EUROPEAN COMMISSION
EUROSTAT

Directorate E: Sectoral and regional statistics
Unit E-1: Farms, agro-environment and rural development

"Identifying the core data needed for agri-environmental statistics: Eurostat "DireDate project"

Author: Johan Selenius
Team leader for Agri-environmental statistics
Tel. (+352)4301-37322
Fax. (+352)4301-37317
E-mail: johan.selenius@ec.europa.eu

1- General context

The contents of this paper describes a potential solution for agricultural statistics vis-à-vis the rather complex European situation concerning agri-environmental statistics and the related agri-environmental indicators. The author believes that the complexity is not restricted to the European situation, but that similar problems exist everywhere, i.e. the fact that parallel and overlapping reporting requirements demanding statistics are brought constantly forward. The statisticians must try to navigate between these demands, somehow identifying the ones which are of higher priority and how to satisfy the underlying data needs without excessively increasing the burden on neither respondents, nor the own institution.

The paper brings forward the background of a running project on "Direct and indirect data needs linked to the farms for agri-environmental indicators", shortened to "DireDate". It also describes some of the first results (August 2010). Similar exercises can be undertook at a smaller scale, giving guidance to identifying for a country or a region which are the basic building blocks needed to be collected that will give a maximum added value to the agri-environmental analyses for the minimum overall costs. The approach can of course be applied to any kind of indicator, like the ones listed in Annex A "Menu of Indicators for Agricultural Statistics" of the Global Strategy to Improve Agricultural and Rural Statistics, or to provide justifications for the core items and associated data as described on page 30 of the same document.

The final results of the project will be made available on Eurostat's Circa website in the public domain AEI Circa, but the progress reports are so far in the restricted section of this website. Interested parties can apply for membership from the author as well as for announcing interest in participating in the final workshop end of March 2011, or for receiving a copy of the final report.

2- Background

The principle that the environmental dimension should be integrated in all European Union policies was introduced in 1998 and a decision was subsequently taken to establish strategies for environmental integration and sustainable development within all policy areas and to monitor progress by identifying indicators.

The integration of environmental concerns into the European Common Agricultural Policy (CAP) is a dynamic process that requires regular monitoring. Agri-environmental indicators (AEI) are key tools in this monitoring exercise. They can serve a variety of policy purposes:

- to provide information on the current state and ongoing changes in the condition of the farmed environment;
- to track the impact of agriculture on the environment;
- to assess the impact of agricultural and environmental policies on the environmental management of farms;
- to inform agricultural and environmental policy decisions;
- to illustrate agri-environmental relationships to the broader public.

A coherent system of agri-environmental indicators must be able to capture the main positive and negative effects of agriculture on the environment and to reflect regional differences in economic structures and natural conditions. In this way it will provide valuable information

for assessing agriculture policy in terms of its contribution to the preservation of environmental resources on which the future of agriculture and society at large depend.

Based on a lengthy discussion between Commission services and the IRENA operation (Indicator Reporting on the Integration of Environmental Concerns into Agriculture Policy) the Commission has subsequently identified a set of 28 agri-environmental indicators to be maintained and further developed (see Annex 1). In this document this set of indicators are referred to as "AEI". Please note that there are many other international sets of agri-environmental indicators, most notably the ones of the OECD, with which Eurostat carries out a close cooperation, as many of the indicators are the same.

2.1 The indicator work

These EU indicators can be grouped into three main categories, based on their level of development:

- operational indicators;
- indicators that are well-defined but have not reached their full information potential because of a lack of regional or harmonised data, or owing to weaknesses in the modelling approaches on which they are based; and
- indicators that still need substantial improvements in order to become fully operational.

The Communication also identified the main challenges ahead:

- consolidating the selected indicators,
- extending the coverage to all Member States and correcting existing weaknesses,
- setting up a permanent and stable arrangement needed for the long-term functioning of the indicator system.

Much emphasis has been put on the cost and resource implications for setting up the indicator system, stressing that existing data sources and data collection structures should be used whenever possible. To ensure a good collaboration between the involved institutions in the countries and to ensure that the underlying data would be collected in a structure manner, the Standing Committee on Agricultural Statistics (SCAS), chaired by Eurostat, was chosen to be the key committee to discuss the overall system.

A close cooperation is running between Eurostat and the other European Commission services responsible for agricultural and environmental policies, the Joint Research Centre and the European Environment Agency, with the aim of developing and maintaining a system of agri-environmental indicators, using as efficiently as possible the existing data collection systems already in place, to ensure a maximum collaboration between the partners, to avoid overlapping work and to ensure that the information flows freely between the partners. For each indicator it is agreed who takes a lead role, making use of their normal working groups and networks most relevant to the work to be carried out.

Eurostat coordinates all other activities (e.g. dissemination of data and built-up indicators), and especially the establishment of a stable arrangement, in cooperation with the Member States through the SCAS. The aim of this work is to set up a system where all the indicators are well defined, the data needs are analysed, the data collection is organised and set up in a sustainable manner, the data flows are in place and automated where possible.

Once the permanent and stable arrangement has been well established for an indicator, including its fact sheet and the data collection systems, Eurostat will, with the support of the other partners, take over the responsibility for the long-term functioning and updating of the indicators, if there are no other agreements indicating different procedures.

When the decision to accept the list of AEI was taken, it was insisted that the work must be carried out in close cooperation with the Member States and that "*The Eurostat's Standing Committee for Agricultural Statistics shall be actively involved in this process, particularly in relation to the identification and allocation of responsibilities among the partner institutions, including the systematic collection and delivery of the data necessary for the compilation, maintenance and updating of the indicators*".

This means that the SCAS is not only responsible for ensuring that the data relating to agricultural statistics are collected, but also for ensuring that a stable system is put in place for providing the information needed for all the indicator work, obviously in close cooperation with the responsible national institutions.

