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Notes on the structure and contents of the revised FDES

UNSD

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Preliminary, April 28, 2011

Introduction

These notes were put together by the UNSD environmental statistics team in order to provide some necessary elements for the discussions at the May 2011 EGM on the revision of the FDES. As such, the notes are preliminary and they have not been formally edited.

A first draft of these notes was discussed with some of the experts who provided valuable inputs and proposals that are reflected in these pages.

These notes are preliminary and they do not intend to propose a particular type of structure for the FDES. Instead, the purpose is to present different options for rows, columns and matrixes, as well as some illustrations of a non-matrix structure for the FDES, to be discussed during the EGM. For each option, this document briefly discusses potential advantages and disadvantages. Some key questions are proposed to provoke ideas and steer the discussion. You may identify these questions by the orange text preceded by the symbol:  .

As it will become apparent when reading and working with alternative structures, there are considerable losses and trade-offs when moving from one option of rows to another, and additional questions arise when considering their combination with different columns options. For example, when disaggregating the rows aiming to increase resolution, there is a loss with respect to the current rows characteristics of being mutually exclusive and hierarchically leveled.

Developing the structural components of the revised FDES is a complex step in the revision process. The Expert Group is expected to discuss the different options and reach an agreement on a recommended structure for the revised FDES.

1. What is a framework?

1. A framework is "an essential supporting structure of a building, vehicle, or object", and "a basic structure underlying a system, concept, or text" (Oxford dictionary). A framework can also be defined as a "basic conceptional structure (as of ideas, for example, the *framework* of the United States Constitution)" and a "skeletal, openwork, or structural frame" (Merriam Webster Dictionary).

2. Although definitions can and do vary, and they can be adapted to different circumstances thus increasing the variety of meanings and applications particularly in distinct knowledge domains, it is important to adopt some working definitions of the most important concepts in the revision of the FDES, starting from the beginning by defining the word framework.

3. A framework is a very wide and general concept, which at the very core means that a set of contents exists, and that those contents are contained within the frame. Thus, in general, a framework can be thought of as a supporting structure that helps to conceive, organize and produce a given set of contents for a distinctive purpose. A framework may be understood as a set of ideas, criteria, and protocols to organize processes, as well as a structural frame in which to build something.

4. There can be, of course, many types of frameworks, as we apply the term to different disciplines and work fields.

5. A conceptual framework can be defined as a set of concepts, ideas and contents that describe and possible explain a specific object of knowledge. It usually contains definitions, assumptions, and a theoretical body in which components of the object of knowledge are described and connected to each other, in order to fully describe and possibly explain the interactions among the components within a whole picture of the phenomena.

6. For example, conceptual framework used in scientific research serves as a description of the main components interacting among each other within a certain phenomena, thus enabling the formulation of assumptions, hypothesis and eventually the development of new scientific knowledge. Applications of conceptual frameworks can be found in many different areas of work, for example, from the business perspective, a conceptual framework is a theoretical structure of assumptions, principles and rules that holds together the ideas comprising a broad concept" (businessdictionary.com).

7. A statistical framework depicts a set of dimensions, components and topics, held together by a certain structure. It organizes the elements that constitute the statistical domain in a coherent way. Even though statistical frameworks become so by being specifically constructed for statistical purposes, this does not mean that they do not contain and use concepts, definitions and even a certain outlook about the specific field.

8. A statistical framework may consist of a conceptual part (the “what”) and an operational part (the “how”). The actual design of a statistical framework hopefully portrays the state of the art and relies on the best practices of the international community, particularly when they refer to emerging statistical domains. Thus, a statistical framework enables the development and production of a set of statistics in a given domain (i.e. social, demographic, environmental), enabling statisticians to guide their work to select and properly compile determined topics, variable sets and prepare the outputs for dissemination accordingly.

9. More specifically, a framework for the development of environmental statistics can be understood as a structure and an organizing tool that presents a logical arrangement of environment statistics topics and variables, as well as analytical categories, facilitating the work of practitioners in the production, dissemination and development of environment statistical series and products.

2. Structure, components and interactions of the environment

10. The state of our environment is the result of dynamic processes involving us all and all of our activities and surroundings. Producing statistics to describe the state and the most important dynamics, changes and trends in the state of the environment is the main challenge that environmental statisticians face everywhere. The revised FDES is a tool to assist in the development, production and strengthening of statistical information in this complex domain.

11. When revising the FDES, particular attention must be given to the main dimensions, topics and structure of the framework, not an easy task for they are all interconnected and a change in one component necessarily affects the structure and vice versa. The actual contents are based on the conception and information about the environment, while the structure should facilitate holding these parts together.

2.1 Disaggregating and prioritizing

12. Considering the immensity and ever changing nature of the environmental dynamics and their interrelations with human activities, the revised framework should clearly define and organize the most useful set of contents. The complete universe, the whole of environmental dynamics can not be measured or described, given the current scientific and statistical knowledge as well as the resources available for environment statistics at the national and global levels.

