



Application of the System of Environmental Economic Accounting (SEEA) Central Framework and SEEA Experimental Ecosystems Accounting at FAO: Preliminary Findings and Ongoing Work

Robert Mayo

Statistics Division, Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Robert.Mayo@fao.org;

Carl Obst

Consultant to the Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Carl_Obst@me.com

Gary Jones

Statistics Department, International Monetary Fund
700 19th Street, N.W.
Washington DC 20431, USA
gjones@imf.org

ABSTRACT

The FAO Global Strategy to Improve Agricultural and Rural Statistics (GS) seeks to achieve a significant improvement in the quality, reliability and cost-effectiveness of agricultural statistics in developing countries. Identifying appropriate indicators and collection methods for agri-environmental data is directly related to implementing the System of Environmental-Economic Accounting 2012: Central Framework (SEEA-CF). There are also synergies with several other GS thematic domains including:

- Improving the methodology for data analysis, “to inform policy decisions and monitor their impact on household incomes, rural development, and the environment”;
- Improving the methodology for using administrative data, by identifying “where, how, and under which conditions administrative data can be used for producing agricultural, rural, and agri-environmental statistics”;
- Creating an appropriate reference framework for mainstreaming agriculture into the national statistical systems, which overlaps with country-level SEEA-CF implementation and its

recognition that the development of an accounting framework, the establishment of the relevant statistical infrastructures, and the organization of information are key tasks that cannot be completed within a single agency.

Moreover, the thematic domains of Better integration of geographic information and statistics (connecting economic and social indicators to land use), Improving the methodology for using remote sensing (land use and land cover monitoring), and; Identifying the most appropriate master frame for integrated surveys (the capability to link the farm characteristics with the household and then connect to both the land cover and use dimensions); pertain directly to application of the accounting framework proposed in SEEA Experimental Ecosystem Accounting, which provides a complementary organisation of environmental-economic data to that outlined in the SEEA-CF. This paper will outline on-going work by FAO, in collaboration with national authorities and international partners, to advance SEEA methodology for the compilation of internationally comparable environmental-economic accounts for the agriculture, forestry, and fisheries sectors. Emphasis is placed on describing the on-going development of a data management and analysis application in FAOSTAT aligned with the SEEA-CF as well as a set of SEEA-based indicators that can support monitoring the development outcomes articulated in FAO's five strategic objectives.

Keywords: System of Environmental-Economic Accounting, agriculture, forestry, fisheries, SEEA-AGRI, FAO strategic objectives; FAOSTAT.

1. Introduction

The endorsement of the System of Integrated Environmental and Economic Accounting (SEEA) Central Framework by the United Nations Statistical Commission in March 2012 provided the first international statistical standard for environmental-economic accounting. This standard is an important step forward in integrating information on economic activity and the environment to better understand implications pertaining to the sustainability of different patterns of production and consumption. This paper describes work being initiated by the Statistics Division of FAO to develop an extension to the SEEA Central Framework that captures the specific relationships between the agricultural sector and the natural environment. This is defined as the System of Environmental-Economic Accounting for Agriculture (SEEA-AGRI). Within this framework, agriculture is interpreted in the broad sense as all activities related to crops, livestock, forestry and fisheries with a primary and intensive use of environmental goods and services. This is different from other extensions (subsystems) of the SEEA Central Framework in the sense that rather than focusing on one specific *resource* (such as water, or energy), SEEA-AGRI focuses on a *group of activities*, and considers the relationship between these activities with the related environmental assets.

The paper provides a brief overview and discussion of some of the key issues that emerge for the construction of such a system. It is organized in five sections. The first three sections explain the need and merits of an integrated approach as well as the linkages with other complementary systems. Section four defines the aim and scope of the proposed framework and in section five the preliminary development is outlined and points with regard to the approach and feasibility of country implementation of the SEEA-AGRI are discussed.

2. The need of an accounting framework for agriculture and the environment

The System of National Accounts (SNA) consists of a coherent, consistent and integrated set of macroeconomic accounts which constitutes the primary source of information about the economy and is now widely used for analysis and decision-making in virtually all countries. While it provides practical measures of macroeconomic performance, the SNA does not incorporate the full costs and

benefits to society of economic activities. One of the main shortcomings of the SNA is that the inputs from the environment to the economy and the effects of economic activity on the environment have not been readily identifiable within the economic accounts generated. The SEEA Central Framework augments traditional national accounts to integrate economic and environmental statistics in an internationally agreed manner that allows for an evaluation of the environmental sustainability of economic activity.

