Agricultural Statistics for Environmental Monitoring and Policy

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[The views expressed in this paper do not necessarily reflect those of the OECD or its member countries.]

ABSTRACT: A number of key challenges confront agricultural statisticians, economists and policy analysts concerned with environmental monitoring and policy analysis, in particular to: improve the availability and the quality of data; enhance the dialogue between economists, statisticians and policy analysts; and produce policy relevant and analytically sound agri-environmental indicators (AEIs). In its policy and indicators work on agriculture and the environment, the OECD has been addressing these challenges, and the paper describes how the OECD has started to develop a set of AEIs. After the introduction, the paper describes the overall policy context of OECD work on agriculture and the environment. Thirdly, it sets out the objectives and framework for the OECD AEI work. Fourthly, it provides a brief overview of recent AEI work in OECD countries. Fifthly, the paper examines recent progress in developing the OECD set of AEIs, and finally, outlines future developments in AEI work.

1. Introduction

> *"It would be very helpful, for purposes of environmental management, to have reliable measures of change at both the national and global levels. Evidently a time series of simple measures, such as ratios, based on readily available statistics … could serve such a purpose. …On the other hand, it is hard to see why a set of simple measures …has never been prepared and published by any national or international statistical agency. The relatively low cost of such an effort, by international standards, makes the omission all the more incomprehensible."* [Ayres 1996]
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> *"Transactions between statistical agencies and the research or analytical agencies and "policy shop[s]" … where the statistical products are used have long exhibited a weakness that is critical in an era requiring greater integration and coordination of decision systems. …Serious mismatches between the characteristics of the statistical products used and the data requirements of analysis result in low quality or badly flawed data for analysis and, thus, often flawed information for decisions. …We need to think more carefully about what is necessary to make [the] transaction between statisticians and analysts an effective one for users of information."* [Bonnen 1997]
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> *"When …environmental indicators are collected for pragmatic purposes, the set of indicators chosen, and the performance measures attached to them depend on who is asking the policy question, the purpose of the agency and the clients it serves. In this regard, it becomes clear again that indicators carry political, as well as intellectual value. They may be used, misused or ignored entirely in the pursuit of specific political aims. Yet the role of indicators is critical in making well informed social choices. Without them, we risk shortsighted and seriously flawed decision making. The current state of research on environmental indicators is reminiscent of the early stages of national income accounts. Experimentation and inconsistencies are inevitable at the beginning. Nonetheless, research must press forward in order to produce rigorous and meaningful indicators."* [Ervin, Batie and Livingston 1995]

The above quotations illustrate the key challenges that confront agricultural statisticians, economists and policy analysts concerned with environmental monitoring and policy analysis to:

- improve the availability and the quality of data,
- enhance the dialogue between economists, statisticians and policy analysts, and
- produce policy relevant and analytically sound agri-environmental indicators.

In its policy and indicators work on agriculture and environment since the early 1990s, the 29 member countries of the Organisation for Economic Cooperation and Development (OECD) have been addressing the challenges described above by:

- identifying the policy relevant concepts and issues,
- initiating an exchange of information and policy experiences among OECD countries,
- establishing a set of agri-environmental indicators to support policy analysis and monitoring, and
- starting analysis and evaluation of agricultural and agri-environmental policy measures in OECD countries.

2. Overall Policy Context of OECD Work on Agriculture and the Environment

The overall objective of the OECD's work in the area of agriculture and the environment is to identify ways in which governments might design and implement policies and promote market solutions to achieve environmentally and economically sustainable agriculture at minimal resource cost to the economy and with least trade distortions [OECD 1998a]. The work is undertaken against the background of growing concern in countries about the effects of agricultural activities and policies on the environment. The achievement of sustainable agricultural production is now widely recognised by governments as a long-term policy objective in agriculture [OECD 1995].

In most OECD countries, agriculture is a heavily assisted industry. Agricultural support policies have multiple and sometimes contradictory effects on the environment [OECD 1998b]. At the same time, countries are engaged in reforms to lower the levels of support and move towards policies that aim to provide targeted assistance to agriculture and that have the potential to be less production and trade distorting [OECD 1998c]. In this context, payments to farmers for environmental purposes are increasing. Such payments are often intended to compensate farmers for the costs of reducing polluting activities or to enhance the provision of environmental services.