13. Thus, statistical decisions have to be made with regard to contents and boundaries, at the appropriate scales, by the environmental statistician considering capacities, resources and the needs of its users. For doing so, it is critical to have at hand the known set of environmental contents that structures the ES topics and the statistical topics to be considered.

14. What is known from the scientific arena and particularly from epistemological thinking holds also true in the field of describing the environment trough a statistics framework. To capture, describe and thus understand complex phenomena it is important to reduce its complexity and examine the parts. The loss of richness due to simplification, reduction and prioritization is the trade off of the feasibility of description and quantification. The analytical process requires the loss of substance when comparing the complex reality with the simplified description, from the field to the map. Nevertheless, there is no other way around it.

15. On the other hand, after the building blocks and most relevant dynamics among them have been described and possibly quantified, it is paramount to know how to put the parts back together and describe as integrally as possible what needs to be described and quantified.

16. Thus, it is necessary to break down these complex environmental dynamics into building blocks, identifying their main components and examining their interrelations. For the purposes of revisiting and revising the FDES this procedure is crucial.

2.2 Adaptation

17. According to different countries' circumstances, it is important to look at the menu of parts and dynamics of the environment, and then identify which are the most important concerns and thus select relevant components to develop and sustain an environmental statistics work program.

18. This is where the FW becomes a useful tool for most countries. It provides with a map to guide both the navigation of environmental statistician and the users of environmental statistics. Having a comprehensive FDES at hand serves as a close to a complete menu of options from where to select and derive nationally relevant subsets of topics, dimensions and sets of variables to be produced.

19. To adapt the revised FDES to national or other territorial circumstances, it is important to think about how to select the most relevant variable families, topics and components of the environment presented in the framework, as well as the sources of data and collaborating agencies.

2.3 Conceptual soundness and statistical feasibility

20. The revised FDES should be thought of and conceived with the highest possible conceptual considerations, while at the same time it should be firmly grounded in the capacities and characteristics of statistical systems worldwide. Conceptual soundness and statistical feasibility are the key factors in the revision of the FDES.

21. There are many concepts and conceptual frameworks to try to understand and describe the complex, dynamic and fluid environment. Some conceptual constructions can be narrow and others can be very complex and comprehensive. They are all important and applicable, under different circumstances and for distinctive purposes. Assessing, understanding and managing the complex environment dynamics have resorted increasingly in the ecosystems approach.

22. The ecosystem approach has been considered as a conceptual foundation for the FDES. It enables the environment to be captured and described as a system, composed of subsystems (ecosystems) that are functional units of biological organisms interacting with inert entities and exchanging matter and energy. Ecosystems are open systems that interchange these matter and energy with the "outside". In any given ecosystem, everything is related to everything else, although we might or might not see it or understand it all. Nevertheless, the systemic view underpinning the ecosystem approach allows us to understand that the ecosystem as a whole is greater and more complex than its parts, and the interrelations among components are equally important than the functioning of each individual part. As humans, we are part of the ecosystems and constantly interact with other components thus impacting it, benefiting from it, and ultimately depending on it. This view is evidently closer to the actual reality in which we live than previous, partial, and stationary ways of thinking about the environment.

23. When considering the ground conditions of work at most NSOs, the resources and the observational units used in general by them and the format of the current statistical series

available, it seems very difficult to actually apply the ecosystem categories as the main structural components (i.e. rows) of the FDES. This seems not statistically feasible at the time, particularly for the developing countries, for a great proportion of the environmental information and most of the demographic, social and economic information that is of interest to the environmental field is not available in a spatial format or it can not be converted to ecosystem units. However, the revised FDES should offer the possibility to adapt a structure based on ecosystems if and when it is feasible.

24. Therefore current limitations should not prevent us to use the ecosystem approach to think about the environment and how it functions and particularly to locate what are the most important environmental concerns worldwide. The ecosystem approach can be used to understand the contents of the FDES and its interrelations, while breaking down the environment (ecosystems) for statistical purposes. The ecosystem approach can be and should be then kept in mind while revising the FDES and in the production of the statistical matrixes.

25. Finally, the FDES can not aim at capturing the complete universe of the environmental dynamics, subsystems and components. Portraying the entire complexity and integrality of the environment as it is in constant interaction with human activity has proven so far unfeasible from a single theoretical elaboration, and also from current statistical systems, both in developed and developing countries. Thus, simplification, dissagregation and delimitation, prioritization and selection are key aspects to keep in mind when developing the revised FDES.

2.4 Structure and spatial considerations

26. Environment and space are intertwined, so environment statistics is becoming increasingly engaged in the development of a spatial support including spatial units of observation and aggregation, new data sources from remote sensing technologies and GIS developments, and the use of these tools to process and also disseminate statistics. This is also happening in demographic and other realms of statistics, at a different pace in every country, but nonetheless is a certain trend in the work of official statistics and evermore so in its environmental domain.

27. The advantages are evident as land/space constitutes a basic component of the environment. Traditional statistical sources such as surveys can provide data of interest about human activities that are environmentally relevant, but equally important are constituents of the spatial dimension, such as the geographical coordinates, the terrain, altitude, temperature, climate, rain patterns and type of soils, all of which are co-determinants of the type of land, land cover and land use. Evidently, it is the territory in itself that holds the biomes and ecosystems where humans live and function.