There are two main groups of reasons that justify the use of an accounting framework for agriculture and the environment based on the SNA/SEEA structure: reasons related to the need to unravel the relationships between agriculture and the environment, and reasons that deal with the methodological and statistical enhancements to be derived from exploiting an established analytical accounting framework.

When exploring the *relationships between agriculture and the environment*, conventional accounts only cover the economic performance and functions of agriculture as reflected in market activities and their evolution over time. In that context, the SEEA Central Framework is a useful tool for organising additional information to evaluate the environmental sustainability of those industries and activities making extensive use of natural resources, either as inputs or as sinks. On the one hand, the relationship between the environment and agriculture is such that natural environments provide a form of infrastructure and a flow of economically valuable and critical environmental assets such as land, soil and water to agricultural activity. On the other hand, agricultural activities may contribute significantly to soil erosion, land degradation and water quality changes.

An important distinction to be made is between those assets that can be attributed to agriculture, and those that cannot. From there, two types of accounting adjustments may be distinguished for agricultural assets. The first would focus on the services derived from the land based stock of assets (habitat and species, landscape, etc). The second would consider the impact of agricultural activities on the ability of these assets to provide environmental services (e.g. sink functions), either by modifying the quality or quantity of the assets being considered.

From a *methodological perspective*, applying the SEEA Central Framework to agriculture will help improve the conceptual basis and analytical capability of agriculture statistics, which is the goal of the Global Strategy to Improve Agricultural and Rural Statistics (GS).¹ The SEEA-AGRI can play an important role in many aspects relating to the implementation of the GS, among others, three are of special importance. First, adopting a macroeconomic accounts approach for developing a statistical framework has the advantage of applying a set of SNA-based standard classifications upon which consistent and comprehensive sets of data series can be compiled. Second, the resulting accounts can provide a complete set of variables for identifying and designing a core and minimum set of agricultural indicators, aligned with the SEEA Central Framework, and applicable across a wide range of developing and emerging market economies. Third, a macroeconomic accounts approach for a statistical framework also responds to the need of having a multipurpose information system that can be used to combine and harmonize data from various surveys, censuses and administrative sources together into an integrated database that supports policy making and analysis.

3. Integrating agriculture activities in one framework

Primary activities rooted in the physical environment (e.g. agriculture, forestry and fishing), are often major sources of countries' wealth. Agriculture as defined by the International Standard

¹ See <http://www.fao.org/economic/ess/ess-capacity/ess-strategy/en/>

Industrial Classification of All Economic Activities (ISIC) includes the exploitation of vegetal and animal natural resources, comprising the activities of growing of crops, raising and breeding of animals, harvesting of timber and other plants, animals or animal products from a farm or their natural habitats. ISIC revision 4, Section A, is divided in three Divisions: (01) Crop and animal production, hunting and related service activities; (02) Forestry and logging; and (03) Fishing and aquaculture (UNSD, 2008).

There are at least two important reasons for the inclusion and integration of agricultural activity in one accounting framework. The first is that *the three Divisions under ISIC revision 4, Section A represent activities that are major users of one or more environmental assets*, in particular soil, water, biological resources, land and ecosystems. These activities as a whole (including livestock grazing in the case of agriculture and aquaculture in the case of fishing) might occupy a significant portion of the economically available (exploitable) land in developing countries.² Furthermore it is not unusual to find farms that are engaged in more than one of these activities and it is not uncommon for agricultural surveys and censuses to include some information about these activities. As a result, the benefits of evaluating and monitoring the rational and sustainable use of the environment vis-à-vis these activities in an integrated accounting framework is invaluable for medium to long-term policy formulation for agricultural, land use and related environmental and ecosystem issues.

The second reason is that *the three Divisions under ISIC revision 4, Section A are strongly related to basic population needs* (food, energy, shelter and other raw materials). Thus, it is strongly advisable to explore the potential of the SEEA Central Framework to agriculture in order to include and address important issues related to food security. The need for integrated and cross sector information that can be useful for decision making in a complex and globalized world is a challenge that can, in large part, be addressed from an extension of the SEEA Central Framework to agriculture.