In this changing policy environment, there is a need for a better understanding of the environmental effects of agricultural support, policy reform and freer trade. This concerns primarily the effects of agricultural policies on the environment, but it also applies to the impact of environmental policies on agriculture, especially as the number of environmental measures affecting agriculture is increasing in many countries.

OECD work on agriculture and the environment takes into account the commitment to agricultural policy reform made by OECD Ministers in 1987, the directions set for sustainable development at the UN Conference on Environment and Development in 1992, and the 1993 Agreement on Agriculture within the Uruguay Round of multilateral trade negotiations.

3. OECD Work on Agri-environmental Indicators

The key questions that underlie OECD work on developing agri-environmental indicators [OECD 1997a], which is part of a more general OECD environmental indicators effort [OECD 1994a, 1997b], include: what is agriculture doing to the environment, and, what impact do different policy measures have? In answering these questions, the objectives for the OECD work in establishing a set of agri-environmental indicators (AEIs) are to:

- *provide information* to government policy makers and the public on the current state of the environment in agriculture, and changes to it;
- *help policy-makers* understand links between causes and effects and the impact of agricultural policies on the environment, and guide their responses to changes in environmental conditions; and
- *contribute to monitoring and evaluating* policy effectiveness in promoting sustainable agriculture.

To achieve the objectives set out above, OECD work on agri-environmental indicators is being developed within a *"Driving Force–State–Response" (DSR) framework* (Figure 1). *Driving forces* are features of agricultural practice which can cause changes in the state of the environment, such as the over-use of chemical inputs. But they may also be beneficial, such as the water-storage capacity of farming systems which can reduce problems such as soil erosion. The *State* refers to the environmental conditions that arise from these driving forces: their impact on, for example, soil, water, air and natural habitats. *Responses* refer to the reactions by farmers, consumers, the agri-food industry and government to perceived changes in the state of the environment, such as the use by some governments of payments to farmers to promote environmental benefits [OECD 1997c].

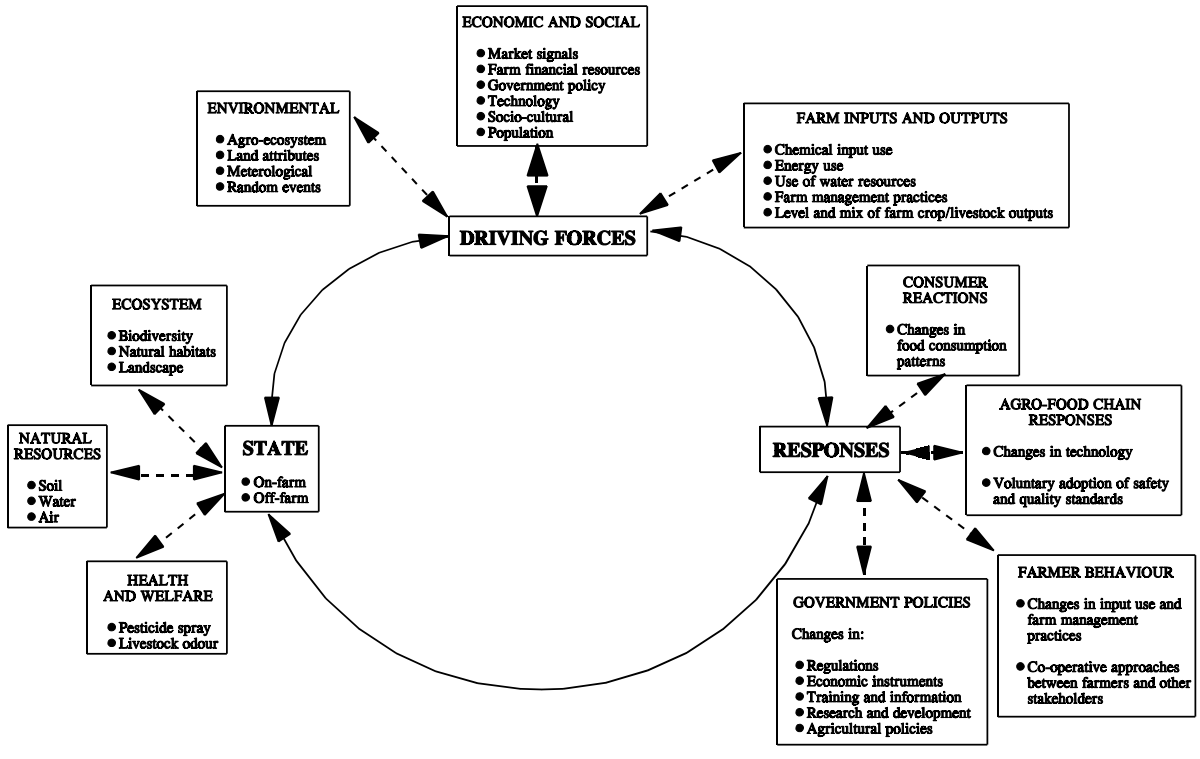
Analysis of the linkages between driving forces, state and response is a key element in shedding light on the relationship between the causes and effects of agriculture's impact on the environment to better guide policy makers in their responses to changes in environmental conditions in agriculture. At this stage of the OECD work and in analysis elsewhere, however, these linkages are not yet fully developed. Significant further work needs to be undertaken on the linkages between indicators in the DSR framework, before causal relationships and feedbacks can be better understood and more easily expressed for use by policy-makers and other stakeholders.

