using standardised questionnaires, which should be completed annually for each energy source (solid fuels, oil, gas, electricity and renewables). In some EU states, energy data is compiled from mandatory surveys, since the data are required to be reported by law. Other countries rely solely on voluntary agreements with companies and associations, which can be problematic when certain data is confidential due to competition in the energy market.

MS are required to report final energy consumption data to Eurostat in fuel specific units, which are then processed into the equivalent tonnes of oil by using calorific values, either collected as part of the questionnaires or using Eurostat default values. Sums of energy consumption for sub-sectors in common units provide aggregate figures by sector. In some countries, final energy use at the sector level is based on modelling and a detailed breakdown cannot be provided.

2. Area under agri-environmental commitment (level 3)

This indicator is calculated from the percentage of utilised agricultural area (UAA) that is enrolled in agri-environmental measures. The UAA includes the total area of arable land, permanent grassland, permanent crops and kitchen gardens used by the holding. Any unutilised agricultural land, woodlands and other land (occupied by buildings, farmyards, tracks, ponds, etc) are not included in the UAA figures.

UUA data is sourced from the EU Farm Structure Survey (FSS)[123], a survey of agricultural holdings that is the main source of information on agricultural statistics. A large number of legal instruments provide detailed specifications on concepts (variables, classifications and population), rules and procedures that should be followed for data collection. Information for the FSS is provided by a national agricultural census in each MS, which should be carried out concurrently every 10 years (last census in 2000). To monitor change in between census years, surveys are conducted at intervals of between 1 and 3 years. The area of land under agri-environmental commitment is determined from common indicators for monitoring the implementation of Rural Development Plans (RDPs)[124].

3. Area under organic farming (level 3):

This indicator measures the share of total UAA that has adopted organic farming practices (existing organically farmed areas and areas in process of conversion). Member States are required to submit yearly information on the area used for organic farming under the organic farming regulation[125]. For this, a common and harmonised ad-hoc questionnaire was developed by the Directorate-General for Agriculture and Rural Development, in collaboration with Eurostat, in order to facilitate comparison and aggregation at an EU level. This data is then combined with the FSS farm holdings data to determine the

[123] Data available online at http://epp.eurostat.ec.europa.eu/portal/page/portal/agriculture/data/ad_hoc_tables_farm_structure_survey

[124] European Commission. 1999 Council regulation (EC) No 1257/1999 of 17 May 1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF) and amending and repealing certain Regulations.

[125] European Commission. 2007 Council Regulation (EC) No. 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No. 2092/91.

proportion of UAA occupied by organic farming. Where possible, results are divided into the total area that is fully converted, and the area that is currently in conversion.

4. Livestock density index (level 3):

The livestock density index should be calculated as the number of livestock units (LSUs) per hectare of utilised agricultural area (UAA). The LSU enables the aggregation of livestock densities for a variety of species and ages into a single common reference unit. Species included in the LSU total for the purpose of this indicator are horses, cattle, sheep, goats, pigs, poultry and rabbits. The indicator is used as a proxy for agricultural intensification in the livestock sector. It is of relevance to agri-environment due to the impacts that high (and low) livestock densities can have on biodiversity, soil and water quality, landscape, and GHG emissions. Livestock numbers are taken from the Eurofarm database[126], and converted into LSUs using livestock-specific coefficients. The number of LSUs per hectare of UAA can then be determined from FSS data.

5. Greenhouse gas emissions by sector (level 2):

For the agricultural sector, this indicator is defined as 'the contribution of key sources of emissions in agriculture to total EU greenhouse gas emissions as well as CO_2 removed by sinks'. Data for this indicator is obtained from UNFCCC greenhouse gas monitoring reports for the EU. Under the UNFCCC[127] and its Kyoto Protocol[128], greenhouse gas emissions and sinks (for LULUCF) are reported annually to measure Member States' progress towards reducing emissions. See section (2.1) for details on the data and reporting requirements under this policy.

6. Share of renewables in gross inland energy consumption (level 1):

This indicator measures and provides information with reference to energy generated from renewable sources, split into hydroelectricity, biomass & waste, wind, solar, tidal and geothermal energies. This indicator is the ratio between the energy produced from renewable energy sources and the gross inland energy consumption for a given calendar year. The recent Directive on the promotion of renewable energy[129] sets a binding target of 20% share by 2010 for all MS, defined as the share of energy from renewable sources in gross final consumption, which will require a slightly different indicator. Data for this indicator is collected as per policy requirements laid out in the renewable energy directive. The methodology and definitions used in its calculation should be those of Regulation (EC) No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics[130].

The energy from biomass component required for calculation of this indicator provides relevant information for the AEI 'Production of renewable energy', which relates to energy production from crops and by-products.

[126] Available online at http://epp.eurostat.ec.europa.eu/portal/page/portal/agriculture/data/database

[127] United Nations. 1992 United Nations Framework Convention on Climate Change.

[128] United Nations. 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change.

[129] Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[130] OJ L 304, 14.11.2008, p. 1.

7. Common bird index (level 1):

This indicator provides information on the abundance and diversity of a selection of 135 common European bird species, including a subset of 36 farmland birds[131] (at most recent update in 2008). These are the same 36 species as in the official FBI, also used for baseline and impact indicators in the RDP (see section 2.3). The EU index is based on trend data collected by volunteers under the Pan-European Common Bird Monitoring Scheme[132], coordinated by BirdLife International and European Bird Census Council (EBCC) and supported by the Royal Society for the Protection of Birds (UK) and Statistics Netherlands.

National indices are calculated for each species, based on the total birds counted, which are then aggregated using country-specific population-dependent weighting factors to give species-level indicators. The species indicators are then combined (a geometric mean is taken) to give an overall multi-species indicator for the EU. At present, the data come from 21 countries in the EU: Austria; Belgium; Bulgaria; Czech Republic; Denmark; Estonia; Finland; France; Germany; Hungary; Ireland; Italy; Latvia; Netherlands; Norway; Poland; Portugal; Spain; Sweden; Switzerland; United Kingdom.

8. Sufficiency of sites designated under the EU Habitats directive (level 2):

This indicator measures the extent to which Sites of Community Importance (SCIs) proposed by member states cover the terrestrial species and habitats as listed in Annexes I and II of the Habitats Directive[133]. Measurement of this indicator requires calculation of the area of habitat and number of species listed in the Directive and occurring in the MS that are covered by the SCIs.

Standard data forms are required for submission under the Directive, which list the habitats and species covered by each proposed SCI. These are then assessed by the EC, EEA and regional and scientific experts to determine the sufficiency of the sites coverage of species and habitats listed (%), which is the basis of this indicator. The evaluation of sufficiency is based on the coverage of the proposed sites in proportion to the range of each species and habitat in the MS' territory. A value of 100% indicates that MS proposals for SCIs are sufficient in meeting the requirements of the Habitats Directive. The indicator is currently being extended in order to include the Birds Directive[134], another key part of EU nature legislation. See section (3.8) for details on the data and reporting requirements under these Directives.

9. Surface and groundwater abstraction as a share of available resources (level 2):

The annual total water abstraction is calculated from the percentage of the total ground/surface water resources available for abstraction over a long-term period (minimum 20 years), referred to as the water exploitation index. The water resources available are calculated from the groundwater recharge (the total volume of water added from the outside to the saturated zone of an aquifer) less the long-term annual average rate of flow required to achieve ecological quality objectives for associated surface waters. The surface water resources available for abstraction are calculated as the total fresh water resources less the amount of groundwater that is available for annual abstraction.