Also, the three Divisions in Section A cover activities that are the source of employment for large sections of countries' populations, especially in rural areas. Information on the sustainability of these activities thus relates directly to the potential to the sustainability of employment of these people.

The SEEA-AGRI envisaged by FAO would have the potential to consistently analyse important trends and give insights about relevant environmental, economic and social issues such as the increase of water demand and abstraction, land use changes, forest clearing, etc., at the macro and national level. Furthermore this information could be related to the physical food balances and other types of analysis elaborated by FAO in order to assess the impact of such phenomenon on food security.

4. Scope and coverage of SEEA-AGRI

The SEEA-AGRI can be defined as a comprehensive and standard satellite account for the integration of agricultural and environmental data based upon internationally agreed concepts, definitions, classifications and inter-related tables and accounts that are universally relevant, regardless of the stage of economic development reached by the country.

² The SEEA identifies as an environmental asset agricultural land distinguishing between i) cultivated land (for temporary crops, for permanent plantations, for kitchen gardens and temporarily fallow land); ii) pasture land (improved and natural); and iii) other agricultural land. Additionally, the SEEA recommends compiling information about irrigated land in order to establish water abstraction from agricultural production, even if this abstraction may not be associated to an economic or market transaction.

The SEEA-AGRI aims to translate policy issues into data needs and requirements in a standard and coherent manner by:

- Enhancing the use of existing agricultural statistics and related common frameworks (supply and utilization tables and food balances, etc.) through the integration of basic statistics consistent with the SNA;
- Providing a consistent, comprehensive, and coordinating framework to link data collected by different surveys, censuses and administrative sources together to build up an integrated database;
- Providing a sound basis for the measurement of a set of economic, social, and environmental indicators for agriculture and rural development aligned with FAO's narrow and broad definitions of agriculture, respectively;
- Providing a framework to expand the analytical capabilities of the original FAO SEAFA and related past FAO initiatives (Fishery and Forestry Accounts);
- Providing a framework that links to other SEEA subsystems being articulated by other agencies (Ecosystems, Water, Energy, etc.).

When looking at agricultural activities within the evolving SEEA-AGRI, agriculture interpreted in a broader sense (i.e. crops, livestock, forestry and fisheries), can be placed at the centre of the analysis, allowing for the assessment of the interactions with other sectors, but concentrating on looking at the particular indicators pertaining to environment-economy relationships. This framework can be considered an extension or application of the SEEA Central Framework, one with a primary and intensive use of environmental goods and services (Figure 1). This is different from other subsystems of the SEEA in the sense that rather than focusing on one specific *resource*, it focuses on one *group of activities*, and considers the relationship between these activities and the related environmental assets. Thus, specific aspects of other, more resource based accounts (e.g. water accounts) are used in the SEEA-AGRI.

