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Agri-environmental indicators and the recently adopted Framework for the Development of Environment Statistics - FDES

Contributed by: *FAO Statistics Division*

I Introduction

In recent years, the environmental challenges facing agriculture have increased as the agriculture sector has adopted new production methods and intensified production to meet higher food demands from continued world population growth. As the population continues to grow, which is estimated to be over 9 billion by 2050, there is an increasing strain on the agriculture to meet food security needs. At the same time the agricultural sector must mitigate the impacts of the increased and sustained agricultural production on the environment as well as adapt to the effects of climate change. The long term environmental sustainability of high production is one major question facing agriculture.

Continued increases in agricultural production raise some environmental challenges that are continually evolving in their nature and complexity. The environmental focus has been on the conservation of the natural resource base upon which agriculture depends, particularly soil, water and genetic resources for crops and livestock. Declining water quality, loss of wildlife habitat, reduced biodiversity, and emissions of greenhouse gases are some of the major concerns specifically linked to agriculture. This paper provides the broad agri-environment statistical

context, describes the recently revised Framework for the Development of Environmental Statistics (FDES) and the new agri-environmental indicator dataset in FAOSTAT. The final section describes current agri-environmental activities in FAO and poses questions for countries on the specific agri-environmental issues they face and their priority needs for agri-environment statistics and indicators.

II Context and Key Roles of Environmental Statistics and Indicators

Sustainable agricultural production contributes to long-term food security. The promotion and support of sustainable agriculture that conserves land, water, biodiversity and ecosystems, while enhancing resilience to climate change and natural disasters, has been agreed upon internationally, as has the need to maintain natural ecological processes[1].

Large scale or intensive agriculture requires the increasing use of chemicals, infrastructure and machinery. In its race to improve crop production, agriculture has become an industry which increasingly uses anthropogenic inputs in the form of chemical fertilizers, pesticides, and modified genetic material. Changes to soil chemistry through fertilizer and pesticide concentrations, as well as alteration of ecosystems through introduction of genetic material all influence the wellbeing and health of humans and other living beings. Agricultural infrastructure (e.g., access roads and networks for delivery of products), immovable irrigation infrastructure, dam construction for access to water resources, as well as wind and solar energy infrastructure for exploiting groundwater resources, all contribute to changes in the ecosystems.

Agriculture both contributes to and is seriously influenced by climate change. It leads to GHG emissions by decreasing carbon sinks (via deforestation and wetland conversion), contributing to methane emissions (via rice cultivation and ruminant livestock), releasing nitrous oxide through nitrogen fertilizers, and emitting carbon dioxide via machinery and transport. In turn, as a result of climate change, agriculture is subjected to changes in water availability, increased exposure to heat stress, changed distribution of pests and diseases, increased leaching of nutrients from soil, greater soil erosion from stronger winds and rainfall, and an increased frequency of wildfires.

Flows and balances of nutrients and their contribution to soil fertility are critical to agricultural production. Globally, human society has led to cycling of nitrogen and phosphorous, and caused an imbalance in these nutrients which is leading to environmental problems such as soil degradation and loss of soil fertility. Improving nutrient efficiency in crop and animal production is integral to mitigating this problem.

[1] United Nations (2012). Rio+20 outcome document, "The Future We Want". Available from http://www.uncsd2012.org/thefuturewewant.html

With livestock production, growth and productivity gains are frequently achieved through the use of antibiotics, hormones, genetic material, and intensive feeding practices. Bacteria in poultry litter, veterinary antibiotics, anti-parasitic medicines and hormones are just a fraction of the contaminants that are introduced to the environment through livestock production. The cumulative effect of releases from livestock production and agriculture make monitoring of the environmental consequences a pressing need.