Examination of agri-environmental linkages in the DSR framework highlights the need to:

- develop knowledge of the physical, chemical and biological factors that relate variations in agricultural practices, input use and production to changes in environmental quality;
- improve knowledge of the economic, sociocultural and policy factors that determine and influence the effects of agricultural activities on the environment; and
- quantify each component in the DSR framework through collection and verification of high quality and analytically sound data.

The DSR framework outlined here is essentially a working tool, with the possibility of its components being modified as understanding of agri-environmental linkages improves and as agricultural and environmental policy goals evolve.

Figure 1. Driving Force-State-Response Framework to Address Agri-environmental Linkages and Sustainable Agriculture



Source: OECD, *Environmental Indicators for Agriculture*, Publications Service, 1997.

4. Overview of Recent Agri-environmental Indicator Work in OECD Countries

Since the early 1990s, there has been some progress in developing analytical frameworks and related indicators with the aim of monitoring the environmental effects of agriculture, and contributing to the evaluation of agricultural and environmental policies. For many OECD member countries, this work is now beginning to involve basic data collection and the measurement of indicators. (This is a selective overview of recent OECD member country work, mainly available in English.) Even so, there remains considerable variability in both the coverage and quality of data and indicators across different countries.

Many OECD member countries periodically publish compendia of general environmental data, which usually encompass an agricultural segment. Significant progress has also been made in developing "state of the environment" reports which interpret general environmental information. Such reports have been published at least once in most OECD countries and on an annual basis in a growing number of cases [OECD 1996]. These reports usually include data and indicators on a number of agri-environmental related areas, such as land use, water resources, fresh water quality, wildlife habitats, landscape and soil, as illustrated for example in a recent report published by the United Kingdom [U.K. Department of the Environment 1996].

Some OECD countries are developing an analytical framework in which to identify and develop indicators that address environmentally sustainable agriculture, such as Australia [Agricultural Council

of Australia and New Zealand 1993, 1996], Canada [McRae 1995, McRae and Lombardi 1994], Germany [Nieberg and Isermeyer 1994], and the Netherlands [Brouwer 1995].

For most OECD countries, the systematic collection of basic agri-environmental data and measurement of AEIs is only beginning. Moreover, where data and indicators exist, the coverage and quality varies across countries, as revealed by an OECD Pilot Survey of agri-environmental indicators conducted in 1995. Even so, responses to the Pilot Survey provide encouraging evidence of the extent and detail of basic agri-environmental data currently available and/or being developed in OECD countries from which it should be possible to calculate AEIs.

The use of AEIs as analytical tools to monitor and evaluate the impact of policies on the environment in agriculture is relatively underdeveloped. A few OECD countries have started work in this area, such as the consideration being given by Canada to develop the predictive capability of AEIs to assess the economic and environmental implications from domestic agricultural policy reform [McRae et al. 1995]. Eventually the Canadian analysis will also be extended to examine longer term sustainability questions by relating anticipated changes in resource quality back to production and agricultural income projections.