With the 28 indicators identified, there is a need to address the above-mentioned challenges linked to these indicators, as the starting point for the discussion. However, as indicated below, the indicators are partly intertwined, not only in the way that they feed each other, or try to give a picture of the same problem from different angles, but also concerning data needs in terms of statistics, technical coefficients and modelling.

For more information, please see our Circa interest page: AEI Circa. Membership will be granted upon request. We have also some data already on line at: Eurostat AEI webpage, from where there is a link to our dissemination database.

2.2 Data needs and availability

We can identify several levels of needs for statistics/indicators on the relation between agriculture and environment. Some of the needs cut through the different layers, but some are valid only on specific levels.

In the **EU institutions**, data are often analysed, and are therefore be collected, on different regional and policy levels (administrative records, rural development and other similar programmes, Nitrogen Vulnerable Zones (NVZ), river catchments, Water Framework Directive (WFD) reporting, etc). Subsequently, it is often difficult to combine such data or to compare them in the perspective of AEI consolidation, depending on the regional level. There is also a risk for overlapping data collection exercises.

Furthermore, in some areas where certain agri-environmental issues are particularly critical, there is a need for data to be made available at a low level in order to make better analyses on a regional level and allow **national** institutions to better target agricultural, environmental and other policy measures. Therefore, when we go further down, to a **regional or local** level, we will see the need of breaking down indicators on parts of water basins, programme zones, etc. This is also true if we go down to the **farm** level, for example administrative data for control reasons, as well as data for assessing the policy needs and success, identifying the "hot-spots", and similar issues.

In addition, there are several initiatives in progress to ensure that data collection is harmonised so that they can be used more efficiently and linked to the geographical location.

On an **international** level (OECD, FAO) data are only needed at a national or supra-national level. Indeed, it is virtually impossible to analyse detailed indicators globally below national level, even if for example FAO also need regional data for specific support projects. In the European Statistical System (ESS) perspective , the aim should be that the AEI data used by any organisation should be channelled through Eurostat, to avoid double and triple work for the Member States and, where possible, discrepancies between different data sets.

Even if an indicator is aggregated at different territorial levels, various users may need varied details. This depends on whether the indicator will be used for different kinds of policy analyses (ex-ante or ex-post), research purposes, monitoring of programme activities, controls, allocation (of funds, support, fines) or perhaps to identify the "hot spots" where concrete actions are needed.

It is certainly too much asked to foresee building an all-surpassing system for the indicators that would fit all these needs, but efforts should aim at creating a system that meets as many as possible of these and other needs, while ensuring reduced **costs** and **response burden** and the availability of harmonised data. The system to be created should be

a) flexible and modular
b) transparent
c) contain coherent data flows

in order to provide data consistent with Eurostat and Member State dissemination purpose and needs (i.e. down to local level where appropriate) and that at the same time to allow potential users (EU institutions, international organisations, policy makers, researchers, general public) to access the data they need, either centrally through Eurostat (original data and built-up indicators)or decentralised in the countries/regions (original data only).

2.3 Data sources

The indicators can be classified in many different manners. In this document we have chosen to use the source of the data as the basis for our classification: will the data needed for calculating the indicator be collected from the farm, i.e. must it be provided by the farmer, or can it be collected in a different way? If it is collected on farm or even parcel level, an additional question to be asked in this context is whether or not the analyses/indicator calculations using this data would benefit from the possibility of combining, at the same level, the data with other farm or parcel level information?

Statistical institutions are increasingly obliged to use already existing sources for the data, and agri-environmental indicators are not an exception, on the contrary, Eurostat is not allowed to setting up new surveys where other possibilities exist. At the same time, it is important to ensure that existing sources are adapted to new emerging needs, regardless of if they are statistical surveys or administrative registers, or something else.

In Annex 1 a first attempt to analyse the potential data sources for the AEI shows that much of the data needed originate from the farms, many could in fact linked be to the parcel. We can see that already now a multitude of different sources are used, some part of the statistical system, some not. Some of these sources have been chosen out of necessity, as no better source was available, other sources have certain defects that should be improved.

Much of the information can be retrieved from the Farm Structure Surveys (FSS)[1], which is not surprising, considering the sheer amount of data collected in these surveys. However, it is probable that the usefulness of the AEI could be improved if they can be combined (or the underlying information) with other data at the micro-level. This doesn't necessarily mean that there should be one huge FSS, but rather that there is a need to study what data could be linked at the farm level to give the best possible estimates of the indicators, alternatively new surveys might be needed.

In addition, any system that is set up for collecting the AEI data also has to provide statisticians, researchers and policy analysts with other data around these issues (e.g. supporting and transversal data, coefficients for calculations or modelling, background information, etc). More information must be gathered from experts in the domain, both in Member States and Commission services, working on the indicators and coefficients before we can have a proper picture of the data needed to estimate AEI with an acceptable quality.

There have been some attempts to identify the data requirements and inter-linkages of the agri-environmental indicators. One of these attempts was made by the Belgian Centre for Agricultural Economy, later the Institute for Agricultural and Fisheries Research, where it analysed an earlier draft set of indicators, trying to identify all data needed and how to best set up a system for providing them. These Belgian actions stemmed from a double problem setting: first, the rather complex reality that the AEI try to capture and, secondly, the institutional set-up (who does what/ collects what?) in which the knowledge exchanges takes place. The solution tested was to elaborate a modular calculation procedure, in which each indicator was broken down into the smallest (or close to) detail needed, and the best available source was then identified. See Annex 2 for a more detailed overview of one module.

What is quite obvious from the Belgian studies is that the coefficients are as important as the statistical figures on crops and animals for the final estimations of many of the indicators, particularly the greenhouse gas and ammonia emissions and nutrient balances. This means that the more information that is made available for improving the use of these coefficients, either as a basis for the calculation of the coefficients, or providing the material for applying the coefficients correctly, the more precise the estimates will be.