[131] The 36 farmland bird indicator species are: *Alauda arvensis; Anthus campestris; Anthus pratensis; Burhinus oedicnemus; Calandrella brachydactyla; Carduelis cannabina; Ciconia ciconia; Corvus frugilegus; Emberiza cirlus; Emberiza citronella; Emberiza hortulana; Emberiza melanocephala; Falco tinnunculus; Galerida cristata; Galerida theklae; Hirundo rustica; Lanius collurio; Lanius minor; Lanius senator; Limosa limosa; Melanocorypha calandra; Miliaria calandra; Motacilla flava; Oenanthe hispanica; Passer montanus; Perdix perdix; Petronia petronia; Saxicola rubetra; Saxicola torquata; Serinus serinus; Streptopelia turtur; Sturnus unicolor; Sturnus vulgaris; Sylvia communis; Upupa epops; Vanellus vanellus.*

[132] Available online at http://www.ebcc.info/pecbm.html

[133] European Commission. 1992 Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

[134] European Commission. 2009 Directive 2009/147/EC of the European parliament and of the Council of 30 November 2009 on the conservation of wild birds.

Water abstraction data is collected voluntarily by MS for the joint OECD/Eurostat questionnaire on inland waters[135], which compiles data on water resources, abstraction and use from national or local authorities. Water abstraction rates for significant abstractions from surface water and groundwater are also required to be reported under the Water Framework Directive (see section 3.4 for details).

10. Biochemical oxygen demand in rivers (level 3):

Biochemical oxygen demand (BOD) is a commonly used indicator of water quality, and estimates the total amount of biodegradable organic matter in a waterbody. The indicator is defined as the mean annual amount of oxygen required to decompose organic matter over a five day period and in the dark (BOD5), although some Member States measure BOD over seven days (BOD7).

Water quality data is collected through the EEA's WISE-SoE[136] data collection process, which compiles validated river monitoring data from across Europe into a relational database known as Waterbase-Rivers. BOD concentration estimates are mapped and aggregated to country-level and River Basin District level in WISE[137].

This indicator is not directly related to any single policy, however the environmental quality of surface and groundwaters and the reduction of organic pollution are objectives in several pieces of EC legislation, including the Nitrates Directive (see section 3.5) and the Water Framework Directive (see section 3.4).

11. Built-up areas (level 2):

This indicator has been developed in order to monitor the development of built-up land and loss of natural and semi-natural land. It is measured by the change in land cover from 1990 to 2000, with data being derived from the EEA CORINE land cover database[138]. More recent imagery from 2006 will be used in future monitoring reports. The amount of artificial surface is reported for categories such as 'urban fabric' and 'mine, dump and construction sites', with further sub-categories in some cases. Measurement of the indicator in this way is likely to underestimate the development of built up land – a report on farmland abandonment in 2008 by the JRC[139] concluded that using CORINE to estimate loss of farmland through soil sealing is not accurate enough and may lead to a large underestimation of the process.

12. Percentage of total land area at risk of soil erosion (level 3):

In the most recent monitoring report[140], this indicator is listed as currently under development, and is expected to be available within two years. When implemented, it will provide an assessment of the amount of land area under risk of soil erosion and will contribute to the sub-theme 'land use'.

[135] Available online at http://rod.eionet.europa.eu/obligations/645/overview

[136] Available online at http://water.europa.eu/en/welcome

[137] Available online at http://www.eea.europa.eu/themes/water/interactive/soe-ri-bod

[138] European Environment Agency. 1994. Corine land cover.

[139] http://agrienv.jrc.ec.europa.eu/publications/pdfs/JRC46185_Final_Version.pdf

[140] European Commission. 2009. Sustainable development in the European Union - 2009 monitoring report on the EU sustainable development strategy.

3.9.2 The reporting requirements: timescale, format, quality

Each MS must submit a national-level progress report to the EC every two years. These national reports are then collated into an EU-level monitoring report by Eurostat [141], which has the following objectives:

- **Policy relevance:** to adapt the SDI set to reflect the latest EU SDS and other associated policy initiatives;
- **Efficient communication:** to focus the set of SDIs with an aim to improve communication and at the same time ensuring maximum stability over time;
- **Statistical quality:** to improve the overall quality of the data set, taking into account the latest datasets available.

The monitoring reports review each of the SDIs individually at an EU level to outline trends in indicator values, and to assess the level of change towards or away from the targets set by the EU SDS.

The data for each indicator is usually required to be reported annually, but some indicators have a longer interval between reporting years, depending on the availability of the data source. The interval between each reporting year, the earliest submission year and the most recent submission year for each SDI relating to AEIs are shown in Table 19.

Table 19: Agri-environment sustainable development indicators, the timescale for reporting requirements, and the earliest and most recent submission for the SDI by Member States

Sustainable Development Indicator	Timescale	Earliest data available	Most recent data available
Energy consumption	Annually	1997	2008
Area under agri-environmental commitment	Annually	2001	2005
Area under organic farming	Every 2-3 years	2000	2007
Livestock density	Every 2-3 years	1990	2007
Greenhouse gas emissions	Annually	1997	2008
Electricity generated from renewable sources	Annually	1998	2010
Common bird index	Annually	1996	2007
Sufficiency of sites designated under the EU Habitats Directive	Annually	2003	2008
Surface and groundwater abstraction as a share of available resources	Annually	1996	2007
Biochemical oxygen demand in rivers	Annually	1995	2006
Built up areas	Every 5 years	1990	2000

[141] Available online at http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/publications

3.9.3 Availability and quality of data at a Member State level

The annual data submitted by each MS are available on the Eurostat website for most of the SDIs[142]. The availability of SDI data for each year is summarised by Member State in Appendix J. The data for most SDIs is available annually, although some SDIs have larger intervals between reporting years (e.g. Livestock density). The SDIs 'Energy consumption'; 'Greenhouse gas emissions', and 'Electricity generated from renewable sources' have a full set of data available for all potential reporting years and for all MS. 'Area under organic farming', 'Livestock density index', and 'Sufficiency of sites designated under the EU Habitats directive' have at least some data available for all MS. The data for the other SDIs is either only partially available, or has not been reported by some MS.

Eurostat reviews the quality of some of the indicators in Quality Profiles[142], which assess the data accuracy and comparability between countries and over time. SDIs that have already been developed are assigned one of three quality grades, as outlined below:

- **Grade A:** The data is collected from reliable and accurate sources, and is documented according to Eurostat's metadata standards. Each Member State must use a common EU methodology, and also be comparable over time;
- **Grade B:** The data standards are as with grade A, but where the data is not comparable between countries or years, or is only partially available, the SDI is classed as grade B;
- **Grade C:** The data does not meet the high quality standards required for grades A and B, and/or has problems with comparability/availability across both countries and years.

The results of the Eurostat Quality Profile assessment for each AEI-related SDI are summarised in Table 20 (where available).