Other countries have also begun to link the development of indicators to policy assessment and monitoring, for example, Canada [Agriculture and Agri-Food Canada 1997], France [Institut Français de l'Environnement 1997], New Zealand [New Zealand Ministry of Agriculture and Fisheries 1995], Switzerland [Office Fédéral de la Statistique 1995] and the United States [U.S. Department of Agriculture 1996, 1997].

5. OECD Indicators to Address Agri-environmental Issues

Indicators are being developed by OECD for the measurement of thirteen agri-environmental areas, which can be grouped under three headings relating to primary agriculture:

The use by primary agriculture of:

- **Nutrients** – mainly chemical fertilisers and livestock manure,
- **Pesticides** – herbicides, insecticides, fungicides and other pesticides,
- **Water** – particularly water for irrigation, and
- **Land** - this covers changing farmland use and the conservation attributes of agricultural land;

The impact of primary agriculture on:

- **Soil quality** – the impact on soil quality, such as to reveal the risk of erosion,
- **Water quality** – the impact on surface and groundwater quality,
- **Greenhouse gases** – both the release and accumulation of such gases,
- **Biodiversity** – of domesticated species used by agriculture, as well as wild species,
- **Wildlife habitats** – changes and fragmentation of habitat in agricultural areas, and
- **Landscape** – changes in agricultural landscapes; and

The environmental impacts from primary agriculture related to:

- **Farm management practices** – on nutrients, pests, soil, irrigation and the farm as a whole,
- **Farm financial resources** – the varying and different sources of financial resources for farms, and
- **Sociocultural aspects** – the impact of the sociocultural structure of rural communities.

(Indicators might be developed at a later stage on upstream/downstream activities related to agriculture, and to examine the impacts of the environment on agriculture, such as acid rain and climate change.)

OECD work is currently most advanced in terms of developing the conceptual understanding, indicators and methods of measurement across the agri-environmental areas concerning nutrient, pesticide, water and land use, land conservation, soil and water quality, and greenhouse gases. It appears, based on preliminary and partial information across these areas, that in many OECD countries over the last 10-20 years there has been some overall improvement in the environmental performance of their agricultural sectors. However, there remains considerable variation within and between countries, although it is possible to identify a number of key points.

Nutrient use:

- Evidence from OECD calculations of annual national nitrogen balances for 28 countries over the period 1985-1996 shows that balances are in surplus for all OECD countries, with the overall trend in the surpluses over the last decade either downwards or constant for most countries. Nitrogen (N) balances measure the difference between the quantity of N inputs into agricultural soil (mainly chemical fertilisers, livestock manure, atmospheric N deposition, biological N fixation) and the N uptake from the soil (from arable and permanent crops, and pasture) divided by the total agricultural land area, expressed as N kg/ha/annum.
- In general, countries with high or increasing livestock densities and intensive agricultural production systems have the highest levels of nitrogen surplus, while for some countries with a relatively low national nitrogen surplus, there are sub-national regions affected by both problems of "excessive" nitrogen loadings and soil nitrogen deficits or depletion (e.g. sub-national regions in Australia, Canada, and the United States).

Pesticide use:

- The trend in pesticide use over the last decade has remained constant or declined for most OECD countries, while for some European countries the reduction has been around or greater than 50 percent, although use has risen in a few cases [OECD 1997d].
- There is considerable variation in the quantities of pesticides used per hectare both amongst various crops and across different countries.
- Technological developments can lead to smaller quantities of active ingredients required per hectare, although the toxicity of new products may still be high. Thus, correlating trends in pesticide use with environmental impacts must be treated extremely cautiously.
- Interpretation of pesticide use data and trends can be significantly improved by linking them to environmental and health risk ranking systems and also other indicators, in particular those covering soil and water quality and farm pest management.

Water use:

- There are wide differences between OECD countries, and also between regions within countries, concerning the availability of water resources, but in some cases there is a growing concern that the agricultural sector is facing water "stress" or shortage [OECD 1998d].
- Actual or estimated trends of agricultural water use are unavailable for most OECD countries. However, over the past 30 years there has been a continuous upward trend in the irrigated area for most countries, and the ratio of the irrigated to total cultivated area has also risen.
- For a few countries where trends in agriculture water use are being monitored, the share of agriculture in total national water use has been growing over the past 20 years (e.g. Canada, France, the United States).