28. It is not adventurous to foresee a future where more and more so the environmental statistics, and other statistical fields, will be increasingly supported in geospatial data formats, from data collection to the dissemination in geographical, interactive platforms. In this world, one will be able to access not only environmental, but also economic, social and demographic data portrayed

in different layers that can be personalized through software that will be interactive and attractive such as Google Earth.

29. The perspective of these geostatistical developments is so wide and important, that it deserves expert consideration from here on. For the FDES revision, these developments and the challenges they present will be considered. Nevertheless, it is considered still early to revolutionize the FDES and transform it into a geostatistical framework, where for example, the rows will contain geospatially determined ecosystems, because we still need to satisfy the criteria that the FDES 2012 should be immediately adaptable and practical for most countries in the world.

2.5 Structure and structuring criteria

30. The structure inside the tallest buildings and greatest organizations is not necessarily visible. It is not there for any other purpose but to hold everything together in the right order and allowing the right interactions among its components. This holds true even at the level of chemical compounds. Evidently, the structure is a means and not and end, but is of so importance that without it, everything will fall apart.

31. Structures need to and do evolve as new knowledge and expertise becomes available, and as the users faces new needs for example in regard to emerging environmental concerns and policy initiatives or agreements. The FDES structure dating from 1984 deserves a clear inspection in the light of the new requirements of ES, considering also the accumulation of environmental knowledge and the policy initiatives in the last three decades. An evolved or even a new structure of the FDES should obviously do the job it is created for, serving as an organizing backbone for the production of ES, as an emerging field that is increasingly present in many countries and agencies.

32. Since the structure holds the parts together, the contents evidently determine the kind of structure that is needed. But at the same time, a particular kind of structure also affects the weight and shapes of its contents. Different structural solutions can be designed for each particular necessity. Structure and contents will determine and shape each other in an iterative process from the beginning of a design process until the final project is finished.

33. Therefore, it will be productive to revise the contents (topics, dimensions) of the ES domain, and when a structure arises, consider if it is the best solution possible for these sets of contents. In the case of organizing the production, development, dissemination and use of ES, the revised FDES requires the careful consideration of different sets of content options and assessment sequences, which are not necessarily exclusive but can rather be considered complementary.

34. When thinking about the structural components we have to keep in mind that it was agreed that the state of the environment and its changes should be in the center of the revised FDES. Therefore it seems logical that the components of the environment should constitute the main structuring criteria of the framework. The other structuring criteria of the framework should be built up of the aspects/attributes of the environmental components that constitute the scope of environment statistics: the state of the components of the environment, changes thereof, and the

impacts of human activities and natural events that contribute to the change. This dimension we can call analytical/assessment categories. A third structuring criteria could be policy relevance.

a. Components of the environment. This structuring criteria aims at deconstructing the environment by describing its main building blocks. Used in different ways, the most common break downs of the environment are those referred to as media components (flora, fauna, water, air, land/soil, etc.). This "media" breakdown can also be approached from the pint of view of environmental resources (natural resources, ecosystem services). Also, more recently, ecosystems categories have been used in order to look not only at the individual components but also at their interactions. Other diverse arrangements of themes and sub-themes have been used based on diverse categorizations according to user needs.

b. Analytical or assessment categories. These categories reflect the aspects/attributes of the environmental components that describe the state and changes of the environment and the activities and events that contribute to these changes. Typically the environment and its trends can be thus categorized by a sequence of Pressures, Driving Forces, State, Impact and Responses stages where causality is not necessarily implied. Other categorizations used in this logic, particularly for assessment of the ecosystems can be illustrated into the following categories: Extent, Characteristics or Quality (Biological, Chemical and Physical) and Productivity. Stocks and Flows, Quality and Quantity (and its further dissagregation) are also other forms of structuring information sets to enable analysis and assessment of the environment.

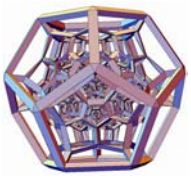
c. Policy criteria: Since the demand to produce ES is ever growing, and as knowledge about the environment and its use and management is increasing rapidly, there is also a natural trend to attempt to organize the ES domain by considering the emerging and cross-cutting policy issues and its main components. Recent policy relevant categories of current predominance to be considered while working from the environment statistics perspective includes for example climate change, biodiversity change, natural resources use, production and consumption patterns and green economy in the context of sustainable development and poverty eradication. Now, with regard to these thoughts, one should not forget that the revised FW should stand the test of time, and therefore the policy relevance perhaps should not be seen necessarily as an structuring criteria, but rather as different and important field or territory in which the FW should be carefully applied**.** Thus, this structuring criteria probably lies at a different level than criteria **a)** and **b)**, and so far it is being considered in the layers array of a FW (depth).

 Question 1: Can you think of other structuring criteria or a different set of structuring criteria altogether for the revised FDES??