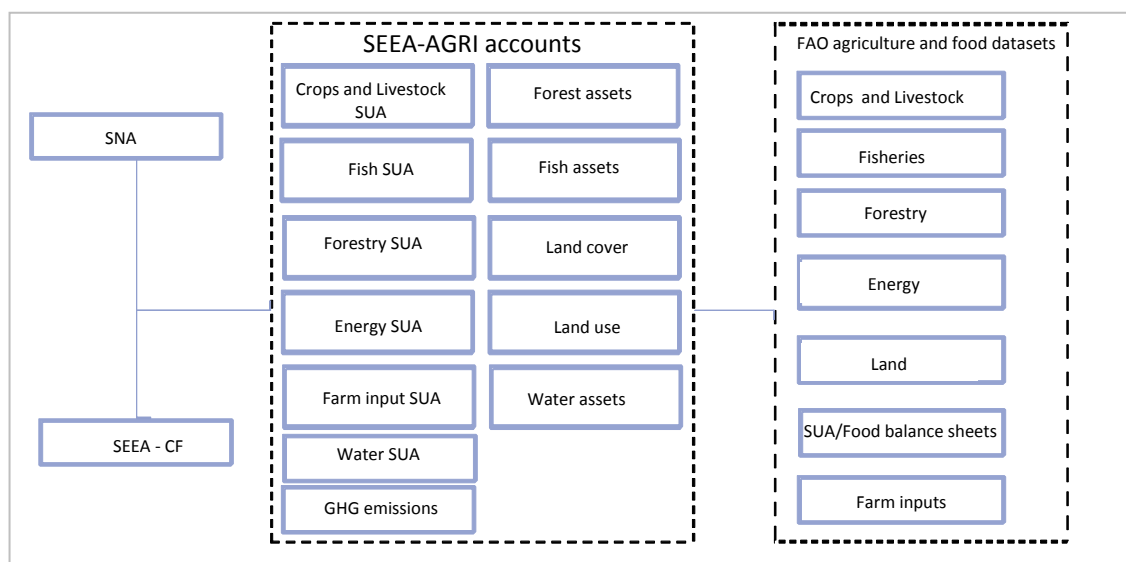


Figure 1: The SEEA-AGRI using SNA/SEEA and FAO datasets

As shown in Figure 1, on one side, the SEEA-AGRI links to the SNA and SEEA Central Framework and its strengths while providing new elements of analysis which are not necessarily incorporated in the Central Framework (in figure 1 only some specific SEEA and some existing FAO accounts and datasets are shown). In turn, the SEEA Central Framework and its other subsystems provide elements that are of interest for the SEEA-AGRI (e.g. water abstraction and

consumption for agricultural activities). On the other side, FAO's datasets and frameworks, mainly Production, Resources, Food Balance Sheets (FBS) and Supply and Utilization Accounts (SUA), among others, may be completely integrated in the SEEA-AGRI tables and accounts. Furthermore, previous SNA-based FAO efforts (e.g., System of Economic Accounts for Food and Agriculture (SEAFSA)) may be conceptually incorporated into SEEA-AGRI. The relationship of the agriculture related accounts (SEAFSA, SUA, FBS) and the environmental related accounts (e.g., SEEA-Water, SEEA-Ecosystems, and FAO's recent work on Agri-Environmental Indicators) highlight crosscutting themes that can be addressed when integrating the frameworks.

In order to achieve a well-articulated SEEA-AGRI that allows for the broadening of analysis through physical and hybrid supply and use tables, covering flows of products, residuals, natural resources and ecosystem services, the subsystem should take into account different categories of accounts of the Central Framework design:

- **Asset accounts.** These incorporate different natural assets and its changes during the accounting period in physical and monetary values. They are relevant to the measurement of sustainable development from a natural capital perspective. They also help to determine where income is arising from the use of resources and how it is apportioned between the extractor and the owner. Thus, they are relevant to the intra- and inter-generational equity issues of sustainable development. Development of the following asset accounts is progressing: forest assets account, fish asset account, water asset account; land cover and land use accounts.
- **Flow accounts.** These are divided into physical flow accounts and combined presentations. They provide information at the industry level (or finer depending on data availability) about the use of materials as inputs to production and the generation of pollutants and solid waste. The objective is to see the extent to which agricultural activities are dependent on particular environmental inputs and the sensitivity of the environment to particular agricultural activities. The individual SUA proposed also permit examination of issues such as food and water security and might be extended to include information related to access to water and energy for example. The following flow accounts are being prepared: Crops and livestock SUA, Fish SUA, Water SUA, Energy SUA, Farm input SUA, Forestry SUA and GHG Emissions. Combined presentations are formed from structuring information from these various SUA by type of activity and also introducing other relevant data such as output, value added and employment.

For the accounts just mentioned, in many cases, measurement in physical as well as in monetary values is possible, but in other cases (i.e. most of the agri-environmental services valuation) valuation is still a subject under discussion, noting that combined indicators are usually possible within the framework. The various accounts will be integrated with the work on Agri-environmental indicators, as the indicators for the most part will flow from the accounts.

5. SEEA-AGRI developments

The United Nations Committee of Experts on Environmental Economic Accounting (UNCEEA) and the London Group on Environmental Accounting (LG) are the best forums for review and discussion towards development of agri-environmental accounting.³ In that context, FAO Statistics Division is working with the LG — establishing a SEEA-AGRI Subgroup — to advance (and mainstream) the methodologies on environmental-economic accounting to food and

³ Additional information on the London Group and the UNCEEA in:
<http://unstats.un.org/unsd/envaccounting/londongroup/> <http://mdgs.un.org/unsd/envaccounting/ceea/default.asp>

agricultural statistics and the related databases maintained across FAO. The development of the SEEA-AGRI is supported by establishment of a working sub-group under the umbrella of UNCEEA/LG and a FAO-specific interdepartmental Task Force that will work to address specific issues and take the leading role in developing guidelines and recommendations. The SEEA-AGRI development strategy has been presented and discussed at the UNCEEA, London Group, the FAO regional statistical meetings such as the Asia and Pacific Commission on Agricultural Statistics (APCAS) and the FAO-OEA/CIE-IICA Working Group on Agricultural and Livestock Statistics (IICA).