Eurostat is fully aware that there are already a number of internationally approved guidelines on how certain indicators/ data sets should be calculated. This is for example the case for Gross Nutrient Balances where Eurostat and OECD has agreed on a common methodology, but even more for Greenhouse Gas emissions where there are detailed IPCC guidelines. Similar guidelines also exist for ammonia emissions. However, Eurostat considers that these guidelines are perhaps trying to reach too far, and asks whether it is realistic to expect all the expected data to be available in all countries, considering the high costs of setting up even a basic agricultural statistics system allowing to assess the food security situation. If the data that are used in the present emission estimates are very unsecure even in many European countries, would it then not be better to concentrate on ensuring that we have good data for estimating the biggest parts of the emissions? Comparability over time and between countries

[1] Note for the reader: in the EU, every 10 years an agricultural census is carried out, and in between 2 sample surveys with more or less the identical variable lists. The common name for these structure related surveys is the Farm Structure Surveys. The latest legislation can be found at: FSS regulation.

are more important to a statistician than getting the estimates right down to the smallest detail, especially considering the cumulative unreliability due to potential bias in the systems.

A key issue for improving the AEI is therefore to better understand the additional information needs that will bring about not only better estimations as such, but also bring more transparency to the system and allow the users to identify the aspects of the agricultural production cycles that have the biggest positive or negative impact on the environment. Thus they would allow policy decisions to focus, not only on what is conceived as the biggest threat, but on the issues where a decision is likely to have the most positive impact, consequently bringing more efficiency to the policies, and this on the most appropriate level.

To better illustrate the information needs, Eurostat has below tried to identify some of the topics that might have an impact on the use of the nutrient input data, which in its turn impacts a number of other indicators. Much of this example is collected from the Belgian reports mentioned above, but they also reflect the information collected by Eurostat from different experts. It should not be taken as exhaustive, neither as correctly identifying the interrelations between the different inputs and outputs, merely as a rough example. It should neither be understood that all of these data should actually be collected, this is a decision that must be taken at a later stage when the added value of the data is valued against the added costs to collect it.

Table 1. Supporting and explanatory information needed for a maximum use of nutrient inputs data:

a. Crops	i. Cultivated crop, including grass ii. Expected yields, including grass iii. Crop previous year iv. Crop planned for the following year v. N and P contents coefficients vi. Tillage practises vii. Soil cover in the winter viii. Use of residues (straw)
b. Animals	i. Number ii. Age iii. Breed iv. Seasonal changes v. Source (FSS, livestock statistics) vi. Horses and ponies outside agriculture vii. Fur animals viii. Excretion coefficients
c. Feeding system and intensity	
d. Housing system	
e. Manure storage, type and time	
f. Cattle, sheep and goats: grazing:	i. Time ii. Area

g. Use of inorganic fertilisers	i. Time of the year ii. Number of applications iii. Type of fertiliser iv. Spreading equipment and use
h. Manure application:	i. Type of manure ii. Time of the year iii. Time of the day iv. Time of incorporation after the spreading v. Phenological stage of the crop vi. Spreading equipment vii. Manure spread the previous years

This list of issues having an impact on the usefulness of the data can be further extended, but should not be exaggerated. This kind of exercise can be applied to all the AEI, the outcome being less complicated for most of them. However, it is likely that the same data needs will pop up in many of the inter-linked indicators.

Each indicator must be broken down in this way before the content and structure of the indicator system can be properly identified.

2.4 Potential indicator system

The indicator system should ideally allow any user to understand the way it is set up, be flexible enough to meet the changing needs at all levels, and create a flow of coherent and harmonised data to all users. The better harmonised such a system is on the European (and international) level, and the easier it is for the users to access the data, the more added value it brings to all stakeholders.

Eurostat has identified 3 main systems available to collect the data needed for the indicators, but this list is not exhaustive and can be extended:

1. **Aggregated statistics**, with which is meant the system of predefined statistical tables that should regularly created. This system allows free hands on collecting and providing the data, but is also quite inflexible as it is only possible to combine statistical data of the same geographical level, and users are "stuck" with what is predefined. Any additional data requests must be channelled back to the original data source, which in the case of AEI might mean several institutions to be involved.
2. **Farm surveys** with a high sample size, **linked to the FSS** micro-data. In this type of surveys, a limited number of questions would be asked from a high number of farms, allowing reliable statistics to be produced, also at regional level.
   This alternative would enhance the FSS data, allowing users to demand any kind of crossing of structural data with environmental data (within statistical limits), and it would be fully harmonised and coherent.
   The drawback is the high costs of such a system, mainly in response burden, as this system would require a large number of respondents to allow statistically reliable data to be provided. Due to this, it is likely that the number of data that can be collected in such a system is limited, leaving much to be desired by the users.

3. To reduce respondent burden, data could also be collected from a smaller number of respondents, in what could be a **survey on farm practices**, where the micro-data would not necessarily be linked to the FSS. The data would not only be used to produce statistics, but also to calculate coefficients, certain indicators and to serve as an input for the FSS data.
   This kind of tool would be ideal for collecting a large amount of interlinked data on inputs, outputs and farm management issues, together with soil, crop and animal data. The drawback is that such a tool would most likely be resource-consuming, both for the respondent and the collecting institution, meaning that the sample would have to be reduced to save money. This could mean that it could not provide statistically reliable data on all the needed parameters, and probably neither on all required regional levels. However, this is also the case with the present European Farm Accountancy Data Network (FADN), and still it is one of the mostly used tools for a large number of analyses. It could also be foreseen that key questions, for example on feeding systems for the animals, could be added to the future FSS surveys to allow an application of the farm practice survey results on the whole FSS population.

These are obviously only very short and rough explanations around the potential data collection systems, and they should not be taken as final, neither to argue for or against one specific solution, as there are advantages and drawback to all of them. It is also possible that the optimal solution would be a combination of the three, or perhaps a fourth alternative, not discussed here. The potential data collection system must be studied in more detail in close cooperation with the proper institutions and stakeholders

3- Objectives

The objective of this Eurostat study 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 and thus serve policy makers, but as well agricultural and environmental researchers, observers of climate change and other environmental issues linked to agriculture. The different needs for data will be analysed and the best way and the appropriate level for collecting them will be identified. The aim is to have at the end of the project one or several suggestions on a future data collection set-up that meets as many of the identified information needs as possible, and that is optimally adapted to user needs, available resources and respondent burden.