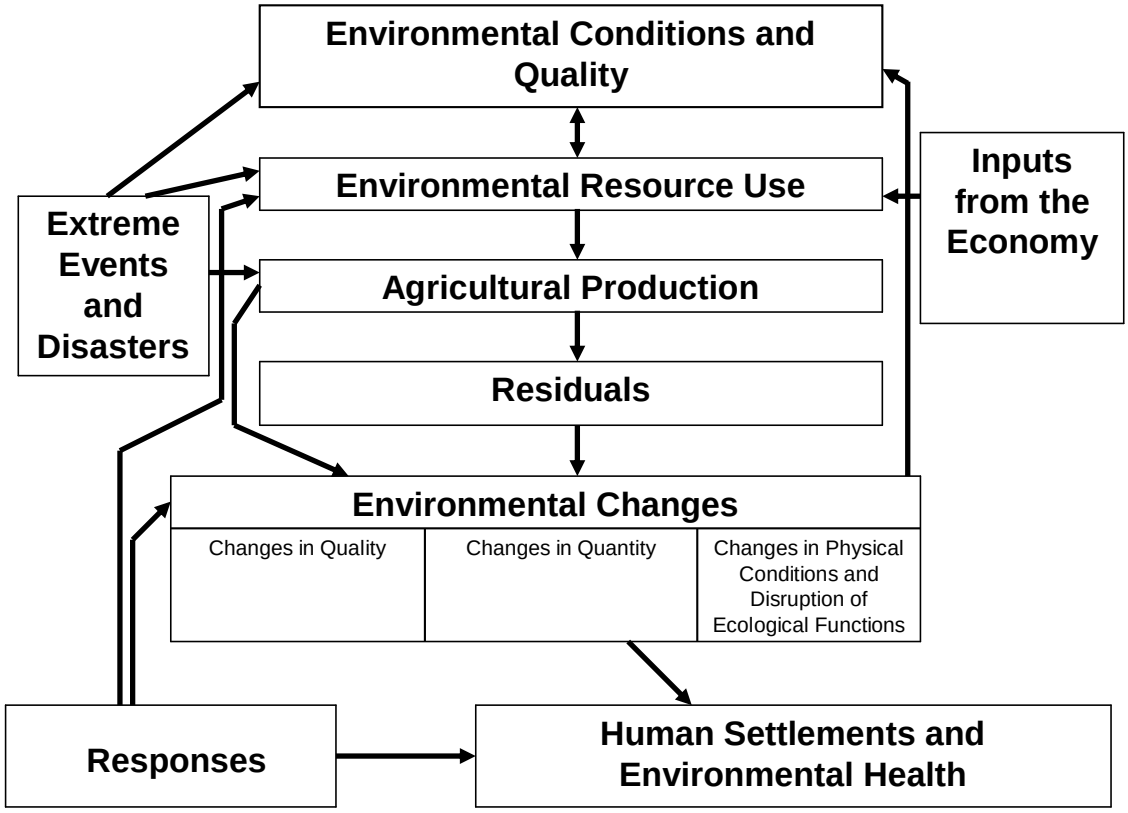
The overall picture of the impacts of agricultural on the environment is one which all countries need. The development and on-going support of an agri-environmental statistics system at country level is imperative to monitor the changing interactions of agriculture and the environment and ultimately to ensure sustainable agricultural production. The following section describes the latest developments in building an environmental statistics system.

III The Framework for the Development of Environment Statistics (FDES)

The FDES is a statistical framework which can help in organizing the collection and compilation of environment statistics. A revision of the FDES (1984) has been undertaken, with the new version being adopted at the 44th session of the United Nations Statistical Commission in 2013[2]. The FAO was a member of the Expert Group who contributed to the FDES revision. The relations between agriculture and the environment are shown in figure 1., which illustrates the major components of the FDES.

Figure 1. The relations between agriculture and the environment *(source: UN FDES, 2013)*

[2] http://unstats.un.org/unsd/environment/fdes.htm



The FDES organizes environment statistics in a simple and flexible manner into components, sub-components, statistical topics and individual statistics, using a multi-level approach. The six FDES components are:

- **Environmental conditions and quality** (FDES Component 1) largely determine the agricultural potential of a country, for these environmental conditions (such as climate and weather, hydrological conditions, terrain, soil types and fertility levels etc.) actually provide the basic ecological support for agriculture.
- **Agricultural production uses environmental resources** (FDES Component 2) such as land, soil, water and energy. In this use the resources are modified both qualitatively and quantitatively, for example water can become polluted and overused compared to locally available stocks, or nutrients from soil can be depleted and would require replenishment by artificial means.
- **Agricultural processes generate different kinds of residuals** (FDES Component 3). Emissions to water occur from the use of agrochemicals. Also important, particularly in terms of contributing to climate change, are the agricultural emissions to air and atmosphere resulting from both land use change associated with agriculture (i.e., deforestation), from the use of fossil fuels for energy and transportation in agriculture, and from livestock digestive functions (methane). The application of and the residuals from substances in agriculture such as fertilizers and pesticides are an environmental health concern. Residuals in soil from the use of agrochemicals play an important role in determining its quality, productive capacity and pollution levels.