Table 20: Results of the Eurostat Quality Profile assessment for relevant SDIs for which a report is available

Sustainable Development Indicator	Accuracy	Comparability across countries	Comparability over time	Overall quality grade
Final energy consumption	High	Not applicable	High	B
Area under agri-environmental commitment	High	Restricted	High	B
Area under organic farming	High	High	Restricted	B
Livestock density	High	High	High	A
Greenhouse gas emissions	High	High	High	A
Common bird index	High	Restricted	Restricted	C
Sufficiency of sites designated under the EU Habitats Directive	High	High	High	A
Surface and groundwater abstraction as a share of available resources	High	Restricted	Restricted	C

[142] Available online at http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators

1. Final energy consumption

Overall data accuracy is reported as being high. To ensure data consistency, a high-level analysis of energy balances at national scale is conducted. Eurostat carries out quality tests on the national energy balance, which have revealed an imbalance in some cases due to differences between supply and consumption. Few countries have addressed these differences. Comparability across countries is not possible unless the population size and GDP of the country is taken into account as total amounts are reported. Although the questionnaire is standardised, data collection methods vary as European standards have not yet been set. There are no breaks in the time series for this indicator.

2. Area under agri-environmental commitment

Overall data accuracy is reported as being high, however double-counting is possible in the case of land being subject to more than one agreement. Comparability is restricted due to differences in coverage and missing data for some countries. There are no breaks in the time series for this indicator. This indicator was listed as having insufficient data in the 2007 monitoring report[143], and was then excluded from the 2009 monitoring report[144] due to the quality concerns described above.

3. Area under organic farming

Overall data accuracy is reported as being high – questionnaires are common and harmonised, and corrections of errors are made when found. A number of Commission regulations ensure harmonisation of methods in the Farm Structure Survey by providing a detailed list of variables, rules and procedures that should be adhered to. This increases comparability across countries. Comparability over time, however, is restricted since data on organic area is collected annually whilst full census data is obtained every 10 years. A small number of breaks in the time series have also been reported for Greece, France and the UK.

4. Livestock density index

Overall accuracy is reported as being high, since this indicator uses livestock data from the FSS. The threshold for holding size differs among MS, however all MS are required to fix the level so as to exclude only holdings that together contribute ≤1% of the standard gross margin. Raw data are provided to Eurostat, which facilitates quality checking and indicator calculation. The same rules apply and the same data are available for all countries, which means that comparability across MS is high. Comparability over time is also high, but there are breaks in the time series for France and UK due to methodological changes.

5. Greenhouse gas emissions

Overall accuracy is reported as being high, since all MS should be adhering to IPCC Guidelines and good practice guidance. Comparability across Annex I countries is also high for the same reason. The same methodologies are used for the base year and all subsequent years, and any methodological changes are applied to all years to maintain temporal consistency. Even though Eurostat report the accuracy of this indicator to be high, there is actually a large degree of uncertainty associated with estimations of N2O emissions in particular (see section 2.1). For the agriculture and LULUCF sectors, the data availability is high, but the accuracy less so.

[143] European Commission. 2007 Measuring progress towards a more sustainable Europe - 2007 monitoring report of the EU sustainable development strategy.

[144] European Commission. 2009 Sustainable development in the European Union - 2009 monitoring report on the EU sustainable development strategy.

6. Common bird index

Overall accuracy of this indicator is high. There is a long history in Europe of ornithologists conducting population estimates of birds for scientific purposes, which are often coordinated by national and regional bodies. The Europe-wide coordination of data collation and computation of indices through the Pan-European Common Bird Monitoring Scheme helps maintain consistency and high accuracy through quality control. In population surveys missing data is common, but gaps are filled using Poisson regression that takes into account over-dispersion and serial correlation. Standard errors are calculated for each species at national, regional and EU level.

Comparability across countries is restricted since survey methods vary, however it is believed that results are sufficiently comparable to produce a reliable indicator at EU level. The list of indicator species has undergone several modifications as new countries have been added and methodologies for species choice have changed. Any changes to the species list will require recalculation of the entire time-series.

7. Sufficiency of sites designated under the EU Habitats Directive

Overall accuracy is considered high, since this indicator is based on data provided by MS under the Habitats Directive using standard data forms. A thorough typology is provided to maximise reporting accuracy. All MS use the same methodology based on their legal framework for protected areas, ensuring high comparability across countries. Comparability over time is also high, however enlargements in the EU in 2004 and 2007 should be considered with respect to the EU-aggregate. At these times, additions were made to species and habitats in the annexes, and additional bio-geographical regions were incorporated. Fluctuations in the indicator may result from such differences.

8. Surface and groundwater abstraction as a share of available resources

Overall accuracy of the data is high. Eurostat validates 90% of submitted data and a data collection guide sets standards for collecting and compiling the relevant data as well as providing a comprehensive methodology and terminology definitions. Comparability across countries is restricted. This is because (as of 2008) relevant data were only available for approximately half of the MS and data collection techniques may vary between MS. In addition, freshwater resources are unevenly distributed throughout Europe, and utilisation varies widely as a function of bio-geographical region, population density and agricultural/ industrial practices. Comparability over time is also restricted due to incomplete time-series for many MS. When complete time-series are available, they are generally comparable over time because of the long period used for the calculation of available resource. Weather conditions may cause short-term fluctuations.

3.9.4 Member States collecting the best data for policy requirements

A report commissioned by Eurostat in 2007[145] carried out a comparative analysis of sustainable development indicators at MS and EU level, with the aim of strengthening the coherence between the indicators used in National Sustainable Development Strategies (NSDS) and the EU-SDIs. With respect to the key themes relevant to agri-environment (sustainable consumption and production; climate change and energy; natural resources), the countries whose NSDS objectives most closely matched those of the EU-SDS were Czech Republic; Denmark; Finland and UK. This should give some indication of the quality of indicator data under these themes; however National Sustainable Development Indicators (NSDIs) are rarely completely identical to those in the EU-SDS. 'Greenhouse gas emissions' is the highest ranked EU-SDI in terms of frequency of appearance in the NSDSs of Member States.

[145] Objectives and Indicators of Sustainable Development in Europe: A Comparative Analysis of European Coherence. 2007. Eurostat.

Referring to the current (2010) availability of indicator data at a MS level as shown in Appendix J, Belgium, Czech Republic, Denmark, Latvia and Slovakia have the most comprehensive coverage in terms of available data for all agri-environment related indicators. This is not, however a reflection of the quality of the submitted data, which is not reviewed at a MS level.

3.9.5 Sustainability of delivery of data

There are many policies and monitoring programmes that provide the data for SDIs. As such, the sustainability of data delivery may vary between indicators. Some SDIs come from policies which must be reported under EU law, and are likely to be the most sustainable (e.g. greenhouse gas emissions data from the UNFCCC policy). Other indicators are derived from data that is submitted voluntarily, or may be poorly regulated, inconsistent or inaccurate. If the data for an SDI is not sustainable, it may be removed from the indicator set, as was the case for the SDI 'area under agri-environmental commitment'.

3.9.6 Alternative sources of information

Much of the data for the SDIs comes from existing EU policies, and as such, more information about an indicator may be obtained from the documentation and reports of the individual policies behind it. There is no known alternative source of information for the whole set of SDIs together.

