ESA/STATISTICS/AC.228
EGM-FDES/1/6

DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS
STATISTICS DIVISION
UNITED NATIONS

Expert Group Meeting on the Revision of the Framework for the Development of Environment Statistics (FDES)
New York, 8-10 November 2010

A Framework for Environmental Statistics

Jesús Romo

General considerations

After nearly three decades of experience on environmental statistical frameworks, a consensus on the need to explicitly incorporate ecosystem concepts to them is being reached. With the revision of the Framework for the Development of Environment Statistics (FDES), the UN Statistics Division has started an important effort in that direction. This paper intends to contribute to that purpose. An outline of the structure of a possible framework incorporating ecosystems is proposed.

Ecosystem statistics provide, by definition, a compendium of conditions prevalent in each and all media comprised in a given ecosystem, without the need to measure all of them. This implies the possibility of assessing the state of the environment in a synthetic and more economic way by measuring only, for instance, top trophic level characteristics in the food chain of a particular ecosystem: if they are in an adequate condition, that would imply the health of the entire ecosystem considered. So there is no need to measure all ecosystem components. This is maybe the main reason from a practical point of view – besides, of course, conceptual clarification – to include the ecosystem dimension in the framework.

The role of an environmental statistical framework is to provide guidance for the design, construction, coordination and evaluation of environment basic statistics at national and other levels. A framework should display a conceptual structure which identifies and logically organizes the topics and variables of environmental concern and their relationships. This paper, as already said, addresses only the conceptual structure, tracing a broad outline of it.

Generally and traditionally environmental statistical frameworks are constructed as matrixes resulting from the Cartesian crossing of two dimensions:

First, in the cases of the UN FDES, the OECD – Core set of indicators – and the EUROSTAT framework, a causality dimension describing the interactions between society and the environment is used. In each case the actual components of the causality dimension are different: activities, impacts of activities, responses to impacts and inventories (AIRI?); pressure, state, and response (PSR); and driving forces, pressures, state, impacts and response (DPSIR), respectively.

Second, for the UN and the OECD frameworks the corresponding causality dimension is crossed with a media dimension (components of the environment) in the case of the UN framework, and with an environmental issues dimension in the case of OECD, giving two dimensional matrixes. The DPSIR may be crossed with several substantive environmental dimensions to provide different frameworks.

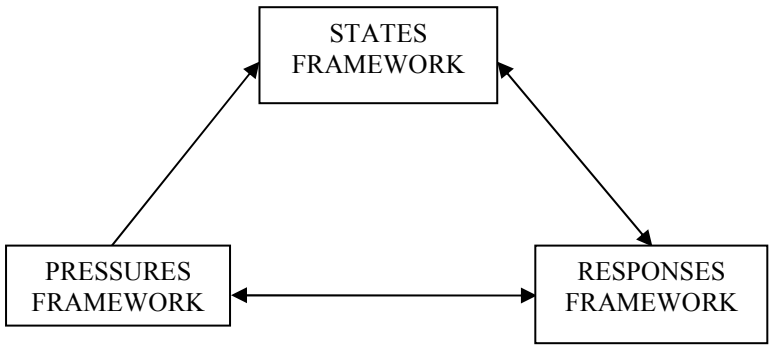
However to continue in this fashion crossing another relevant third dimension: ecosystems, will lead us to a complex – tridimensional – structure with many holes: either meaningless crossings or difficult to obtain statistics. Furthermore, the ecosystems dimension, which is not defined as a simple linear classification but by a multilayer nested structure, would complicate additionally the tridimensional framework. These reasons suggest the need to depart from the tridimensional matrix approach to incorporate ecosystems. In a different order of ideas, there is another consideration which stems from the complex structure of the ecosystem dimension and should be taken into account; it is that such dimension is especially relevant to characterize the state of the environment. This implies that crossing it with other categories of the casualty dimension maybe not worthwhile, which could help to simplify the framework.

The proposed framework

Then, in view of all that said, the framework here considered manages a structure with three related elements, corresponding to the PSR categories. Each element will be, by itself, a specific framework, one for pressure, one for state and, finally, one for response. Relationships between these specific frameworks or sub frameworks are a fundamental portion of the overall framework. The PER choice is made for simplicity, any other causality classification will do for the purposes of this paper. DPSIR will probably be the best choice for countries already there, but it requires a well developed environmental statistical system.

A graphical representation of the proposed framework, a set of three sub frameworks and their mutual relationships – not all of them two way –, is shown in FIG.1 in the next page.

FIG. 1 THE PROPOSED FRAMEWORK



The state sub framework

Two dimensions characterize the state sub framework: media and ecosystems. The components of the environment or media dimension is formed, as in FDES, for air, water, land, soil, biota (flora and fauna) and human settlements. Although boundaries for environmental statistics have to be defined elsewhere, it is assumed here that the state of the environment of interest covers, on the one hand, only that part of natural capital obtained by excluding subsoil non renewable resources, on the other, human settlements.

The ecosystem dimension is formed, as said above, by a multilayer nested structure of classifications of ecosystems at different levels or scales: at first level, terrestrial and maritime; then, at second level, for terrestrial, as an example: forest, jungle, humidals, pastures, agricultural land, human settlements, inland water; then, at third level, for forest, again as an example: conifers, latifolia, etc; and so on. Relevant ecosystem classifications have to be adjusted to each particular country, especially in the more detailed scales.