The way in which these potential structuring criteria are being considered for the revision of the FDES is not as alternative logics, but rather as possibly complementary ways in which to think

about and break down the environment. The simultaneous consideration of the structuring criteria should facilitate the elaboration of the revised FW from its conception to its final substance and presentation. For example, in the 1984 FDES, two of these structuring criteria have been utilized: the media components as rows and the modified PSR as columns in order to portray them in a single synthesis matrix. As mentioned, the third will probably be crucial when designing the layers of the revised structure of the FDES.

 Question 2: Can you think of other way to portray the new FDES that is not a matrix-type structure ?



2.6 Presentation and visualization of the structure: Matrix or non-matrix structure?

The following pages will explore examples of some options corresponding to matrix and non-matrix type framework structures, along with its corresponding contents.

Whenever possible, examples and a brief summary of advantages and disadvantages are also offered to guide the expert's reading.

3. Possible FDES structures based on matrixes

35. If a matrix is the way to present and visualize the revised FDES, some considerations should guide the design of the new structure. As stated before, the revised FDES should be kept simple, adaptable and flexible, even if it will again be presented as a set of matrixes that structure the contents with different layers and applications.

36. Most of the environmental statistics' work, both within countries and in agencies, has relied in the utilization of frameworks that are usually depicted in some form of a matrix, organizing the information combining categories drawn from two main dimensions (columns and rows) according to specific versions of the first and second structuring categories described above.

37. Furthermore, from its origin in 1984, the UN FDES was been illustrated in a synthesis, two-dimensional matrix, supplemented by additional, more disaggregated tables on specific topics of the environment[1]. One of the structuring categories depicted in the rows is the media components of the environment, while the other structuring category used is a slightly modified version of the Stress - Response framework developed by Statistics Canada for environment statistics.

38. Thus, in order to produce an evolved, revised FDES, and considering the criteria of maintaining the FDES' simplicity and flexibility as well as the developments in the field, a matrix arrangement that organizes the revised dimensions, topics and variable families remains a strong option. Nevertheless, a non-matrix arrangement is still a possibility, as it will be illustrated in the following pages.

39. The decision of what version of the structuring criteria to be used (for organizing its components or categories) and in its turn what contents should be placed in its columns and rows, and how aggregated or disaggregated these two dimensions will be, has proven a difficult task and requires the contribution of the experts.

40. In this sense, the decision of rows and columns contents should be a carefully considered process in where the potency of the resulting FW is maximized. It calls for a statistical decision, hopefully founded on sound criteria and expertise. In this regard, any FW will be arbitrary, so that it can truthfully best serve its own purpose.

41. The quest for a revised FDES within a matrix array has proven complex, but some lessons can be derived at this point. As it could be expected, not all the criteria and desired elements of the revised FDES can be satisfied at the same time by a given combination of rows and columns, for there are evident trade offs when trying to improve the current FDES. Other important understandings and the most common structural problems encountered when working with new matrix structures are summarized below.

[1] Furthermore, practical guidance to assist the practitioners in the collection, processing and disseminating of the data series were to be contained in specific manuals and handbooks.

1. In any event, the cells resulting at the cross between rows and columns do not have to be statistically relevant in all cases, as is the case in other statistical domains, not all resulting matrix' cells necessarily have to contribute with significant topics or sets of variables. Expert judgment should be applied in order to clearly identify those cells that are not expected or intended to harbor information pieces.

2. Because rows and columns are mutually interdependent, when disaggregating the rows, the more columns we have, the more cells to be produced, possible loosing relevance in some of them. If we have too many columns, this will probably require fewer rows too. So there is an evident trade off between the number of columns and the number of rows, which means that it is very difficult to have considerable resolution in both axis of the matrix at the same time.

3. With regard to the need to disaggregate the rows (components of the environment) to gain resolution in the information contents, so far it has proven difficult. When trying to disaggregate the rows, the new components could be either non-mutually exclusive (and thus will overlap) and also they could be not comprehensive (not everything could be captured) or the components could be misallocated at the wrong digit level. This last problem is very common when producing a component list based on the policy relevant environmental issues. There is then a trade off between dissagregation/resolution, the mutual exclusivity of the components, and the capacity to capture the environment as a whole.