3.9.7 Developments and progress

The set of SDIs are reviewed by the EC and a working group on SDIs, which consists of experts such as statisticians, scientists and policy representatives at a national and EU level. Following the renewed SDS in 2006, a review of the original 2005 set was required to meet the new mandate, following the objectives below:

- **Policy relevance:** to adapt the SDI set adopted in 2005 to the renewed strategy;
- **Efficient communication**: to streamline the set of indicators in order to improve communication whilst maintaining the maximum stability of the set over time;
- **Statistical quality:** to improve the overall quality of the set, taking into account recent statistical developments.

As more information becomes available, further improvements to the SDI set may be made, with new SDIs added or existing ones streamlined. In some cases, SDIs have also been removed from the set due to a lack of sufficiently accurate data, as is the case with the indicator 'area under agri-environmental commitment', which was removed in the 2009 monitoring report.

Some SDIs are not yet in use, and may be classed as 'currently being developed' if the indicator is expected to be ready for use within two years (i.e. the following monitoring report). SDIs are listed as 'to be developed' when there is not enough information available at that time.

Examples of developments specific to individual SDIs are detailed below:

Final energy consumption

A new regulation on energy statistics was agreed in 2008 and amended in 2010[146], the objective of which is to provide a legal basis for voluntarily produced statistics that are comparable across the EU. This should improve the reliability and timeliness of data for this indicator without any extra burden on respondents.

Common bird index

Work is currently ongoing to develop a similar indicator for European woodland birds. There is also a need to develop monitoring strategies for other animals and plants that would be suitable as indicators of environmental quality. At present, comprehensive Europe-wide population data for other taxa is scarce.

Sufficiency of sites designated under the EU Habitats Directive

Once sufficiency has been achieved, this indicator will no longer be able to monitor progress in halting the loss of biodiversity. Further work on this issue has been carried out and is expected to lead to the development of new indicators.

[146] Regulation (EC) No 1099/2008 of the European Parliament and of the Council on energy statistics, and Commission Regulation (EU) No 844/2010 of 20 September 2010 amending Regulation (EC) No 1099/2008 on energy statistics

3.9.8 Potential synergies of reviewed data with AEIs

AEI indicator	Assessment of requirement/ provision under the EU SDS[147]	Units and resolution
AEI 1 – Agri-environmental commitments	'Area under agri-environmental commitment' is calculated as % of UAA enrolled in AE measures. Excluded from 2009 report due to quality concerns.	*Units:* Ha *Spatial resolution:* National *Temporal resolution:* every 2 years
AEI 4 – Area under organic farming	The SDI 'Area Under Organic Farming' is reported as share of UAA.	*Units:* Ha *Spatial resolution:* National *Temporal resolution:* every 2 years
AEI 8 – Energy use	The SDI 'Final energy consumption, by sector' is reported for the agriculture sector. Not required by farm.	*Units:* Ktoe *Spatial resolution:* National *Temporal resolution:* every 2 years *Subdivision:* energy source
AEI 9 – Land use change	The SDI 'Built-up areas' measures change in land use from natural/ semi-natural to built up land.	*Units:* Ha *Spatial resolution:* National *Temporal resolution:* approx every 6-10 years
AEI 10.2 – Livestock patterns	The SDI 'Livestock density index' is directly relevant to the main AEI.	*Units:* LU/ha UAA *Spatial resolution:* National *Temporal resolution:* every 2 years
AEI 19 – GHG emissions	The SDI 'Greenhouse gas emission by sector' is directly relevant. It uses information on GHG emissions from the agriculture sector.	*Units:* Ktoe *Spatial resolution:* National *Temporal resolution:* every 2 years *Subdivision:* GHG
AEI 20 – Water abstraction	The SDI 'Surface and groundwater abstraction as a share of available resources' is partially relevant. It provides data in terms of the percentage of the available renewable resource under the sub-theme 'Freshwater resources', but does not specify end use.	*Units:* % *Spatial resolution:* National *Temporal resolution:* every 2 years *Subdivision:* groundwater/ surface water
AEI 21 – Soil erosion	The SDI 'Percentage of total land area at risk of soil erosion' is currently under development, but will be directly relevant to this AEI. It is represented under the sub-theme 'Land use'.	*Units:* % *Spatial resolution:* National *Temporal resolution:* every 2 years
AEI 24 – Production of renewable energy	The SDI 'Share of renewables in gross inland energy consumption' is directly relevant to this AEI	*Units:* ratio *Spatial resolution:* National *Temporal resolution:* every 2 years *Subdivision:* renewable energy source (e.g. biomass & waste)
AEI 25 – Population of farmland birds	The SDI 'Common bird index' is an index for common farmland species, which is directly relevant. This is represented under the 'Natural Resources' theme.	*Units:* Index *Spatial resolution:* National *Temporal resolution:* every 2 years
AEI 27.1 – Water quality – nitrate pollution	The SDI 'Biochemical oxygen demand in rivers' is directly related to water quality. Nitrate concentration is a more specific measure of water quality, but will be correlated. This is represented under the sub-theme 'Freshwater resources'.	*Units:* BOD5 or BOD7 *Spatial resolution:* National *Temporal resolution:* every 2 years

[147] Information for this summary was sourced from: *Sustainable development in the European Union – 2009 monitoring report of the EU sustainable development strategy*. Eurostat statistical books.

4 Summary & Conclusions

A summary of the common data requirements for the reviewed policies and the AEIs is provided in Table 21.

A double tick is given when the data requirement under the policy exactly fulfils the parameter requirement of the indicator. A single tick is given when the data provision under the policy contributes some, but not all, of the data for the parameter. Parameters in bold are measurements for the main indicator, and others are for supporting indicators. The level of detail required by the policy is outlined in the footnotes.

Table 21: Common data requirements for AEI indicators and the nine reviewed policies

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
1	**Agri-Environmental commitments**	**Share of area under AE commitments / total UAA**	×	×	✓✓[148]	×	×	×	×	×	✓✓[149]
		Area under AE commitments (per category)	×	×	✓✓[148]	×	✓[150]	×	×	×	×
		Area under AE commitments within Natura 2000 sites	×	×	✓[151]	×	×	×	×	×	×
		Share of agricultural holdings with agri-environmental commitments/ total number of agricultural holdings	×	×	✓[152]	×	×	×	×	×	×
		Share of total expenditure for AE payments/ total rural development expenditure	×	×	✓✓[153]	×	×	×	×	×	×
		AE payments/ UAA	×	×	✓✓[153]	×	×	×	×	×	×

[148] RDP - Physical area under AE commitment required at MS level by measure. Total UAA required at MS level as a baseline indicator.

[149] SDI – Area under agri-environmental commitment is calculated as % of UAA enrolled in AE measures. Excluded from 2009 report due to quality concerns.

[150] ND - Area under NVZ mandatory action programme commitments required at MS level.

[151] RDP – Supported agricultural land under N2K (Measure 213) and supported forest land in N2K (Measure 224) required at MS level where applicable.

[152] RDP – Number of holdings under AE commitment required at MS level by measure. No information on total number of holdings required.

[153] RDP – Total expenditure for AE schemes required at MS level, as is total RDP expenditure and total UAA.