4- Activities/tasks/input

The following tasks were identified by Eurostat to be carried out, not necessarily sequential in time:

Task 1: Analyse the AEI for data requirements, availability and gaps, as well as additional information requirements (such as coefficients used). For the indicators not yet fully developed, estimated data requirements will be sufficient;

Task 2: Analyse other reporting needs related to the AEI that also require collection of similar data both by examining legislation, instructions etc., and by contacting

working groups, task forces, and similar structures set up to support these reporting activities:

- UNFCC reporting[2],
- Rural Development programme monitoring indicators[3],
- Land Use, Land-Use Change and Forestry (LULUCF)[4],
- Water Framework Directive,
- Nitrates Directive,
- Directive on National Emissions Ceilings for certain atmospheric pollutants
- Framework Directive on the Sustainable use of Pesticides
- The NATURA 2000 network (Birds and Habitats Directives)

Among the structures to be contacted are the Task Force on Reactive Nitrogen (http://www.clrtap-tfrn.org), the EU Footprint project (http://www.eu-footprint.org/home.html.

Task 3: Analyse the methodologies for calculating greenhouse gas and ammonia emission and nutrient balances (nitrogen and phosphorus), with particular stress on the coefficients used in the calculations and the underlying data needs. Identify best practices for these coefficient calculations, based on available scientific research;

Task 4: Summarise the data needs identified in tasks 1-3, determine the smallest common denominator for the calculation of these data, identify potential harmonisation synergies and give recommendations for priority data collection;

Task 5: Analyse needs for and feasibility of data complementarities and combination for the calculation of the indicators: at parcel, farm, regional or national level and the subsequent demands on the collection and processing systems;

Task 6: Characterise Member State data collection and reporting systems, involving also non-governmental actors like advisory services, research communities, and farmers' associations, and give best practise recommendations for a common data collection arrangement;

Task 7: Organise approximately 5 task force/ expert meetings, with an approximate number of 6 participants each, covering specific issues, to be defined on the basis of the previous tasks.

Task 8: Submit a technical document summarising the results of tasks 1 to 7, intended for the workshop in task 9.

Task 9: The results of the tasks 1 to 8 will be presented and discussed at a workshop with the Member States and other potential stakeholders (DG AGRI, DG ENV, EEA,etc) in March 2011.

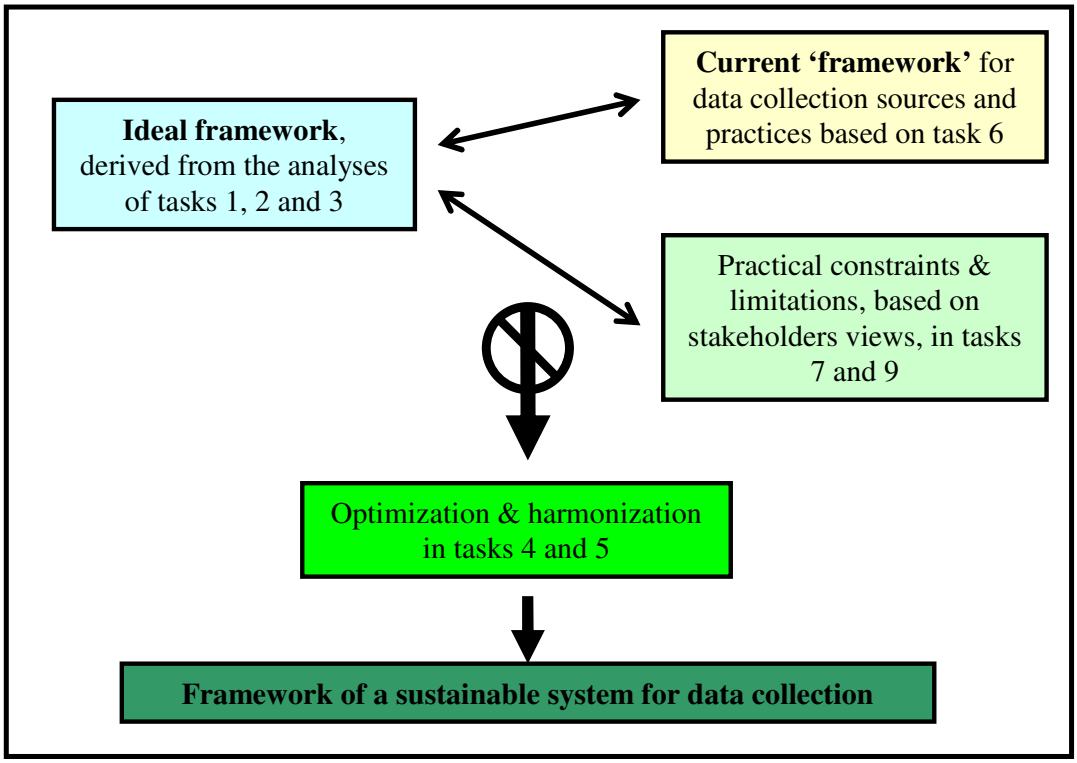
---

[2] http://unfccc.int/ghg_data/ghg_data_unfccc/items/4146.php

[3] http://ec.europa.eu/agriculture/rurdev/eval/index_en.htm

[4] http://unfccc.int/methods_and_science/lulucf/items/3060.php

Figure 1. Possible interpretation of the work in the study; 'a multi-dimensional and multi-scale optimization and harmonisation assignment'.