- **Extreme events and natural disasters** (FDES Component 4) can also affect environmental resource stocks and therefore their use, as well as the production and yields of agriculture and livestock.
- **Human settlements and environmental health** (FDES Component 5). Of particular importance are human health problems related to waterborne and airborne diseases as well as toxic substance exposure and its consequences on health. The use of toxic substances in agriculture such as those found in pesticides (fungicides, herbicides, insecticides, rodenticides, etc.) and their potential appearance in food are important environmental and health concerns.
- **Information on the responses of society aimed at protecting, managing, and restoring environmental resources** (water, energy, soil and land) and at reducing the negative environmental impacts of agricultural activities is important (FDES Component 6). The relevant information about environmental protection expenditure, economic measures, actions and programmes aimed at protecting and restoring soil and water functions to sustainable levels, as well as promoting organic and sustainable agriculture, cleaner energy production and efficiency in agriculture, is significant. These social efforts can diminish the negative impacts and effects of agriculture on the environment and human health, and depending on the magnitude of impacts over time and across space, they could even restore the environmental quality and conditions and ensure the sustainable use of environmental resources.

Each of the FDES components is broken down into sub-components and in turn contains the relevant statistical topics. The statistical topics represent the measureable aspects of the components of the FDES taking into consideration the types and sources of data needed for their description. The FDES list the most important environment statistics needed to describe the statistical topics, thus giving guidance to countries when they develop their environmental statistical programme. The basic set of statistics, Core set (Tier 1) are the high priority statistics and are relevance to most countries. Tier 2, includes environment statistics that are of priority and relevance to most countries but need more investment in time, resources or methodological development. Tier 3, includes environment statistics which are either of less priority or require significant methodological development. The basic set of statistics is designed with enough flexibility to be adapted to countries' environmental concerns, priorities and resources.

As can be seen in an extract from FDES, Sub-component 2.5: Biological Resources, (see figure 3.) the items highlighted in bold text (Area harvested, Area planted, etc) are considered the Tier1, priority items for data collection.

Figure 3. **Sub-component 2.5: Biological Resources**

Sub-component 2.5: Biological Resources

Topic 2.5.3: Crops	2.5.3.a: Main annual and perennial crops **2.5.3.a.1: Area harvested** **2.5.3.a.2: Area planted** **2.5.3.a.3: Amount produced** *2.5.3.a.4: Amount of organic production* *2.5.3.a.5: Amount of genetically modified crops produced* 2.5.3.b: Amount used of: **2.5.3.b.1: Natural fertilizers** (e.g., manure, compost, lime) **2.5.3.b.2: Chemical fertilizers** **2.5.3.b.3: Pesticides** 2.5.3.c: Monoculture / resource-intensive crops 2.5.3.c.1: Area being used for production …

The FDES was developed to be compatible with other statistical and analytical frameworks such as The System of Environmental and Economic Accounts (SEEA), the Driving force – Pressure – State – Impact - Response framework (DPSIR), etc.

IV FAO's Agri-environmental Datasets, Statistics and Indicators

In recent years with environmental issues being raised higher up the global statistical agenda, more attention has been placed on the datasets and indicators related to the environment. FAOSTAT and the underlying datasets have traditionally focused on the production and trade aspects of food and agriculture for food security. With the understanding that agri- environmental sustainability is key to long term food security, more attention is now being played to developing agri-environmental indicators and datasets to monitor these issues.

The FAO has been working closely with the OECD and Eurostat in the development and convergence of agri-environmental statistics and indicators. The OECD has published the Environmental Performance of Agriculture in OECD Countries since 1996[3]. This publication is the fourth volume of the series on Environmental Indicators for Agriculture which examines performance across OECD countries in terms of environmental themes: soil, water, air, biodiversity, farm management and agricultural inputs. The Eurostat and OECD agri-environmental datasets do not include indicators from developing countries and therefore global or regional comparisons are not possible.