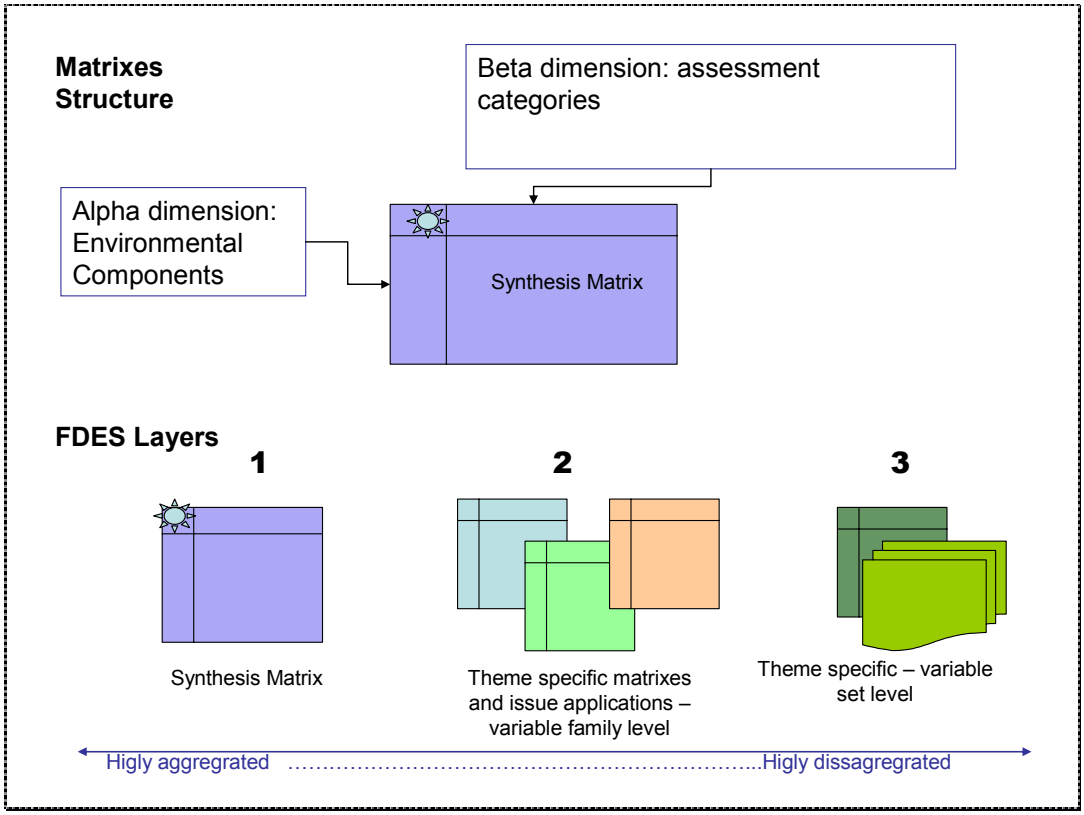
4. The columns are in need of profound revision from the original 1984 FDES. Nonetheless, as it will be described later, different possible sets of rows yield different results both in terms of advantages and disadvantages.

5. Rows and columns are interdependent, so the contents of each axis in a matrix will shape and determine the contents of the other axis. This poses a considerable difficulty, because when analyzing the potential of a given set of components of the environment (rows) or of certain assessment categories (columns), the consideration of the mutual interaction of both axes is inevitable. For example, as it will be described later, some choices of columns work better with environmental resources, but not so great with air and atmosphere, etc. Actually, the only way to asses how well rows and columns work together, is actually constructing blueprints of matrixes and allocating topics and contents in the cells.

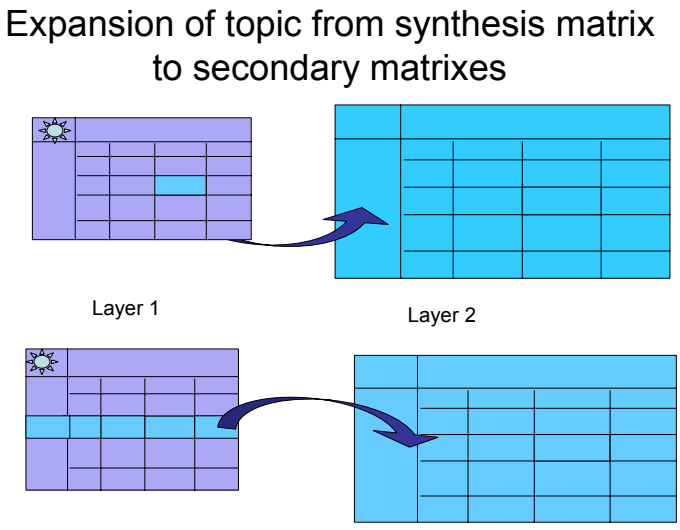
3.1 A multi layered matrix-type revised FDES

42. To accommodate the complexity of the environment into a set of environmental topics, sub topics, variable families and variable lists, it will also be necessary to arrange a multi-layer structure within the revised FDES, as illustrated:

Diagram : A two dimensional, multi-layer structure of the revised FDES



43. Each cell or row in the synthesis matrix can be further broken down to second and third level matrixes containing more disaggregated topics, sets of variables and data items:



44. By providing a multi layer arrangement, each country or agency can decide not only what components of the FW to prioritize, but also what other contents to incorporate and where to eventually relocate some of the families of variables, according to their circumstances, needs and resources. This is at the core of the flexibility characteristic that the revised FDES wishes to retain from its origin.

45. For each issue or high profile environmental concern, there is a subset of components of the environment that are of higher relevance to be considered for assessment purposes. Thus, a subset of cells of the general synthesis matrix of the FDES should be defined in order to accommodate the work of the practitioner in these emerging issues, Since one of the possible ways to structure the revised FDES is to continue to use a two-dimensional matrix, it will be then necessary to carefully consider what elements will be placed in what place. Also, when considering the contents (rows), the different layers of the revised FDES can be proposed and analyzed.