Land use and conservation:

- Some highly fertile agricultural land is being converted to urban use in many OECD countries, while increasing afforestation of marginal agricultural land is also evident in some countries.
- Abandonment of agricultural land is of importance to some OECD countries, especially where this land is valued for its biodiversity, habitat and landscape features [OECD 1997e].
- In some countries, there are signs that the rate of wetland loss to agriculture is declining, while in many countries the area of land under "organic" farming systems or some form of environmental management scheme is expanding.
- As agricultural land can help to prevent flooding, reduce soil erosion and landslides, and conserve water, changing agricultural land to other uses can impair its conservation function.

Soil quality:

- There is growing evidence that improvements in soil quality are being achieved through the adoption of soil conservation practices in most OECD countries, although the extent of soil degradation still affects a significant share of the total agricultural area in many countries.
- Preliminary research suggests that there are important regional differences in trends in soil quality within countries, especially where soil conservation practices are not being used by farmers and intensive cropping systems and high livestock stocking densities persist.
- While soil degradation can occur naturally or results from sectors such as forestry, estimates in the United States, for example, have shown that agricultural activities account for 60 percent of total soil erosion, the remainder resulting from natural events and other land uses.
- There is currently little information on some aspects of soil quality, notably changes in soil structure, while some recent studies suggest that biological degradation is the most serious form of soil degradation, as it affects organic matter and the fertility and productivity of soils.

Water quality:

- There are no clear overall trends yet established concerning the impact of agriculture on water quality in OECD countries because of limited data.
- Agriculture is a major contributor to nitrate and phosphorous loadings in surface, ground and marine waters for a large number of OECD countries, mainly resulting from the use of chemical fertilisers and livestock manure production.

- Silting of rivers, lakes and estuaries from agricultural soil erosion is a significant problem in a number of countries, and can lead to the impairment of reservoirs, water systems used for transport and recreational purposes.
- The contamination of groundwater in agricultural areas is a problem arising from the leaching of nitrates, phosphorous and pesticides, and as it may take many years for this process to occur, this might be a key issue in countries where groundwater is the major source of water supplies.
- The potential impact of agriculture on water quality is being estimated through "risk" indicators in a growing number of countries, mainly because monitoring the "state" of water quality is difficult in terms of distinguishing the contribution of agriculture compared to other sources of water quality impairment, such as from forestry or industry [OECD 1998d].

Greenhouse gases:

- The share of agriculture in total gross national greenhouse gas (GHG) emissions is in general low, although for a few countries the share is over 20 percent.
- Agriculture in OECD countries contributes about 40 percent of both total gross methane and nitrous oxide emissions, with livestock production, fertiliser application and paddy rice production as the main sources of these GHGs.
- It is difficult to identify trends in agricultural GHG emissions because of limited data, but extrapolating from changes in cattle numbers, fertiliser use and the area of paddy rice would suggest that over the past decade agricultural emissions of GHG have declined for most OECD countries, although for some countries GHG emissions would appear to be rising.
- Agricultural soils can act as both a source and sink for GHG, and while further work is required to better understand the sink functions of agriculture, the capacity as a sink is enhanced by improved soil management and other agricultural practices.

The agri-environmental areas least developed in terms of conceptual understanding of the area, identification of relevant indicators and methods of measurement, and incomplete or unavailable data include: biodiversity, habitats, landscape, farm management and financial resources and sociocultural issues. Some OECD work has been completed on defining possible indicators for these areas, as described in the following paragraphs.

Agriculture and biodiversity: The development of indicators to address biodiversity in agriculture is complex because of differing levels at which it operates in agriculture. Since it is possible to preserve biodiversity *ex situ* and *in situ* the indicators that could address biodiversity in agriculture will need to reflect both approaches, including the measurement of the biodiversity of "domesticated" species in agriculture (e.g. varieties of wheat, etc.), and the impact of agriculture on the biodiversity of "wild" species (e.g. plants, insects, birds, etc.)