5- Expected results/reports

Expected results

- Inventories:
    a. A study containing an analysis of the 28 AEI with specific emphasis on the data requirements and existing gaps;
    b. A study containing an overview of AE related reporting requirements in the EU, with specific emphasis on data requirements;
    c. A study reporting on the methodologies used for the calculations of greenhouse gases, ammonia and nutrient balances with suggestions for best approaches for calculating the coefficients, and in addition, recommendations for data needed for these calculations;
    d. A study giving an overview of national data collection systems, weighed against the needs for new data and harmonisation at international level and analyses on potential common data collection structures
- Recommendations
    a. An initial (6 months after the start of the project) and a final review of the data needs identified, identifying potential harmonisation synergies and giving recommendations for priority data collection;
    b. Recommendations for best practices for data collection systems, based on the present systems in the Member States.
    c. A final review of the results with recommendations for the future data collection system for AEI, given both in relation to other available data sources, and to the

need to combine sources to give optimal results. These recommendations must be weighed against available resources, response burden and need for harmonised data at European and international level

- A technical document summarising the results of tasks 1 to 7, intended for the workshop in task 9.

Expected reports

- Minutes of all project meetings, the workshop, and of the expert meetings containing views and advices on different issues, alternatively expressed in exchange of e-mails
- Interim progress reports for the quarterly meetings
- A final report on the activities of the project

6- Guiding principles

Following the discussions during the kick-off meeting and internal project meetings, the consortium carrying out the study identified a number of guiding principles for developing the sustainable framework for data collection and reporting. These guiding principles follow in part from the challenges and possible pitfalls indicated in Table 2; these principles are presented below:

- *Lego bloc principle*, i.e., design the framework and its building blocs in a way that it provides flexibility. The building blocs should to be used many times for many different functions. The framework has to be robust (sustainable) and flexible at the same time, to be able to adjust to future changes.
- *Multiple solutions principle*, i.e., there is not just one optimal solution for deriving the framework, but a range of possible solutions. Hence provide various proposals and indicate their pros and cons and 'margins of flexibility';
- *Primary source principle, i.e.*, data collected directly at source, at the farm level, likely have a much larger accuracy than data derived from indirect sources;
- *Effectiveness and efficiency principles*, i.e., collect the data once; use them many times; Transmit the data once; use them many times; cluster data where possible;
- *First things-first principle,* i.e. the emphasis of the work has to be on the most important aspects. The priority activities have to be identified and these have to be carried out.
- *Subsidiary principle*, i.e., the idea that the central authority should have a subsidiary function, performing only those tasks which cannot be performed effectively at a more immediate or local level.

These are the guiding principles identified so far; likely additional ones will be identified during the course of the project

Table 2. Challenges and possible pitfalls, as identified during the first project meeting

1. How to prevent to re-invent the wheel? Make use of existing/available information
2. How to prevent going too much into detail? Keep an eye of overall objectives
3. How to deal with different practices and data collection in different cultures, climates, etc?
4. How to find common denominators for the indicators?
5. How to create a flexible and at the same time practical framework?
6. How to formulating recommendations for harmonization in a changing world?
7. How to integrate and satisfy the wishes of the diverse group of stakeholders?
8. How to minimize data collection and respondent burden of Member States?
9. How to making practical recommendations?
10. How to deal with the interdependency of tasks without waiting on each other?
11. How to close the gap in outcome (results) of different balance approaches?
12. How to be pragmatic and scientifically sound in the same time?
13. How to get science out of this project?
14. How to remain focused on the data requirements of the selected indicators
15. How to establish linkages between indicators and data requirements?
16. How to prevent too much emphasis (bias) on single issues that have the main interest of the consortium members?

7- Consortium

The study is carried out by a consortium under the lead of Professor Oene Oenema from Alterra, Wageningen UR, The Netherlands, with the following consortium members:

Department of Agro-ecology and Environment, University of Aarhus, Denmark
Institute of Technology and Life Sciences, Falenty, Poland
Department of Sustainable Agricultural Systems, University of Natural Resources and Applied Life Sciences, Wien, Austria,
ADAS, Wolverhampton, United Kingdom

ANNEX 1. List of agri-environmental indicators and potential sources of information for the AEI

No	Title	Potential initial source	Possible collection method	Presently suggested source
1	**Agri-environmental commitments**	Parcel Farm	Farm surveys, Administrative records	Administrative records of the Commission
2	**Agricultural areas under Natura 2000**	Administration	Farm surveys, Administrative records	Administrative records of the Commission
3	**Farmers' training levels and use of environmental advisory services**	Farm	Farm surveys, Administrative records	Farm structure surveys (FSS); Administrative records
4	**Area under organic farming**	Farm	Farm surveys, Administrative records	FSS; Administrative records
5	**Mineral fertiliser consumption**	Parcel Farm	Farm survey, accounts	Farm surveys, Farm accounts
6	**Consumption of pesticides**	Parcel Farm	Farm survey, Accounts	Farm surveys, Farm accounts
7	**Irrigation**	Parcel Parcel Farm	Farm survey Accounts	FSS
8	**Energy use**	Farm	Farm survey, Accounts	Energy statistics
9	**Land use change**	Spot analyse	Remote sensing Survey on the ground	Remote sensing Survey on the ground
10.1	**Cropping patterns**	Farm Spot analyse	Farm survey, Remote sensing Survey on the ground Administrative records	FSS
10.2	**Livestock patterns**	Farm	Farm survey, Administrative records	FSS
11.1	**Soil cover**	Parcel Farm Spot analyse	Farm survey, Remote sensing Survey on the ground	FSS, supporting data needed from other sources
11.2	**Tillage practices**	Parcel Farm	Farm survey Survey on the ground	Survey on Agricultural Production Methods (SAPM)
11.3	**Manure storage**	Farm	Farm survey	FSS, SAPM
12	**Intensification/ extensification**	Farm	Farm survey, Accounts	FADN
13	**Specialisation**	Farm	Farm survey, Accounts	FSS
14	**Risk of land abandonment**	Farm, Modelling, Scientific research	Not defined	Not defined