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
2	**Agricultural areas under Natura 2000**	**Share of UAA under N2K/ total UAA**	×	×	✓✓[154]	×	×	×	×	✓[155]	×
		Area of habitat types dependent on extensive agriculture under N2K	×	×	×	×	×	×	×	✓[156]	×
		Share of N2K payments/ rural development expenditure	×	×	✓ [157]	×	×	×	×	×	×
3	**Farmers' training levels and use of environmental farm advisory services**	**Number (share) of farmers having made use of environmental farm advisory services per year**	×	×	✓✓ **158**	×	×	×	×	×	×
		Share (number) of farmers having practical experience, basic training, and full agricultural training	×	×	✓✓**159**	×	×	×	×	×	×
		Share of UAA (ha) managed by farmers having practical experience, basic training, and full agricultural training	×	×	×	×	×	×	×	×	×
4	**Area under organic farming**	**Share of areas under organic farming/total UAA**	×	×	✓✓[160]	×	×	×	×	×	✓✓[161]
		Area under organic farming	×	×	✓✓[160]	×	×	×	×	×	✓✓[161]

[154] RDP - % UAA/ forest under N2K required as a baseline indicator at MS level.

[155] BHD – Area (ha) of Natura 2000 sites are required at the MS level. No information on UAA required.

[156] BHD – Area covered by each priority habitat and the main pressures impacting it are required at biogeographic region and MS level. An optional N2K assessment can be made, but the mandatory requirements are across the whole territory. This may provide relevant information for habitats impacted by agricultural pressures.

[157] RDP - Linked to RDP Measure 213, but does not require financial output data for the indicator. Measure 213 not implemented in all MS.

[158] RDP - The number of farmers using environmental farm advisory services is an output indicator of Measure 114.

[159] RDP – The share of farmers having practical experience, basic training and full agricultural training is a baseline indicator for Axis 1.

[160] RDP - where there is a measure of support under RDP funding, data on area under organic farming is required at MS level.

[161] SDI - 'Area Under Organic Farming' as share of UAA required at MS level.

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
5	**Mineral fertiliser consumption**	**Application rate of N**	×	×	×	×	✓✓[162]	✓✓[166]	×	×	×
		Application rate of P	×	×	×	×	✓[163]	×	×	×	×
		Absolute volumes of N	✓✓[164]	×	×	×	✓✓[165]	✓✓[166]	×	×	×
		Absolute volumes of P	×	×	×	×	✓[163]	×	×	×	×
		Application rate (organic fertilisers) of N	×	×	×	×	✓✓[167]	✓✓[166]	×	×	×
		Application rate (organic fertilisers) of P	×	×	×	×	✓[163]	×	×	×	×
6	**Consumption of pesticides**	**Application rates of different pesticide categories**	×	×	×	×	×	×	✓✓[168]	×	×
		Used/sold quantities of different pesticide categories	×	×	×	×	×	×	✓✓[169]	×	×

[162] ND – Annual contribution of mineral and organic forms of N (Kg/ Ha) required as part of MS action programmes.

[163] ND - Some MS have submitted this data. Not a specific requirement but may be necessary to understanding the impact of action programme measures.

[164] UNFCCC – Total use of synthetic fertiliser (kg/N/yr) required for Tier 1. For Tier 2, applications may be broken down by climate zone/ soil type.

[165] ND – Annual use of mineral and organic forms of N (kT) required as part of MS action programmes.

[166] NECD – Annual consumption of N by major N-fertiliser type, including organic N, and by land-use (arable or grassland) required.

[167] ND – For each farm, the amount of livestock manure applied to land each year including by animals themselves, should not exceed 170kg N per ha.

[168] FDSUP – Key data to be collected are the quantity (Kg) of each substance used on each crop and the area (Ha) treated with each substance.

[169] FDSUP – Sales data that will be required are the annual weight (Kg) of all active substances defined in the Regulation. Usage data as above.

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
7	Irrigation	**Share of irrigable areas / total UAA**	×	×	✓✓[172]	×	×	×	×	×	×
		Irrigable areas	×	×	×	✓[170]	×	×	×	×	×
		Irrigated areas	✓[171]	×	×	✓[170]	×	×	×	×	×
		Irrigated crop areas	✓[171]	×	×	×	×	×	×	×	×
		Irrigated area/ total UAA	×	×	✓✓[172]	×	×	×	×	×	×
		Irrigated crop area/ cropped area	✓[171]	×	×	×	×	×	×	×	×
		Share of holdings using one or more of the 3 irrigation systems surveyed in FSS	×	×	×	×	×	×	×	×	×
8	Energy use	**Total energy use at farm level in GJ per ha per year**	×	×	×	×	×	×	×	×	✓[173]
		Annual use of energy at farm level by fuel type (GJ/ha)	×	×	×	×	×	×	×	×	✓[173]
9	Land use change	**Percentage of the total agricultural area that has changed to artificial surfaces compared to a reference period**	×	✓✓[174]	×	×	×	×	×	×	✓[175]
		Land use change from agricultural land to artificial surfaces (ha)	×	✓✓[174]	×	×	×	×	×	×	✓[175]

[170] WFD – Locations of abstraction points and rates of abstraction required for pressures & impacts assessment, for which knowledge of irrigable/ irrigated areas is needed.

[171] UNFCCC – Area irrigated is required for rice crops only.

[172] RDP - Water use is required as a baseline indicator, defined as % irrigated UAA.

[173] SDI - 'Final energy consumption by sector' for agriculture sector, required by energy source in Ktoe, not in GJ/ha. Not required by farm.

[174] LULUCF – area of cropland converted to settlements is one of the reporting categories.

[175] SDI - 'Built-up areas' measured by the change in land cover over time from natural/ semi-natural to artificial surface.

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
10.1	Cropping patterns	**Share of agricultural land types/ total UAA**	✓[176]	✓✓[177]	✓[178]	×	✓✓[179]	✓✓[180]	✓✓[181]	×	×
		Area occupied by the major agricultural land types (e.g. arable crops, permanent grassland and permanent crops)	✓[176]	✓✓[177]	✓[178]	×	✓✓[179]	✓✓[180]	✓✓[181]	×	×
10.2	Livestock patterns	**Livestock density (LU/UAA)**	×	×	×	×	×	×	×	×	✓✓[182]
		Number of major livestock types (e.g. cattle, sheep, pigs, and poultry)	✓✓[183]	×	×	×	✓[184]	✓✓[185]	×	×	×
		Share of major livestock types	✓✓[183]	×	×	×	✓[184]	✓✓[185]	×	×	×
		Grazing stocking rate (grazing LU/grasslands and forage crops)	×	×	×	×	×	×	×	×	×
11.1	Soil cover	**Share of the year when the arable area is covered by plants or plant residues**	×	×	✓[186]	×	✓[187]	×	✓[188]	×	×

[176] UNFCCC – Calculation of emissions from soils, crop residue burning and rice cultivation require activity data on cropping patterns, particularly for Tier 2.

[177] LULUCF - Areas of broad land use categories in each MS are required. These include cropland and grassland.

[178] RDP – The % UAA used for extensive arable crops and grazing is required as a baseline indicator.

[179] ND – Area of permanent pasture and permanent crops, plus total agricultural land, required as part of action programmes at MS level.

[180] NECD – Calculation of emissions from soils and field burning of stubble require activity data on area of arable land and grassland, specifically including legumes, unfertilized grazed grassland, and other crop types.

[181] FDSUP – To calculate pesticide usage statistics, data on area of each crop type (incl. grassland) to which pesticides applied will be required.

[182] SDI – 'Livestock density index' calculated as number of LU per hectare of UAA.