Although the idea will not be further developed here, it is maybe worth considering that any ecosystem classification implies, or could be made to imply, a spatial, at least two dimensional, distribution of particular ecosystems. So, at different scales, the spatial and ecosystem dimensions merge: ecosystems, for our purposes, give content to space. Then,

statistics with a precise spatial reference will be particularly relevant when ecosystems are considered. Also, and this will be a recurrent consideration when dealing with links between sub frameworks, it is only at the most detailed spatial level that statistics can be causally related: pressure to state, response to state and pressure.

A graphical representation of the matrix so defined, the state sub framework, is shown in FIG. 2.

FIG. 2 THE STATE SUB FRAMEWORK

		ECOSYSTEMS								
		TERRESTRIAL					MARITIME			
		FOREST			JUNGLES	…				
		CONIFERS	LATIFOLIA	…						
MEDIA	ATMOSPHERE									
	WATER									
	LAND/SOIL									
	FLORA									
	FAUNA									
	HUMAN SETT.									

TRADITIONAL MEDIA STATISTICS

ECOSYSTEM STATISTICS (SEVERAL LEVELS)

ECOSYSTEM BY MEDIA STATISTICS

The marginal rows and column of this matrix, as illustrated in FIG. 2, provide the place for traditional national statistics for each media, and for different levels, corresponding to the scale considered, of ecosystem statistical measurements. Each cell provides the place for a particular media statistics, water for example, in a particular ecosystem, forest for instance.

In general, for each media and ecosystem, stock statistics for quantity and quality have to be provided on a periodic basis, as well as statistics of the changes (both natural or man related impacts) in quantity and quality occurred in the inter periodic interval. The possibility indicated earlier of assessing the state of the environment in a synthetic and more economic way via a particular kind of ecosystem statistics could be applied here.

The pressure sub framework and its relationships

As in the previous sub framework, two dimensions characterize the pressure sub framework: human activities and type of impact.

Human activities and some natural phenomena impact the state of the environment. A classification of economic activities – production and consumption –, other human activities – non economic – and natural causes of the impacts, constitutes one dimension of this sub frame.

The type of impact constitutes the second dimension. It considers two broad categories: use of materials – consumption of natural capital – and residuals – emissions, discharges, waste – polluting the environment.

The pressure sub frame is presented In FIG.3.

FIG. 3 THE PRESSURE SUB FRAMEWORK

	MATERIALS	RESIDUALS
PRODUCTION		
AGRICULTURE		
CONSUMPTION		
OTHER HUMAN ACTIVITIES		
NATURAL CAUSES		

The cells of the matrix so defined must contain statistics describing, for a given time period, the amount in physical units and if possibly in monetary values of natural resources used – timber cut, fish captures – or of residuals impacting environment – emissions to air, discharges to water bodies, waste, etc. The spatial level of detail of

statistics will span from aggregate national statistics to local statistical information corresponding ideally to the impact of, for example, a specific industry affecting a specific ecosystem or their components.

It is only at this specific detailed spatial level, as was previously said, that the one directional causal link of pressures that impact the state of the environment can be properly identified, as in the example just considered.

The response sub framework and its relationships

Human activities are needed to maintain and restore to sustainable levels the natural capital, both in quantity and quality. Again as in the previous sub frameworks, two dimensions will be used to define the response sub framework: type of actors and place of action.

A classification by type of actors: government, industries, households, etc., whose actions represent the social response to environment deterioration, constitutes one dimension of the framework.

The place of action constitutes the second dimension: the environment, for actions oriented directly to maintain or restore it, or pressures, for actions oriented to diminish it.

A representation of the response sub framework is given in FIG. 4.

FIG. 4 THE RESPONSE SUB FRAMEWORK

	ACTIONS ON THE ENVIRONMENT	ACTIONS ON PRESSURE
GOVERNMENT		
INFORMATION GATHERING		
INDUSTRIES		
AGRICULTURE		
HOUSEHOLDS		
OTHER		

The cells of the matrix so defined must contain statistics describing, for a given time period, the actions taken to preserve or restore the environment. Response statistics are

typically produced from administrative records. The spatial level of detail of statistics will span from aggregate national statistics, useful to asses the national effort in favor of the environment, to local statistical information which should allow evaluation of the effectiveness of actions taken – be them directly on the environment or on pressures – by comparing conditions in the environment before and after those actions were performed – allowing, of course, the necessary time for them to work. For this evaluation, spatially detailed state of the environment statistics have to be available.

The two way relationships of response both to pressures and to the state of environment sub frameworks will now be considered. First, the one way relationships of the response sub framework to the corresponding sub frameworks of state and pressure have in this case been explicitly incorporated as columns, response actions on the environment to preserve or restore it, or response actions on pressure to diminish their impact, in the sub framework. Second, the links of state and pressure towards response – typically the data gathering in state and pressure necessary to design public and private policies: the social response – are also considered in the sub framework.

Final remarks

To incorporate the ecosystem dimension to a revised FDES, although necessary, will not be easy. The overlap of traditional media statistics – which for many reasons have to be maintained – with ecosystem statistics induces a high degree of repetition and complexity for any framework. I´m afraid, we will have to live with it. The outlined framework presented intends to reduce the complexity by focusing where it seems irreducible: the state of the environment, this allows a simple treatment of pressure and response. In the short and medium terms, we maybe have to live with not related media and ecosystem statistics, the marginal rows and columns of Fig. 2.

The split of the PSR framework in a set of three sub frameworks and their relationships, throws some light into the fact that only very detailed spatial statistics, for each sub framework, permit to follow the causal links between them, and, therefore, understand what is going on in a particular phenomena.

Finally, I hope this paper may help in some way other participants to design an environmental statistical framework with an ecosystem dimension.