Within this framework the SEEA-AGRI should ensure consistency in the classifications, concepts, definitions and policy applications through extensive and timely consultations with partner countries and at the international level. This collaboration with national experts and other specialists will facilitate piloting the SEEA-AGRI among selected countries in Africa, Asia, and the Latin America/Caribbean region. These possible country applications of an evolving SEEA-AGRI will assist in addressing those methodological aspects that still need to be resolved within the SEEA Central Framework in the context of countries where data are not necessarily accessible in terms of quantity and quality. The initial work involves relying on current data collected and available to FAO (mainly internal FAO datasets, sourced from national statistical reporting to FAO). This approach to developing the initial tables will provide us with a good indication of the possibilities of putting together the SEEA-AGRI from current data.

Development of the SEEA-AGRI accounts: The following Flow accounts are being prepared: Crops and livestock SUA; Fish SUA, Water SUA, Energy SUA, and Farm input SUA. The accounts follow the standard SEEA-Central Framework structures and principles. The various SU accounts will follow the general structure of that illustrated for maize in Table 2. These accounts are currently being prepared for all crops and livestock products for all countries and from the year 2002 to currently available data. Asset accounts: Forest Assets account; Fish Assets account; Water asset account; Land cover and land use accounts are also being prepared.

Once each of these accounts has been populated during an initial phase using data in existing FAO datasets a full stock-taking of data issues, conceptual and methodological problems is to be undertaken. Further phases in the SEEA-AGRI will be planned on the basis of these assessments.

An important aspect to be investigated is the coherence between information from an asset perspective and from a flow perspective and across different information within the same activity. For example, investigation will be needed of coherence between land use, production statistics, water use and energy use for different crops. A strength of the SEEA is the provision of an integrated framework for data confrontation. In this context, reviewing, revising and expanding the definitions and classifications used in relevant FAO datasets is an essential element of FAO efforts aimed at developing a SEEA-AGRI framework.

Similarly, a stock taking and evaluation of developing and emerging market country specific examples in terms of Agriculture, Forestry, and Fisheries accounts, respectively, that can inform and serve as an input to SEEA-AGRI development will be conducted. Alignment with other SEEA extensions and relevant regional (e.g., E.U.) work will also be established. This involves development of the related physical flow, environmental activity, and asset accounts for land, water and energy, as relevant, along with a preliminary articulation of an integrated presentation of these. Where appropriate, relevant elements of the additional portions of the SEEA, namely Experimental Ecosystem Accounting and relevant thematic documents - SEEA Water and SEEA Energy - will be used to expand and elaborate on the methodological guidance included in the SEEA Central Framework. A key feature of this initiative is the leveraging of diverse FAO datasets, datasets maintained by national authorities available on-line, and data of other international organizations

and their standardization to common SEEA-related concepts and definitions pertaining to the agriculture sector, broadly defined as crops, livestock, aquaculture and agroforestry.

Pilot application and feedback: FAO will work with pilot countries from various regions. Pilot applications will illustrate the data demands, technical capabilities, and the analytical possibilities to be derived from the *minimum required*, *recommended*, and *desired* SEEA-AGRI datasets to be outlined in the final document prepared.

It is expected that a final draft SEEA-AGRI will be ready by the end of 2014 and then be submitted to the FAO governing bodies and subsequently to the United Nations Statistical Commission.

One of the characteristics of the SEEA is its implementation flexibility. A core *minimum required* dataset for agriculture should be conceived as a complete system which is internally consistent with the Central Framework, but designed such that it can be implemented equally well in part or in whole. Depending upon the specific issues faced, a country may choose to implement only a selection of the accounts included in the SEEA-AGRI. Even if a country desires eventually to implement the full *desired* dataset system, it may decide to focus its initial efforts on those accounts that are most relevant to the issues it wishes to address.