[183] UNFCCC - Tier 1 categories are dairy cattle; non-dairy cattle; buffalo; sheep; goats; camels; horses; mules & asses; swine poultry. Tier 2 categories provide further level of detail for cattle, buffalo and swine: e.g. mature, immature, females, males

[184] ND – MS are not required explicitly to collect data on livestock numbers, but they are necessary for calculation of manure applications to land.

[185] NECD – animal numbers, by category, collected and applied to varying level of detail across the Member States

[186] RDP - The forested and wooded land area managed primarily for soil and water protection is a baseline indicator.

[187] ND – Soil crop cover in winter is not a specific data requirement, but MS are encouraged to collect these data.

[188] FDSUP – Calculations of pesticides applications to particular crops will require temporal information on crop growth.

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
11.2	Tillage practices	**Share of arable areas under conservation or zero tillage/ total arable area**	×	×	×	×	×	×	×	×	×
		Arable areas under conservation tillage and zero tillage	×	×	×	×	×	×	×	×	×
11.3	Manure storage	**Share of manure stored in different manure storage systems**	✓✓ [189]	×	×	×	✓✓[190]	✓✓[191]	×	×	×
		Share of manure applied with different application techniques and incorporation time	×	×	×	×	✓[192]	×	×	×	×
		Share of animals in different housing systems	×	×	×	×	×	×	×	×	×
12	Intensification/ extensification	**Share of low, medium, high-input farms (based on average input expenditure/UAA)**	×	×	✓[193]	×	×	×	×	×	×
		Average expenditure per ha	×	×	×	×	×	×	×	×	×
13	Specialisation	Share of the agricultural area (ha) managed by specialised farm types	×	×	×	×	×	×	×	×	×
14	Risk of farmland abandonment	Farms with farmer aged 55 years	×	×	✓✓ [194]	×	×	×	×	×	×
		FNVA/AWU per farm	×	×	✓ [195]	×	×	×	×	×	×

[189] UNFCCC - default manure management systems are anaerobic lagoon; liquid system; daily spread; solid storage and drylot; pasture range and paddock; used fuel; other system. Livestock populations must be disaggregated by climate (warm, temperate, cool).

[190] ND – The type of storage used for FYM and slurry are data required as part of action programmes.

[191] NECD – Calculation of emissions from manure management require activity data on the frequency distribution of the respective manure management systems.

[192] ND – Information regarding manure application techniques may be provided by some MS as part of action programmes.

[193] RDP – areas of extensive agriculture (as % of UAA) are required as a baseline indicator.

[194] RDP – required for baseline indicator 'age structure'

[195] RDP - necessary for impact indicator on economic growth

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
15	Gross nitrogen balance	**Potential surplus of nitrogen on agricultural land (kg N/ha/year)**	×	×	✓✓[196]	✓✓[197]	✓✓[198]	×	×	×	×
16	Risk of pollution by phosphorus	**Potential surplus of phosphorus on agricultural land (kg P/ha/year)**	×	×	✓✓[196]	✓✓[197]	✓[199]	×	×	×	×
		Vulnerability to phosphorus leaching/run-off	×	×	×	×	×	×	×	×	×
17	Pesticide risk	**Index of risk of damage from pesticide toxicity and exposure**	×	×	×	×	×	×	✓✓[200]	×	×
18	Ammonia emissions	**Ammonia emissions from agriculture (ktonnes/yr)**	×	×	×	×	×	✓✓[201]	×	×	×
		Share of agriculture in total ammonia emissions	×	×	×	×	×	✓✓[202]	×	×	×
19	GHG emissions	**Greenhouse gas emissions from agriculture: (ktonnes CO_2 equivalents/yr)**	✓✓[203]	✓✓[204]	✓✓ [205]	×	×	×	×	×	✓✓[206]

[196] RDP – required for baseline indicator 'Water quality – gross nutrient balances'

[197] WFD - The N/P balance surplus is a commonly used indicator for identifying areas vulnerable to nutrient pollution in the pressures and impact analysis.

[198] ND – the action programmes should contain rules relating to the limitation of the land application of fertilizers based on a balance between the foreseeable nitrogen requirements of the crops, and the nitrogen supply to the crops from the soil and from fertilization. This should therefore be calculated at farm level.

[199] ND – Some MS report data on total phosphorous and orthophosphate as eutrophication parameters.

[200] FDSUP – requires that MS adopt harmonised risk indicators for pesticides, although these still under development.

[201] NECD – estimation of emissions of ammonia from the agriculture sector are made each year by MS.

[202] NECD – estimation of emissions of ammonia from all relevant source sectors are made, and the share of each sector calculated.

[203] UNFCCC – GHG emissions are reported by each Annex I Party for agricultural sources annually.

[204] LULUCF – Emissions of CO_2 from agricultural land are recorded in the cropland category. Emissions from other land-uses are also calculated.

[205] RDP – reported as the baseline indicator 'Climate change: GHG emissions from agriculture'.

[206] SDI - 'Greenhouse gas emission by sector' (including sinks)

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
		Share of agriculture in GHG emissions	✓✓[207]	✓✓[204]	×	×	×	×	×	×	✓✓[206]
20	**Water abstraction**	**Share of agriculture in water use**	×	×	×	✓✓[208]	×	×	×	×	✓[209]
		Water use for irrigation (m3/year)	×	×	×	✓✓[208]	×	×	×	×	×
21	**Soil erosion**	**Areas with a certain level of erosion risk**	×	×	✓✓ [210]	×	×	×	×	×	✓✓[211]
		Estimated soil loss by water erosion (T/ha/year)	×	×	×	×	×	×	×	×	×
		Estimated soil loss by wind erosion (T/ha/year)	×	×	×	×	×	×	×	×	×
22	**Genetic diversity**	Number and range of crop varieties and livestock breeds	×	×	✓[212]	×	×	×	×	×	×
		Share in production of main crop varieties registered and certified for marketing	×	×	×	×	×	×	×	×	×
		Number of breeds per total livestock population for different types of livestock	×	×	✓[213]	×	×	×	×	×	×
		Distribution of risk status of national livestock breeds in agriculture	×	×	×	×	×	×	×	×	×

[207] UNFCCC – GHG emissions are reported for all relevant source sectors, and the

[208] WFD – Significant water abstractions from each surface water and groundwater body by type are required to be identified. For each sub-unit or RBD, the volumes extracted per year or in different seasons by category of abstraction are required to be reported.

[209] SDI - 'Surface and groundwater abstraction as a share of available resources'

[210] RDP – data required for baseline indicator 'Areas at risk of soil erosion'

[211] SDI - 'Percentage of total land area at risk of soil erosion' ***Currently under development***

[212] RDP - Partially reported as output indicator of Measure 214 – 'Number of actions related to genetic resources'.

[213] RDP – partially reported under an output indicator of Measure 214, which requires information on the number of LU for commitments relating to the conservation of local breeds in danger of being lost to farming.