46. It also should be kept in mind that at different levels of the FDES (from the synthesis matrix to statistical topic matrixes), the structuring criteria could be changed, combined or expanded to obtain a better or more potent application for specific environmental statistics topics. In this regard, a particular cell from the first layer synthesis matrix of the FDES could be further expanded into its second layer introducing a third dimension to accommodate specific needs of this particular content. For example, stocks and flows structuring criteria (columns) can perfectly be used in the second layer or level of the FDES for those statistical topics that are natural resources (water, forest, coastal and marine resources, land, subsoil assets, etc), but it is highly possible that these type of structuring criteria are not to be used when dealing with other statistical topics such as biodiversity or human settlements.

47. It is important to also consider that different sorts of more complex three-dimensional arrays can be produced, but they could only be justified by adding value to the FW and continue to comply with the criteria defined for it.

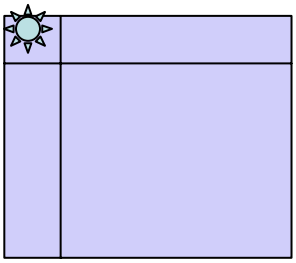
3.2 Description of the layers

48. As stated before, the revised FDES, as the 1984 FDES, may contain different layers of aggregation – dissagregation in order to accommodate the sought contents and structure.

49. At this point, the illustrations of the layers will be done in a somewhat abstract and incomplete manner, for the actual rows and columns of the synthesis matrix (Layer 1) have not yet been determined, and therefore the break downs and dissagregation of its contents to the more detailed level (layers 2, 3….) can not be adequately exemplified with real environmental contents.

50. The first layer shows the most aggregated level of the FDES, containing the components of the environment at the one digit level, which can be portrayed in a synthesis matrix arrangement:

3.2.1 Layer 1: The synthesis matrix



51. This synthesis matrix portrays the highest level of aggregation, including themes and sub-themes that combine two structuring criteria, that is components of the environment and assessment categories, as follows:

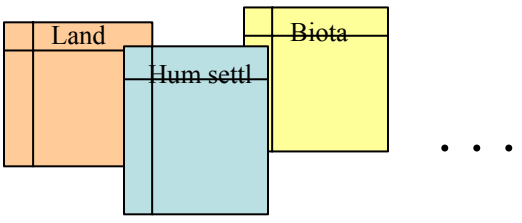
a) Rows: Components of the Environment
b) Columns: Assessment or analytical categories
c) Aggregation level: highest (one digit), to the theme and sub-theme level.

Illustration (synthesis matrix):

	COLUMNS: Analytical Categories (information categories)		
ROWS: Component of the Environment (1 digit)	▣	■	▣
Biota	Exotic species introduction	Flora, Fauna Endangered Species	Protection of Biodiversity
Fresh Water	Pollution	Lakes Rivers Underground	Water treatment
Coasts, Seas and Oceans	…	…	…
Land, Soil, Subsoil			
….			

Note: The symbols labeling the columns (▣■▣) are used in the place of Pressure, State, Response or other assessment category until those are decided upon.

3.2.2 Layer 2: Theme-specific matrixes and "issue-application" matrixes



52. These matrixes can provide a greater detailed description of the themes, sub-themes and variable families or statistical topics, for they contain more disaggregated information, up to the

level of variable families. The layers in general and the second one in particular, enable the third structuring criteria, which is policy relevance. Thus, two types of matrixes can be constructed: Theme-specific matrixes, and also cross-cutting, high relevance, policy driven, issue applications.

3.2.2.1 Theme- specific matrixes

53. This second layer type of matrixes can portray each component of the environment in more detail, offering a menu of families of variables for each analytical/assessment category.

a) Rows: A specific component of the environment, disaggregated in its subcomponents or themes.
b) Columns: Assessment or analytical categories that will be decided for the synthesis matrix
c) Aggregation level: medium, two digits, to the variable families or statistical topics level

Illustration. Please keep in mind that the topics or contents in the cells are for illustrative purposes only. Actual definition of the topics requires a decision about the nature of the columns of the FDES.

Environment component (1 digit)	**Break down** (two digits)	▣	◘	▣
Forest (Classification of forests)	Quantum	Forest production (timber, chips, cellulose, etc.) production Deforestation Aforestation Reforestation Forest fires	Forest extent Forest cover of land territory Forest diversity	Protection of natural forest ecosystem Certification of managed forests (FSC)
	Composition	Plantation of forest	Natural forest Planted forest Endemic forests Substitution	
	…			

3.2.2.2 Cross-cutting, high environmental concern applications

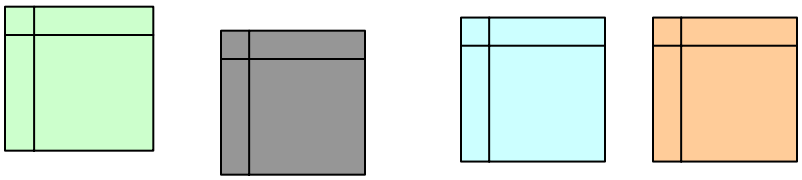
54. Because high concern environmental and SD issues are usually cross-cutting, this other second layer type of application will probably require the need to integrate either whole or parts of different, selected, theme-specific matrixes. Also, subsets of topics or families of variables classified in the field of cross-cutting row of the synthesis matrix will also be useful to be incorporated when considering the production and dissemination of statistical series in these types of applications.