The work with EUROSTAT and OECD has led to the development of a new Agri-Environmental dataset[4] in FAOSTAT, which was released in May 2013, based primarily on data available in FAO (FAOSTAT, FAO Forest Resources Assessment[5]; AQUASTAT[6]). The

[3] http://www.oecd.org/tad/sustainable-agriculture/agri-environmentalindicators.htm
[4] http://faostat.fao.org/site/674/default.aspx
[5] http://www.fao.org/forestry/fra/
[6] http://www.fao.org/nr/water/aquastat/main/index.stm

indicators have been produced in-line with the agri-environmental indicators frameworks developed by OECD and EUROSTAT. Each indicator is described by different data series (see Annex 1. for the full list). The following topics are covered by the indicators are:

- Air & Climate Change;
- Energy (use in agriculture and bio-energy production);
- Fertilizers Consumption;
- Land (area, use-change, irrigation, conservation, cropping patterns, organic, protection)
- Livestock density;
- Pesticide use;
- Soil (erosion, degradation and carbon);
- Water use.

In developing this new FAOSTAT Agri-environmental indicators database, the high statistical data demands needed to create such a database became very apparent. It is very easy to develop a long list of agri-environmental indicators, however suitable quality country data is often not available to compile these indicators. For example, one of the important agri-environmental indicators for developed countries with an intensive agriculture is the Nitrogen balance in Agriculture – (kg N per ha agricultural land). This indicator provides an insight into the links between agricultural nitrogen (N) use, losses of N to the environment, and the sustainable use of soil N resources; it indicates the total potential risk to the environment (air, water and soil). Calculating the Nitrogen balance in agriculture is not easy, as it has high data demands. Data are needed on the inputs: fertilizers; livestock manure; biological nitrogen fixation; atmospheric deposition of nitrogen compounds; other inputs (seeds, planting material, etc), as well as the outputs: marketed crops; non-marketed fodder crops and grass, in order to calculate it.

The suite of agri-environmental indicators in the FAOSTAT database has a very developed country perspective as the indicators are essentially those used by OECD and Eurostat in their policy and monitoring activities. It is a concern that the agri-environmental indicator needs of developing countries are not fully reflected in the current suite of indicators.

The FAO Medium Term Plan and Programme of Work and Budget 2014-15[7] includes a new Strategic Objective 2 "*Increase and improve provision of goods and services from agriculture, forestry and fisheries in a sustainable manner.*" There is now a need for FAO to be able to monitor and report on this new Strategic Objective. During 2014, FAO will be reviewing the current list of agri-environmental indicators, taking into account the revised FDES, the lessons learned from developing the new FAOSTAT Agri-environmental indicators dataset and inputs from countries to ensure that regional agri-environmental issues are addressed.

[7] http://www.fao.org/docrep/meeting/027/mf490e.pdf

V Current activities and Future Directions for Improving Environment Data and indicators

The FAO Statistics Division reviews annual country data questionnaires to ensure they collected data on relevant policy and monitoring issues and are consistent with international statistical standards, etc. The Land use questionnaire has recently under-gone a revision and now includes items on land used for organic production and land in conversion to organic production. By adding the organic area and the area in conversion to organic production, additional valuable information will be made available to policy analysts and makers on this farm management practice. In addition, the Land use questionnaire has included items that are necessary for calculation of Green House Gas emissions from Agriculture (GHG) such as a detailed land-use change matrix. The adoption of The System of Environmental-Economic Accounting (SEEA)[8] by the United Nations Statistical Commission has led to a revised classification in the Land use questionnaire.

The 1998 Rotterdam Convention was established in order to monitor and control the trade in certain hazardous chemicals and pesticides entered into force in 2004, with specific Harmonized System Codes[9] being created for most of the chemicals in the Convention. The FAO Statistics Division has now included the trade in the chemical and pesticides listed in the Rotterdam Convention in FAOSTAT[10]. The dataset provides, by country the import quantity and values and export quantity and values of the hazardous pesticides in the Rotterdam Convention, which allows greater monitoring by countries.

The FAO has long maintained global datasets on agriculture and forestry that constitute a valuable resource for calculating GHG inventories. A new domain on greenhouse gas (GHG) emissions has just been released in FAOSTAT[11]. This is intended as the first in a range of services aimed at agri-environmental indicators, to help member countries enhance their capacity to identify, assess and report environmental statistics. The newly added GHG database offers a complete time-series of emission statistics for all countries over the period 1990-2010. It provides countries with vital, regularly updated information to help them consistently identify, assess and report GHG emissions from their agriculture, forestry and other land use sectors, as part of the activity data they already report to FAO.