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
23	**High nature value farmland**	**Share of estimated area HNFV/total UAA**	×	×	✓✓[214]	×	×	×	×	×	×
		Estimated area HNFV	×	×	✓✓[214]	×	×	×	×	✓ [215]	×
24	**Production of renewable energy**	**Share of primary energy from crops and by-products as of total energy production**	×	×	×	×	×	×	×	×	✓✓[216]
		Production of primary energy from crops and by-products (Ktoe)	×	×	✓✓[217]	×	×	×	×	×	×
		Area of energy crops (biodiesel crops, ethanol crops and short rotation forestry)	×	×	✓✓[218]	×	×	×	×	×	×
		Renewable energy production from agriculture	×	×	✓✓[217]	×	×	×	×	×	×
		Renewable energy production from forestry	×	×	✓✓[217]	×	×	×	×	×	×
25	**Population of farmland birds**	**Farmland bird population index**	×	×	✓✓[219]	×	×	×	×	✓[220]	✓✓[221]

[214] RDP – should be reported under baseline indicator 'Biodiversity: High Nature Value Farmland areas' and impact indicator 'Maintenance of high nature value farming and forestry areas', although these indicators are not yet well developed.

[215] BHD Natura 2000 sites could make up part of the HNVF definition

[216] SDI - 'Share of renewables in gross inland energy consumption' using the subcategory biomass & waste.

[217] RDP – reported under baseline indicator 'Climate change: production of renewable energy from agriculture and forestry' and impact indicator 'Contribution to combating climate change'.

[218] RDP – reported for baseline indicator 'Climate change: UAA devoted to renewable energy' & impact indicator 'Contribution to combating climate change'.

[219] RDP – reported for baseline indicator 'Biodiversity: population of farmland birds'.

[220] BHD – the Birds Directive requires data on bird species listed in the annexes to the Directive present in the MS territory, although this is not consistently gathered/ reported across MS.

[221] SDI - 'Common bird index'

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
26	Soil quality	**Agri-environmental soil quality index**	×	×	×	×	×	×	×	×	×
		Productivity: capacity of soil to agricultural biomass production	×	×	×	×	✓[222]	×	×	×	×
		Fertilizer response rate: input-need to attain optimal productivity (input change / yield increase ratio)	×	×	×	×	✓[222]	×	×	×	×
		Soil environmental quality: Carbon storage; filtering; buffering (Environmental)	×	×	×	×	✓[222]	×	×	×	×
		Production stability: the soil response to climatic variability also in relation to the organic matter stock of agricultural soils	×	×	×	×	✓[222]	×	×	×	×
27.1	Water quality-Nitrate pollution	**Annual trends in the concentrations of nitrate or total oxidised nitrogen (expressed in mg/l NO3) in ground and surface water bodies**	×	×	✓✓[223]	✓✓[224]	✓✓[225]	×	×	×	×
		Share of agriculture in total nitrate pollution	×	×	×	✓✓[226]	×	×	×	×	×
		Nitrate concentration in water bodies	×	×	×	✓✓[224]	✓✓[225]	×	×	×	✓[227]
27.2	Water quality-Pesticide pollution	**Annual trend in the concentrations (µg/L) of selected pesticides compounds in ground and surface waters**	×	×	✓✓[223]	✓✓[228]	×	×	×	×	×

[222] ND – soil characteristics are reported under the ND for some MS, and may provide similar information to these parameters.

[223] RDP – reported under the baseline indicator 'Water quality: Pollution by nitrates and pesticides', for which annual trends in concentrations are required.

[224] WFD – the measured concentrations of nitrate in ground and surface water bodies are to be reported for each monitoring programme/ category on a regular basis.

[225] ND – concentrations of nitrate in ground and surface water monitoring sites are reported under the ND requirements. The monitoring programmes must be carried out at least every 4 years.

[226] WFD – pressures and impacts analysis will identify the most significant sources of pollution in each RBD, including agricultural sources.

[227] SDI - 'Biochemical oxygen demand in rivers' is directly related to water quality, and will be correlated with nitrate concentration.

[228] WFD – measured concentrations of priority and other substances in surface and groundwater bodies are to be reported for each monitoring programme/ category on a regular basis.

INDICATOR		PARAMETERS	Policy requirements (× = none; ✓ = partial; ✓✓ = total)								
			UNFCCC	LULUCF	RDP	WFD	ND	NECD	FDSUP	BHD	SDI
28	Landscape - State and diversity	Degree of naturalness	×	×	✓[229]	×	×	×	×	×	×
		Rural-agrarian landscape structure	×	×	✓[229]	×	×	×	×	×	×
		Societal appreciation of the rural-agrarian landscape	×	×	✓ [230]	×	×	×	×	×	×

[229] RDP – Linked to Axis 2 payments

[230] RDP - Linked to Axis 3 payments

From Table 21, it can be ascertained that the majority of parameters required for calculation of AEIs are also required for or provided by reviewed environmental policy, at least in part. The exceptions are;

3. Farmers' training levels and use of environmental farm advisory services – Share of UAA managed by farmers having practical experience, basic training and full agricultural training
7. Irrigation – Share of holdings using one or more of the 3 irrigation systems surveyed in FSS
10.2 Livestock Patters – Grazing stocking rate
11.2 Tillage practices*
11.3 Manure storage – Share of animals in different housing systems
12. Intensification/ extensification* – Average expenditure per ha
13. Specialisation*
16. Risk of pollution by phosphorous – Vulnerability to phosphorous leaching/ run-off
21. Soil erosion – Estimated soil loss by water/ wind erosion
22. Genetic diversity* - Share in production of main crop varieties registered and certified for marketing; Distribution of risk status of national livestock breeds in agriculture
26. Soil quality* – Agri-environmental soil quality index

Other parameters are not fully compatible with data requirements for policy. These are;

1. Agri-environmental commitments – Area under AE commitments within N2K sites; Share of agricultural holdings with agri-environmental commitments
2. Agricultural areas under Natura 2000 – Area of habitat types dependent on extensive agriculture under N2K; Share of N2K payments/ rural development expenditure
5. Mineral fertiliser consumption – application rate of P; absolute volumes of P; application rate (organic fertilisers) of P
7. Irrigation – Irrigable areas; irrigated areas; irrigated crop areas; irrigated crop area/ cropped area
8. Energy use* - Total energy use at farm level; annual energy use at farm level by fuel type
11.1 Soil cover*
11.3 Manure storage – Share of manure applied with different application techniques and incorporation time
12. Intensification/ extensification* – Share of low, medium, high-input farms
14. Risk of farmland abandonment – FNVA/AWU per farm
22. Genetic diversity* - Number and range of crop varieties and livestock breeds; number of breeds per total livestock population for different types of livestock
26. oil quality* - Productivity; Fertilizer response rate; Soil environmental quality; Production stability
28. Landscape – State and diversity*

*do not have any parameters that are fully aligned with policy requirements

The AEIs for which data requirements have the most in common with policy data requirements and that have parameters represented across at least three policies include the following;

5. Mineral fertiliser consumption

10.1 Cropping patterns

10.2. Livestock patterns

11.3. Manure storage

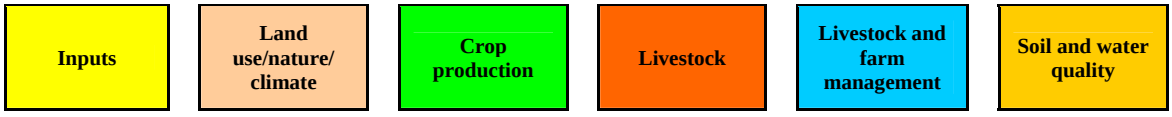
15. Gross nitrogen balance

16. Risk of pollution by phosphorous

19. GHG emissions

27.1. Water quality – Nitrate pollution

The evaluation of common data needs between AEIs and policies can also be presented using the 'building block' principle (Figure 2), which is explained in Tasks 4 & 5. This figure stacks each building block required for calculation of AEIs against each policy for which it is also required. Building blocks are grouped and coloured by category, making it easier to ascertain where the majority of the building blocks within each category are also collected under a policy. The choice of building block parameters and categories is an ongoing process, and is subject to change following further review. The aim is to represent the priority data needs for AEIs. The current categories are shown below:



The 'building block' approach also makes it apparent which policies have most data requirements in common with the AEIs. In many cases, the parameter (as required by the AEI) is only partially fulfilled by the policy requirement (e.g. crop area data may only be required for a subset of crops). In these cases, the block is intersected in the figure to indicate this. Similarly, in some cases not all MS collect data for the parameter in question under the policy, in which case the block is intersected in the opposite direction. If both of these limitations occur, the block is intersected in both directions. This is clarified below;

From inspection of Figure 2, the coverage of AEI parameters within each category across policies can be summarised:

Inputs

The inputs category includes pollution from fertilisers and pesticides; water abstraction; and energy use. Most of the input parameters that are also needed for policy are represented under the policies that require the calculation of pollution levels from agriculture – namely UNFCCC; WFD; Nitrates Directive; National Emissions Ceiling Directive; and Framework Directive on the Sustainable Use of Pesticides. This group of parameters is also represented under RDP and EU-SDS, however these data are usually collected from other existing sources.

Land use/ Nature/ Climate

Parameters on land use, nature and climate are well represented under RDP; LULUCF; Birds & Habitat Directives; and EU-SDS. Crop area by crop type and climate feature across a number of policies.

Crop production

The crop production parameters that are needed for policy are represented under the policies that require calculation of pollution or emissions from crop production: UNFCCC and National Emissions Ceiling Directive. The renewable energy production parameter also features under RDP and EU-SDS.

Livestock

Similarly, livestock parameters are required under policies that calculate pollutants from livestock: UNFCCC; Nitrates Directive and NECD.

Livestock and farm management

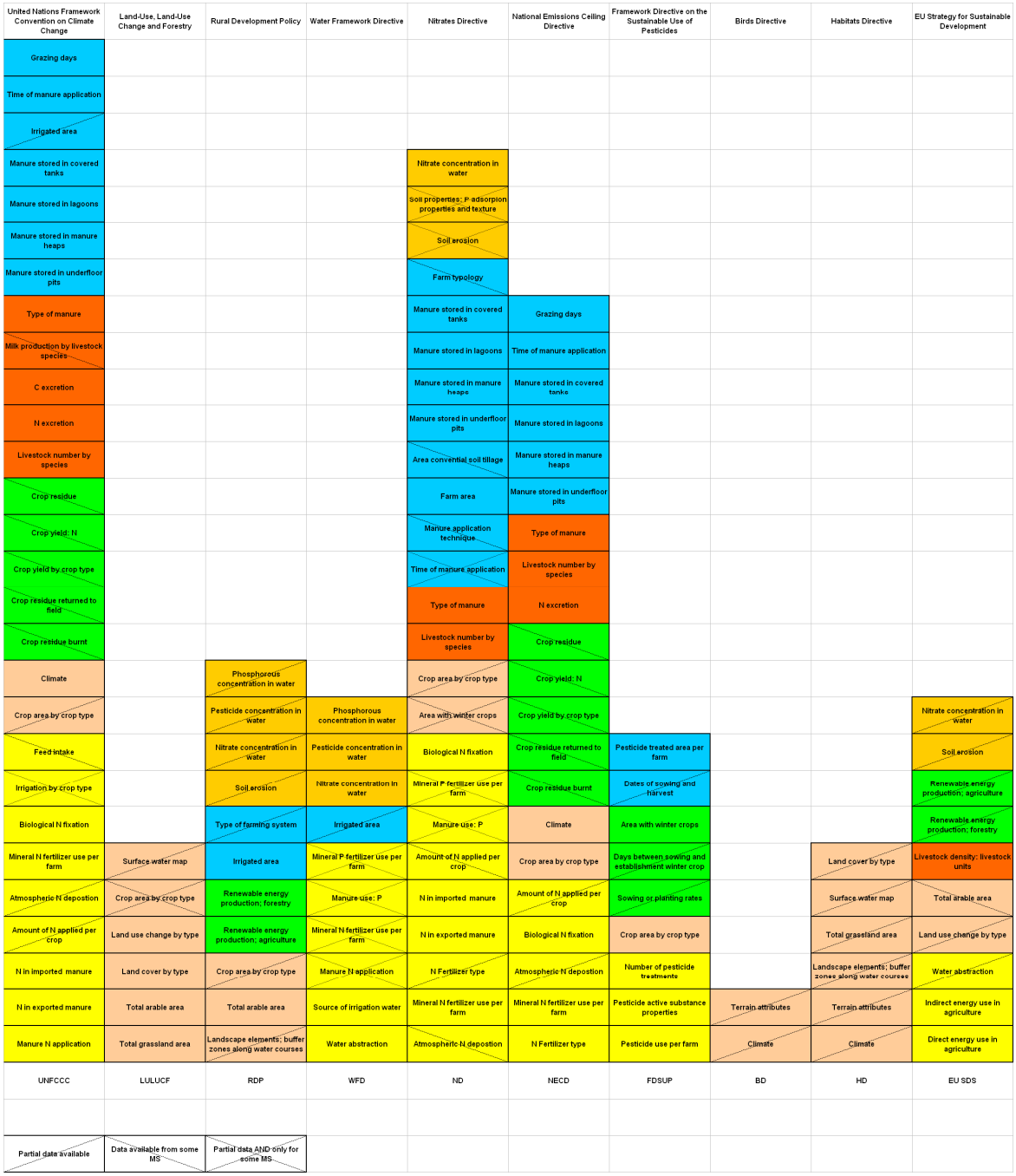
The type of manure storage is data commonly collected for policy purposes, specifically UNFCCC; Nitrates Directive and NECD. A soil tillage parameter is also required for the latter two.

Soil and water quality

Soil data is fairly sparsely collected for policy, the most significant being under the Nitrates Directive. Soil parameters are well represented under EU-SDS, but do not necessarily exactly match the AEI parameters. Water quality is the ultimate reporting requirement of WFD and Nitrates Directive. These data are collected from other sources for RDP and SDI as indicators.

Figure 2 provides a consolidated summary of the data requirements of AEIs and policy relating to agriculture and the environment. The policies collecting data applicable to SDIs are stacked above the parameter, and ranked in order of the coverage available. From Figures 2 and 3, it is clear to see that there are a large number of parameters that are required by more than one policy, outweighing those that are required by one policy only or not at all. This balance encouragingly points towards an opportunity to harmonise data collection and the identification of synergies between policies across the EU.

Figure 2: Building block diagram showing the AEI parameters that are also required for each of the reviewed policies, coloured by the category of the parameter



The block is intersected if the data requirement for the AEI is not fully met by data collected for the policy.

Figure 3: A building block diagram showing the policies that require data applicable to each of the AEIs.

The block is intersected if the data requirement for the AEI is not fully met by data collected for the policy.

European Commission

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