a) Rows: A subset of relevant components of the environment, disaggregated in sub components. Some variable families from the cross cutting row could also be incorporated.
b) Columns: Assessment or analytical categories
c) Aggregation level: medium, to the variable families' level

55. As it can be seen in the following examples, the second layer of the FDES can take the form of these tow types of sumatory of partial or total theme-specific matrixes

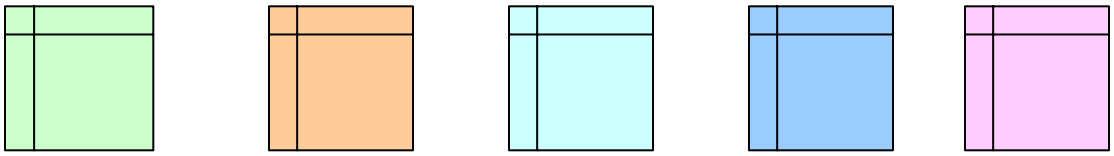
Illustration:

Example 1: Climate Change



∑ forest + emissions + climate + atmosphere + agriculture

Example 2: Natural Resource Depletion



∑ forest + land use + water + oceans and coasts + biota + additional agricultural and reference variables

56. The specific components of summation or cross-cutting matrixes are to be decided by the specific national or territorial circumstances, resources and sources of statistical information available, from the main theme-specific menus contained in the different matrixes of the second layer of the revised FDES.

3.2.3 Layer 3: Sets of illustrative, partial, individual variables matrixes

57. The third layer of the rev FDES, that goes to the individual variable level, will probably be only partially illustrated with selected theme-specific matrixes showcasing some of the real environment statistics variables to the most disaggregated level possible.

58. It will be the work of each country or agency to actually produce and complete these variable-level matrixes for their own statistical and assessment purposes.

59. The UN will most likely continue to produce list of variables globally relevant for many environmental themes (such as it has already done so with the IRWS and the IRES), but it is expected that each country or agency, according to national circumstances will adapt, complete and select from these menus to prepare their official environmental data gathering work.

a) Rows: Each component of the environment, disaggregated in sub components (classifications)
b) Columns: Assessment or analytical categories
c) Aggregation level: lowest, illustrating with selected set of individual variables

 Question 3: Can you think of other layers or possible windows opening the info to more specific levels?

3.3 Structuring the rows: Components of the Environment

60. The definitions of the actual rows containing different ideas about what are the components of the environment that are at the same time statistically feasible, it is a very complex task.

61. Keep in mind that any break down of the environment into components will be arbitrary. Ideally, the components should be derived from a specific and sound conception and try to minimize the overlap among them (classifications).

62. Evidently, the environment components can and do overlap, but this is true for any break down of the environment, it will always be arbitrary and in accordance to a given purpose.

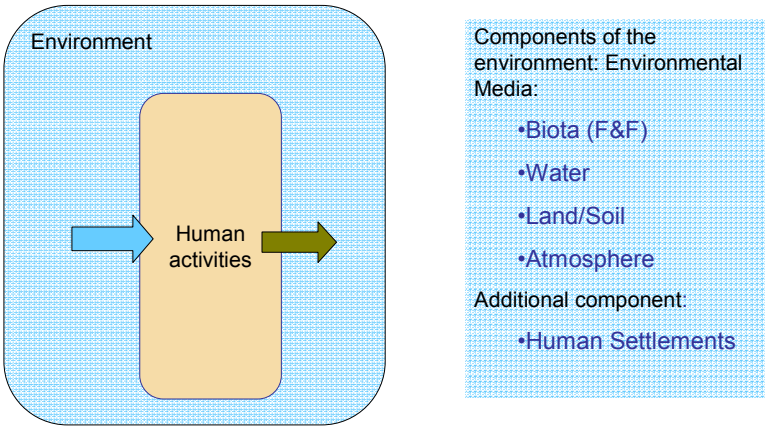
63. For inspiration, here are two sets of components: the original rows of the 1984 FDES, highly aggregated and mutually exclusive, and on the other hand we also present a more disaggregated list of current components mostly found in national and agencies environmental statistics publications. The new rows of the revised FDES will probably stay between these two options.

3.3.1 Rows in the 1984 FDES

Components of the environment	Information categories			
	Social and economic activities, natural events	Environmental impacts of activities/ events	Responses to environmental impacts	Inventories, stocks and background conditions
1. Flora				
2. Fauna				
3. Atmosphere				
2. Water **(a) freshwater** **(b) marine water**				
3. Land/soil **(a) Surface** **(b) Sub-surface**				
6. Human settlements				

64. The original 1984 FDES structure is based on the conception that the human activities "take" from the environmental components (media) and then "return" to the environment pollutants and residuals, as illustrated bellow. The media components include biota, water, land/soil and atmosphere; but note that human settlements as an additional component was added in the original FDES:

Conception of FDES 1984:
Human activity takes inputs from the environmental media and then returns back pollutants and residuals to the environmental media



Question 4: What would be in your thinking about the new components of the environment, considering that the experts want more disaggregated than the 1984 FDES rows, but sustain the conceptual soundness?