One of the main concerns is that a great deal of data may be required to implement the accounts pertaining to a *minimum required* dataset SEEA-AGRI and these data may not completely exist in many developing and emerging market countries. The FAO Global Strategy to Improve Agricultural and Rural Statistics (GS) will be developing Agri-Environmental indicators linked to recommended core data collections and these will need to be harmonized with the SEEA-AGRI developments. Furthermore, the accuracy of the data collected is usually filled with uncertainties. These are known shortcomings of the basic data and core indicators currently provided by countries already managed at the global level by FAO and published through FAOSTAT.

The proposed scope and coverage of the SEEA-AGRI being developed will benefit from contributions from countries and users, especially with regard to the development of indicators for specific Agri-environmental policy issues. The authors welcome such contributions in the development of the SEEA-AGRI.

Table 1: The SEEA-AGRI and the linkages with the dimensions of the Global Strategy to Improve Agricultural and Rural Statistics

Dimensions of agricultural statistics data requirements				
	Asset accounts (SNA)	Flow accounts	Expenditure and transaction accounts	Macroeconomic aggregates and indicators
Economic dimension				
Crops and livestock	Product stocks and resource stocks, as well as capital stock such as equipment, buildings, irrigation systems.	Inputs for production, outputs from production, agroprocessing, prices, final consumption. Value of imports and	International transfers, government expenditures, private expenditures, rural expenditure, infrastructure expenditure.	GDP and NDP for the agricultural sector
Forestry and logging				
Fishing and aquaculture				
Environmental dimension				
Water	Changes in water quality, changes in water availability.	Abstraction and consumption of water by the agricultural sector and subsectors. Flows of pollutants emissions	Expenditures according to CEPA and CEM. Economic instruments and environmental transactions within the agricultural sector.	Adjustments of the macroeconomic aggregates. Depreciation by depletion, degradation and defensive expenditures accrued to the agricultural sector. Intensity and efficiency indicators of resource use.
Land cover and use	Changes in land cover and land use (possible to register ecosystems associated with land). Changes in landscape.	Agricultural sector land use according to subsector.		
Energy	Use of stocks of agriculture food product land for biofuels. Energy plantations	Biofuels production and consumption. Firewood use.		
Climate change	Associated with land cover and land use. Changes within agriculture (i.e. from crops to livestock)	Emissions of GHGs and energy supply and use for the agricultural sector. Firewood use.		
Soil	Changes in soil composition and attributes	Soil losses and gains according subsectors.		
Wastes		Generation of waste and disposal of wastes from agricultural activities		
Biodiversity	Changes in biodiversity due to agricultural activities.	Activities within the sector that contribute to biodiversity maintenance.		
Social dimension				
Food security	Food availability, household capital stocks	Food consumption in terms of calories and nutrients available and consumed.	Public investments	Efficiency indicators and indicators of wellbeing.
Poverty reduction		Income of rural households from the agricultural sector		
Risk and vulnerability	Capital stocks	Commodity prices.		
Gender		Sex distribution factors.		

Based on WB, UN, FAO (2011)

Table 2. Crops and Livestock Supply Utilisation Account example (1,000 tonnes).

Product	Output		Total Output	Import	Total Supply	Intermediate consumption					Household consumption	Waste	Stock Variation	Export	Total Use	
	Ag. Industry	Manu. Industry				Agricul. Ind. (Feed)	Seed	Energy Use	Manu. Industry	Processing	Other uses					Food
Maize	376	N.A.	376	1	377	293	1		132				0	-55	6	377
Maize (processed)	N.A.	132	121	24	156						9	112	11			156

REFERENCES

- FAO, Asia and Pacific Commission on Agricultural Statistics, (2012), 24th Session, Viet Nam, *Towards a System of Environmental Economics*.
- FAO-OEA/CIE-IICA working group on agricultural and livestock statistics for Latin America and the Caribbean, (2013), 26th Session, Trinidad and Tobago, *Towards a System of Environmental Economic Accounting for Agriculture (SEEA-AGRI)*.
- FAO, World Bank, United Nations, (2010) *Global Strategy to Improve Agricultural and Rural Statistics*.
- United Nations, (2008), *International Standard Industrial Classification of All Economic Activities Revision 4*.
- United Nations, European Commission, FAO, World Bank, IMF, OECD (2012) *System of Environmental-Economic Accounting 2012 Central Framework (SEEA)*.