15	**Gross nitrogen balance**	Farm, Modelling, Scientific research	Farm survey, Accounts, Administrative records	Member state calculations
16	**Risk of pollution by phosphorus**	Farm, Modelling, Scientific research	Farm survey, Accounts, Administrative records	Member state calculations
17	**Pesticide risk**	Farm, Modelling, Scientific research	Farm surveys, statistical, scientific and other sources	Not defined
18	**Ammonia emissions**	Farm, Modelling, Scientific research	Farm surveys, statistical, scientific and other sources	Not defined
19	**Greenhouse gas emissions**	Farm, Modelling, Scientific research	Farm surveys, statistical, scientific and other sources	Not defined
20	**Water abstraction**	Farm, Modelling	Farm surveys, statistical, scientific and other sources	FSS/ SAPM
21	**Soil erosion**	Parcel Farm, Spot analyses	Farm surveys, surveys on the ground, remote sensing, statistical, scientific and other sources	JRC database
22	**Genetic diversity**	Farm Breeding companies	Farm surveys Surveys of the breeding companies	FAO
23	**High nature value farmland**	Farm, Modelling, Scientific research Spot analyses	Farm surveys, statistical, scientific and other sources	Not defined
24	**Production of renewable energy**	Farm, Energy production/ providers companies	Farm surveys Surveys of the energy companies	FSS Crop statistics Energy statistics
25	**Population trends of farmland birds**	Spot analyses	Survey on the ground	BirdLife
26	**Soil quality**	Parcel Farm, Spot analyses	Farm surveys, surveys on the ground	JRC database
27.1	**Water quality – Nitrate pollution**	Watercourses	Surveys of water quality	EioNet
27.2	**Water quality – Pesticide pollution**	Watercourses	Surveys of water quality	EioNet
28	**Landscape – State and diversity**	Modelling, Spot analyses	Surveys on the ground, remote sensing	Surveys on the ground, remote sensing

ANNEX 2. Belgian modular approach

We will here examine only a few of the results presented in the Belgian reports, to underscore the need for complex data, if we want to develop AEI in a coherent manner.

According to Belgian report, the operational model for calculating ammonia emissions might look like this:

Figure 1. Operational model for the calculation of ammonia emissions

NH_3-emission$_{stable}$ (year, animal) = ∑[N-production$_{stable}$(year, animal, stable type)
* NH_3-emission coef$_{stable}$ (year, animal, stable type)]

Where:
N-production$_{stable}$ (year, animal, stable type) = ∑[N-production$_{total}$ (year, animal)
*%in_stable(year, animal)
*stable type(year, stable type, animal)]

NH_3-emission$_{external\ storage}$ (year) = Storage capacity(year)
* N-content (year, animal group)
* NH_3-emission coefficient$_{external\ storage}$ (year, animal group)

NH_3-emission$_{spreading}$ (year, animal) = N-production$_{applicable}$(year, animal)
* N-fraction(year, animal, manure)
NH_3-emission coefficient$_{spreading}$(year, animal, manure, land)
*%grass or farmland(year, manure, land)

Where:
N-production$_{applicable}$ = N-production$_{stable}$
- NH_3-emission$_{stable}$
- NH_3-emission$_{external\ storage}$
- N-export

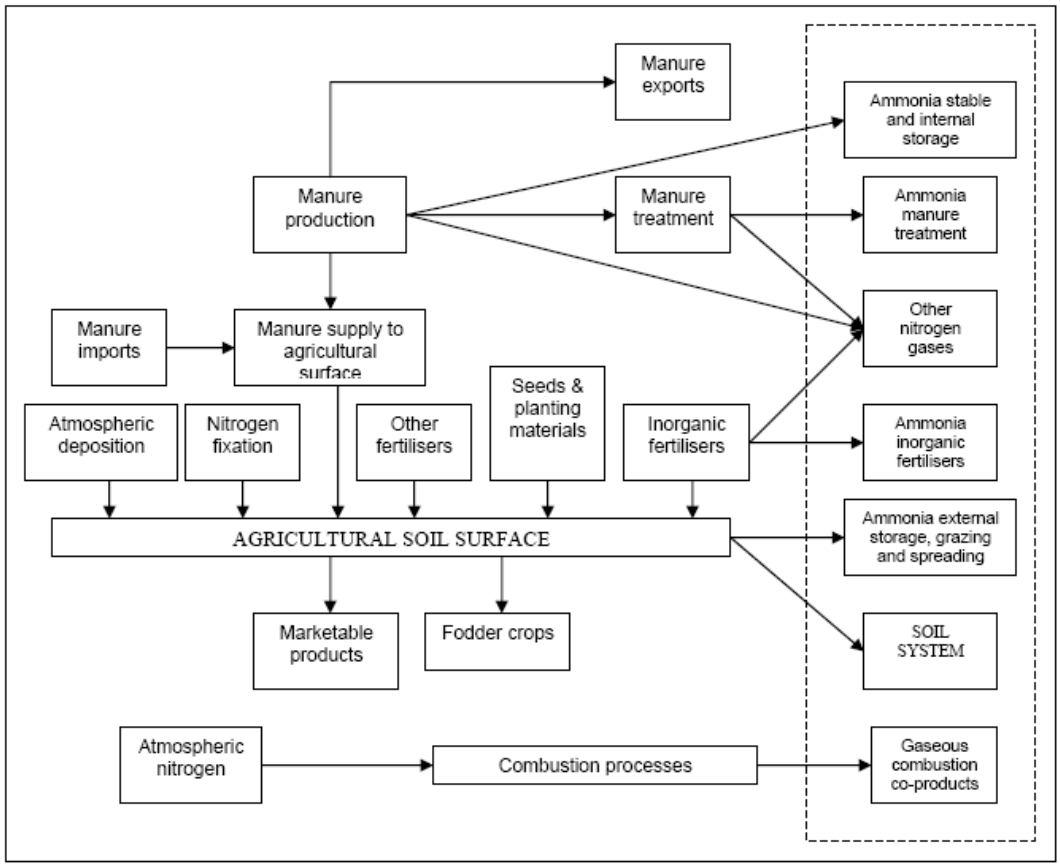
NH_3-emission$_{grazing}$(year, animal) = ∑[N-production$_{grazing}$(year, animal)
* NH3-emission coef$_{grazing}$ (year)