Agriculture and wildlife habitats: The indicators under consideration to measure agriculture and wildlife habitat include: changes in the area of selected "large-scale" habitats in agriculture such as wetlands and pasture; fragmentation of habitats both in the agro-ecosystem and "natural" habitats; and length of "contact zone" between agricultural and non-agricultural lands. None of these indicators provide a direct causal link between agricultural activities and impacts on habitats, although if used in conjunction with other indicators, such as those that address nutrient and pesticide use and farm management, they may contribute information to establish these linkages. The indicators outlined here provide little information on the relationship between changes in the quality of habitats and agriculture,

although the measurement of changes in "key indicator" wildlife species and habitat fragmentation could be of value in this context.

Agricultural landscape: This is a complex area, but some OECD countries are beginning to develop landscape indicators [OECD 1997c] by *estimating the monetary value of landscape* using economic non-market valuation techniques, such as the contingent valuation method. There remain many conceptual and practical difficulties with these techniques as they can be resource intensive when applied on a large scale and involve subjective judgements. A few countries are also developing an *inventory of physical landscape features*, such as the linear distance of hedgerows, monitoring trends in land use and appearance of key species. A problem with this approach is the choice of features or key species to include in the inventory (which will vary among countries and regions), and the problem of assessing whether a change in the inventory represents a positive or negative environmental impact related to agricultural activities.

Farm management: A number of indicators to assess the environmental impacts of farm management practices are under consideration, including the measurement of:

- *nutrient management* - the share of land which is analysed regularly for soil phosphorus; the share of farms using a nutrient management plan; the areas of land which require less than normally recommended nutrient inputs and also receiving excessive (i.e. above recommended levels) of nutrient inputs; the timing of slurry application and months of available slurry storage on farm; and the use of low ammonia emission slurry application machinery;
- *pest management* - the share of land on which integrated pest management practices are adopted; the use of pest forecasting systems; the areas of cropping land on which pesticides are not applied; and the efficiency of pesticide spraying equipment in applying pesticides;
- *soil management* - the share of land on which soil conservation practices are adopted, including the use of winter cover crops and appropriate tillage practices;
- *irrigation management* - the efficiency of water use on irrigated land in terms of the quantity of water used to produce a unit of agricultural output, and the pricing of water to agriculture; and
- *whole farm management* - the rate of adoption of farm plans or property management plans — which, when fully developed, may contain information relating to economic, farm production and biophysical or environmental factors — either approved by governments or voluntarily.

Farm financial resources: The indicators under consideration to address the issue of farm financial resources and the environment include measurement of net farm and off-farm income, policy transfers, average rate of return on capital employed, and the average debt/equity ratio, on a per farm basis and adjusted for inflation in real terms. More work has to be completed on defining the direction of environmental impact associated with changes in the level of farm financial resources. Further investigation is also required of the links between farm financial resources, farm management practices employed, and the effect on the environment, taking into account other factors, such as longer term climatic changes and population growth, which may indirectly influence farmer behaviour and environmental outcomes.

Sociocultural issues in relation to agriculture: Although the importance of sociocultural issues in the analysis of agriculture and the environment, including sustainable agriculture, is generally accepted, no precise definition of the policy issues nor relevant indicators have yet been established. However, some indicators are under consideration, including the measurement of:

- land use changes, especially the transfer of agricultural land to use for urban development,
- changes in population growth and composition, in particular rural-urban changes,
- education and training of farmers, in relation to the adoption of environmental plans and sustainable farming practices, and
- farmer health and safety, related to the use of agricultural pesticides and machinery.

6. Future OECD Agri-environmental Indicator Work

Building on recent progress to date, the OECD agri-environmental indicator work is expected to advance future analysis in the following areas.

- Improve the conceptual and analytical understanding of the links between agriculture and the environment in specific areas to help identify which policy relevant indicators might be developed and how they should be measured, such as biodiversity, habitats, and landscape.
- Identify policy relevant indicators and methods of measurement for those agri-environmental issue areas where the conceptual basis is advanced but for which indicators and methods of measurement have not yet been established, such as pesticide use, soil and water quality.
- Collect, systematically, basic agri-environmental data and begin the calculation of indicators where methods of measurement are established. In this regard, work is already underway on calculating indicators and collecting basic data related to, for example, nutrient use and greenhouse gases.
- Examine how the "driving force-state-response" (DSR) framework and related indicators can be used as analytical tools to better understand agri-environmental relationships in policy analysis and to evaluate the impact of policies on the environment in agriculture.