[8] http://unstats.un.org/unsd/envaccounting/seea.asp
[9] http://www.pic.int/home.php?type=t&id=234
[10] http://faostat.fao.org/site/423/default.aspx#ancor
[11] http://faostat3.fao.org/home/index.html#DOWNLOAD

The emissions estimates are computed from FAOSTAT activity data following the internationally approved methodology for GHG reporting developed by the Intergovernmental Panel on Climate Change (IPCC). Progress made thus far includes a robust technical peer review of the GHG database from dozens of experts at FAO and around the world. The GHG data are now open to the public, facilitating feedback from countries.

Within the framework of the Global Strategy for Food and Agriculture Statistics, FAO's Statistics Division will play an active role in the development of agri-environmental indicators that will be relevant and useful to its member countries within Asia and the Pacific. The Statistics Division's CountrySTAT[12] Programme will also be able to serve as a vehicle for the formation of partnerships with national statistical offices and ministries of agriculture of the region for promoting and developing agri-environmental statistical systems and for building national capacities at the country level.

The Statistics Division will coordinate the review of databases at FAO and the assessment of country statistics not reported by FAO for their potential contribution in the development of environmental indicators. The Division, working in partnership with countries, will guide the development of a set of environmental indicators which will reflect the critical linkages between agricultural activities and environmental impacts and will set standards for inter and intra country comparison of environmental statistics in the region. The linkages would encompass both the positive and negative impacts on agriculture and on the environment and adverse consequences of man-made environmental damages on agriculture.

One of the main concerns is that the current suite of agri-environmental indicators in FAOSTAT do not reflect the agri-environmental statistical monitoring needs of developing countries and in particular critical agri-environmental issues in Africa.

APCAS members are asked to express their views on:

- What are the critical agri-environmental issues in the region?
- The completeness and suitability of indicators included in the new suite of Agri-environmental indicators in FAOSTAT;
- The capacity of countries to produce the basis statistical data required for the indicators and what specific support is needed to do so?

Queries may be addressed to: Robert.Mayo@fao.org or Resource-Statistics@fao.org

[12] http://www.fao.org/economic/ess/countrystat/en/

Annex 1. FAOSTAT Agri-Environmental Indicators

Domain	Indicator
Air & Climate Change **Ammonia emissions**	Ammonia (NH3) emissions from agriculture as a % of total NH3 emissions
Energy **Energy use in Agriculture and Forestry**	Agriculture and forestry energy use as a % of total energy use
Bioenergy production	Bioenergy production as a % of total renewable energy production
Fertilizers Consumption **Nitrogen Consumption**	Nitrogen nutrient use per arable and permanent crop area (N tonnes / 1000ha)
Phosphate Consumption	Phosphate nutrient use per arable and permanent crop area (P205 tonnes / 1000ha
Nitrogen and Phosphate	Nitrogen and Phosphate nutrient use per arable and permanent crop area (N = P205 tonnes / 1000ha)
Land **Agricultural area**	Agricultural area as a % of land area
Agricultural area use change	Changes in agricultural area (% per year)
Area equipped for irrigation	Area equipped for irrigation as a % of agricultural area
Conservation agriculture	Conservation agriculture area (>30% ground cover) as a % of agricultural land
Cropping patterns	Permanent crops area as a % of agricultural land
	Permanent meadows and pastures area as a % of agricultural land
	Arable land area as a % of agricultural land
Organic agricultural area	Organic area as a % of agriculture land
Protected land area	Protected terrestrial area as % of land area
Livestock **Livestock Density**	Livestock total per hectare of agricultural area – (livestock total number / ha)
Cattle and Buffalo	Cattle and buffalo as % of total livestock
Pigs	Pigs as % of total livestock
Sheep and goats	Sheep and goats as % of total livestock
Poultry birds	Poultry birds as % of total livestock
Pesticides Use	Pesticide use per arable and permanent crop area (tonnes / 1000ha)
Soil **Soil erosion-GLASOD**	Average soil erosion expressed in GLASOD erosion degree
Land degradation-GLASOD	Average land degradation expressed in GLASOD erosion degree
Carbon in topsoil	Average carbon content in the topsoil as a % in weight
Water use in agriculture	Water withdrawal for agricultural use as a % of total water withdrawal