Where:
N-production$_{grazing}$ (year, animal) = ∑[N-production$_{total}$(year, animal)
* [1-%in_stable(animal)]

NH_3-emission$_{inorganic\ fertiliser}$ (year, region) = use$_{inorganic\ fertiliser}$(year, region)
* NH_3-emission coef$_{inorganic\ fertiliser}$ (region)]

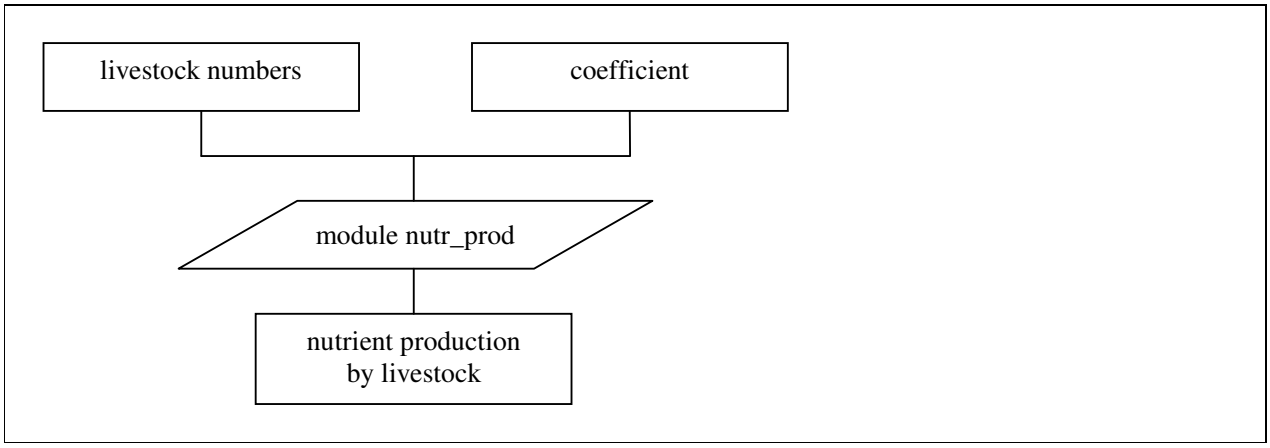
On the other hand, the nutrient balance looks like this:

Figure 2. The most important components of the nutrient balance



According to Figure 3, the manure production can be broken down as:

Figure 3. Manure production module



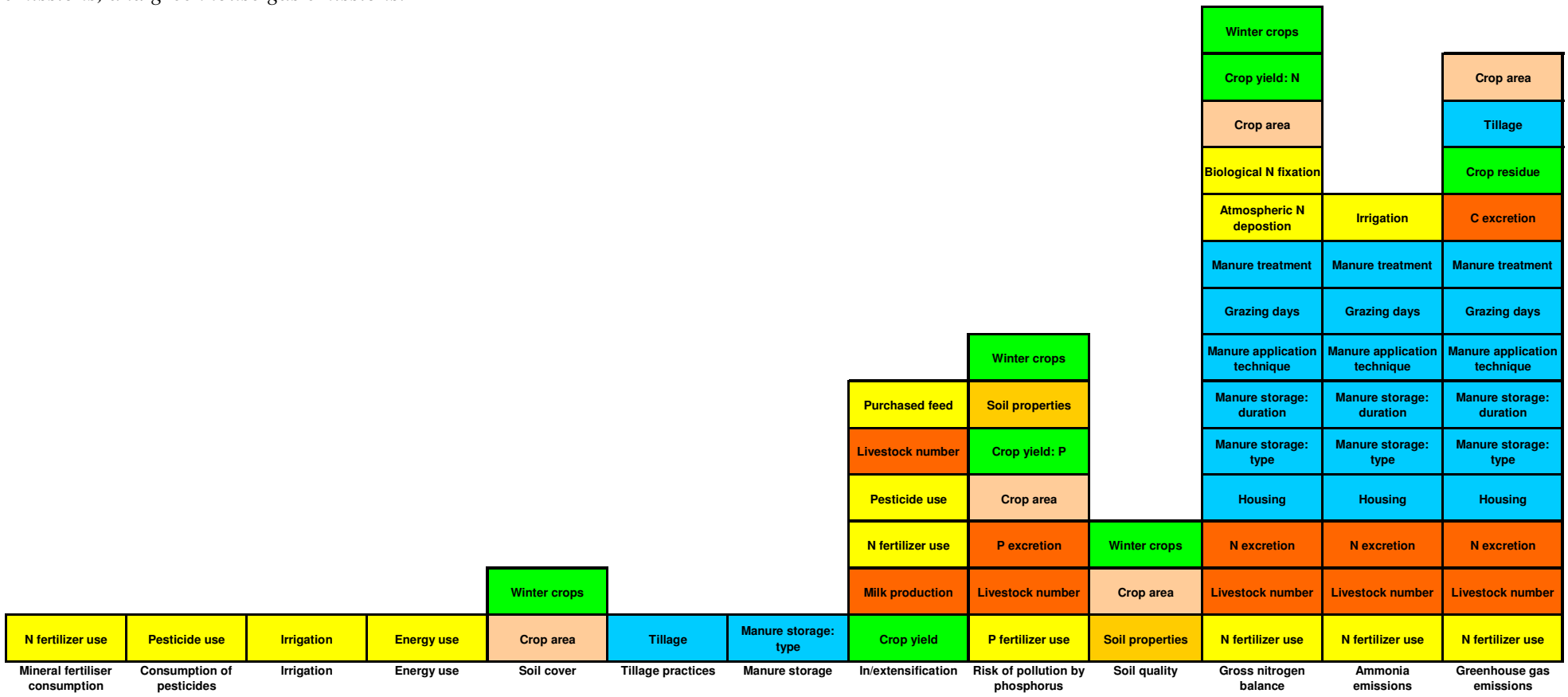
Annex 3. First results on identifying priority data collection