The ongoing and future OECD work on AEIs is progressing through the input and cooperation of:

- *"Lead" OECD member countries*, which involves drawing on the expertise and special interest of member countries across the agri-environmental issue areas for which indicators are being developed, such as the recent work by the Belgian authorities on developing a methodology to calculate nutrient balances [Bomans et al. 1996];
- *OECD Secretariat*, through the collection of basic data, calculation of indicators, harmonisation of indicator methodologies, and the use of indicators in policy analysis [OECD 1998a];
- *Other OECD work*, including the Group on the State of the Environment, which is developing a core set of general environmental indicators [OECD 1993, 1994a, 1997b]; the Pesticide Forum work on pesticide risk indicators and integrated pest management [Grandy and Richards 1994]; the Forum on Climate Change and Energy, the Greenhouse Gas Inventory Group together with related work on energy balances by the OECD International Energy Agency; and the Group of the Council on Rural Development which is working on establishing a set of rural indicators [OECD 1994b]; and
- *International organisations*, in particular OECD is working closely in developing indicators with international organisations, for example FAO, and agencies such as Eurostat.

The work on developing AEIs promises to provide valuable information by revealing where a problem may be emerging that might require a policy response, and as a contribution to monitoring the effects of actions taken by farmers in response to changing policy incentives or disincentives. This work is

beginning to quantify environmental trends in agriculture, and provide consistent time series on key agricultural and environmental parameters. The indicator work is also starting to identify more clearly the linkages, outlined in the DSR framework, between changes in farm input use, farm management practices and environmental outcomes.

Illustrative is the calculation of nutrient balances. Rather than examine the nutrient use issue through the simplistic, but frequently used indicator of chemical fertiliser use per hectare of agricultural land, nutrient balance indicators attempt to capture in a comprehensive way the greater complexity of the nutrient use issue. This is achieved by including both the nutrient inputs from fertiliser use on crops, livestock manure, atmospheric deposition, and other sources of nutrients, as well as the removal of nutrients through harvested crops and pasture. Combined with indicators being developed on land use, water quality, and farm management practices, this will help to establish a more comprehensive view of environmental performance trends in agriculture.

While the AEI work is beginning to provide the basis for quantitative policy monitoring and impact analysis, there is still clearly the need to further advance the work. This may involve exploring the possibilities of incorporating indicators into economic and policy assessments of agri-environmental linkages through three interlinked stages:

- *Physical measurement* of agri-environmental linkages, such as the quantity of nutrient loading per hectare of agricultural land, the tonnes of soil eroded per annum, the concentrations of pesticides in water, and trends in wildlife species. These measurements are usually either made by site specific monitoring or through the use of bio-physical equations and models to estimate physical changes.
- *Economic valuation* of the costs and benefits of agriculture on the environment. Approaches to making an economic assessment of agri-environmental impacts can range from relatively simple measurements — for example, the expenditure that has been used by farmers and government sources for environmental conservation in agriculture — to more complex approaches, such as cost-benefit analysis — for example, estimating the environmental costs from agricultural pesticide use compared to the benefits derived from controlling pests and diseases and improving agricultural productivity.
- *Policy impact assessment* of the effects of agricultural policies on the environment. This will usually entail a more comprehensive examination of not only physical environmental impacts associated with agriculture, but also take into account other policy, economic, financial and social considerations. Thus, when economic values are generated from physical data/indicators related to agri-environmental linkages, assessment can be made of the trade-offs among alternative policy options and comparisons between different farm management practices and systems.

The OECD report on *The Environmental Effects of Reforming Agricultural Policies* [OECD 1998b] concludes that it is too early to clearly and fully determine the impact on the environment of agri-environmental measures introduced in recent years. The report suggests, however, that recent agricultural policy reforms in most OECD countries have reduced some of the pressures from agriculture on the environment.

Much of the information, data and indicators that have facilitated the assessment of agri-environmental measures and policy reforms has drawn on AEI work. The OECD report on reforming agricultural policies [OECD 1998b] notes, however, that there is still a lack of qualitative and quantitative data for environmental performance assessment in agriculture, although evaluations of some programmes are underway and preliminary results are becoming available.

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