Figure 1. Parameters required for AEIs grouped in different categories (Building blocs). (Air quality blocs will be disaggregated when work progresses)

Building blocks for AGRI-ENVIRONMENTAL INDICATORS

Inputs	Land use/nature	Crop production	Livestock	Farm management	Soil and water quality	Air quality
N fertilizer use	Crop area	Crop yield: N	Livestock number	Housing	Soil properties	CH4 and N2O emissions from agriculture
Atmospheric N depostion	Area under AE commitments	Crop residue	N excretion	Manure storage: type	Estimated soil loss by water erosion	Ammonia emissions from agriculture
Biological N fixation	Agricultural areas under Natura 2000	Winter crops	C excretion	Manure storage: duration	Estimated soil loss by wind erosion	
P fertilizer use	Area under organic farming	Crop yield: P	P excretion	Manure application technique	Soil erosion	
Irrigation	Land cover	Crop yield	Milk production	Grazing days	Nitrate concentration in water	
Pesticide use	Area specialised farm types	Crop varieties	Livestock breeds	Manure treatment	Pesticides concentration in water	
Pesticide active substance properties	Estimated area High Nature Value Farmland	Renewable energy production; agriculture		Farm typology		
Purchased feed	Supported areas for renewable energy production	Renewable energy production; forestry		Training of farmers		
Manure application	Farmland bird population counts			Soil tillage		
Energy use	Risk of land abandonment			Farmers use of environmental farm advisory services		
Water abstraction	Agriculturally linked linear elements			Rural tourism		
	Land use change					
	Area of energy crops					

Figure 2. The parameters required for (calculation of) AEI's (example). There is a clear overlap in data requirement of the AEI's nitrogen balance, ammonia emissions, and greenhouse gas emissions.



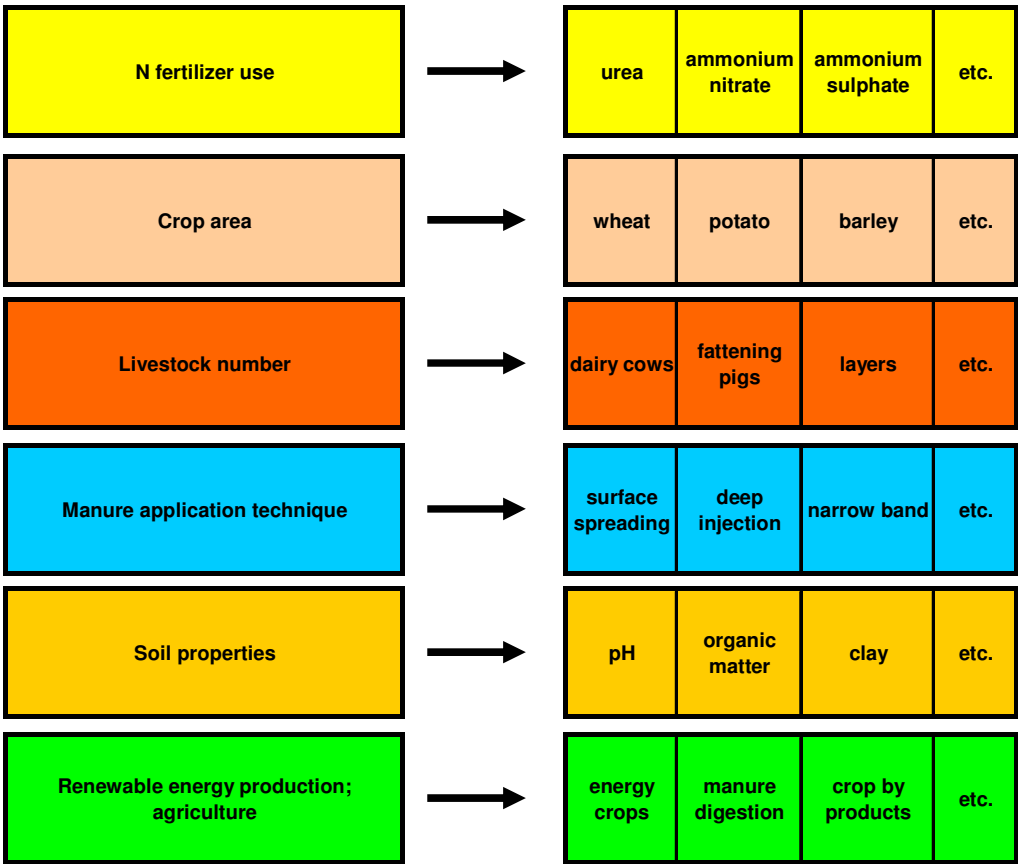


Figure 3. Each building block consists of smaller building blocks.

First recommendations for priority data collection

1. There is a large similarity in the need for data for the following priority AEIs (i) N balance, (ii) ammonia emission, and (iii) greenhouse gas emissions. All these AEIs also include the AEIs N fertilizer consumption and manure storage. This points at a clear potential for common and harmonized data collection and processing for a significant part of these priority indicators. It is recommended to set up a system of data collection of these "N and manure related AEIs".
2. There are linkages in the required parameters in the soil-related AEIs (soil cover, soil quality, N balance, risk of P leaching), which indicate that there is harmonization potential for these AEIs. It is recommended to develop a system of data collection for the soil-related AEIs, including an assessment of the linkage with the data requirements of "N and manure related AEIs".
3. The data requirements for the priority AEIs energy use, irrigation, and consumption of pesticides are not strongly related to the data need of other AEIs (but there are linkages with the second priority AEIs). Potential for harmonization of data collection are limited within the first priority AEIs (but there are linkages in the data need for second priority indicators).
4. The following step is that for each parameter the required level of detail (types of fertilizers, livestock, crops, housing systems etc.) and the scale (country, region, farm, field etc.) have to be determined. It is recommended to focus first on the "N and manure related AEIs" and on "the soil-related AEIs".