3.3.2 Rows according to relevant environmental topics and sources of information

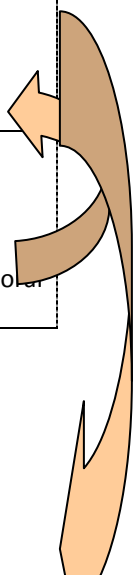
65. The following is a list of common subject areas usually found in national environmental statistics production. The list can be thought provoking, when considering different components of the environment and how they interrelate and overlap.

66. These thematic areas of environmental statistics are listed and structured in a way as to illustrate its possible and most common contents. They constitute usual topics most environmental statisticians already use both at the national level and within international agencies. They combine the need of specific specialized knowledge, and the interaction with distinctive informers and collaborating institutions. They do not follow a single approach: they combine environmental media and policy/management issues. These common components can be observed in the organization of the production of ES as they correspond to specialized topics (i.e. water, forest, biota) that require specialized knowledge and interaction with given institutions and experts (i.e hidrologists/water authorities, forest engineers/authorities, ecology experts/biodiversity protection authorities, respectively). Most likely, the data sets to be collected within each component can be drawn by one (or more) specific data source(s). This arrangement will not allow the application of the same columns to the different rows.

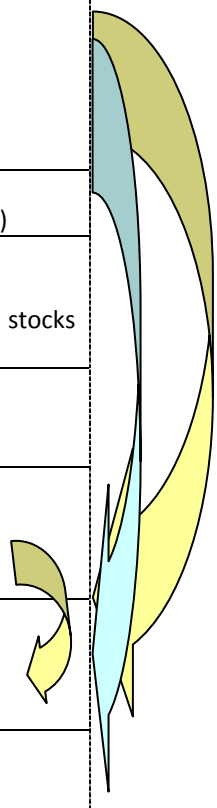
67. Keep in mind that the list of component is a mixture of different levels of composition, it was not derived from a clear conception about the components of the environment, and the thematic areas do overlap (as shown by the arrows).

List of common COMPONENTS OF ENVIRONMENT STATISTICS

	Environmental Component	**Sub-Component (examples from different categorizations)**
1	Biota	1.1 Flora (marine-terrestrial) 1.2 Fauna (marine – terrestrial) 1.3 Threatened Species 1.4 Biodiversity
2	Coast and Oceans	2.1 Coasts and marine extension (territorial) 2.2 Coastal pollution 2.3 Surface temperature 2.4 Sea level 2.5 Marine ecosystems health (coastal, tidal, coral reef, etc).



3	Inland Water	3.1 Stocks/Flows Lakes Rivers Underground …. 3.2 Quality 3.3 Management
4	Forests	4.1 Extent 4.4 Quality… or same as in 3 (stocks – flows)
5	Land, Soil and Subsoil	5.1 Territory 5.2 Land Use and Land Cover 5.3 Subsoil …. Further disaggregated in stocks and flows)
6	Energy	6.1 E Production, Consumption 6.2 E Renewability 6.3 E Intensity (carbon and ec)
7	Atmosphere, Air and Climate	7.1 GHG Emissions (CO2, CFCs, etc) 7.2 Temperatures 7.3 Precipitation 7.4 UV Radiation
8	Extreme events - natural disasters	8.1 Geological 8.2 Meteorological 8.3 Hidrological …
9	Human settlements	10.1 Total, urban and rural population 10.2 Safe Water 10.3 Sanitation 10.4 Waste 10.5 Vulnerable, precarious settlements 10.6 Green areas
10	Cross cutting issues	SCP, Green Economy, environmental instruments (taxes, eco-labelling, subsidies), Environmental Management, Environmental expenditure. Environment and cultural heritage.



68. Last but no least, there are some environmental variables and families that are of a cross-cutting nature and that do not belong exclusively to any component of the environment, thus it would be important to consider whether it would be wise to provide a final row accommodating this need.

Question 5: Can we think of other way to structure the rows or break down the components of the environment, less aggregated than the current rows in the 1984 FDES ?

3.3.3 Expansion of the decided rows to construct an interagency – source matrix

69. By using some sort of institutional-source matrix like illustrated in the following table, the different decide contents of the revised FDES can be linked to specific areas of expertise that require the collaboration with specialized informing institutions and entail the use of specific types of sources.

70. In the next table, for selected environmental component commonly considered, the most common institutions and statistical sources required for the production of ES at the national and global scale are described for illustration purposes.

	Environmental Component	National collaborating agencies, experts and scientists	National statistical source / agency	Global agencies /Stats collection
1	Biota	Ecology scientists and experts Biodiversity protection authorities and agencies	Administrative records protection authority	IUCN UNEP UNSD
2	Coast and Oceans	Geographical institutions Marine biologists Marine and coastal agencies	Scientific assessment of marine ecosystems and coastal ecosystems, reports Administrative records (marine and coastal authorities)	UNEP
3	Water	Hydrologists, meteorologists Water authorities (national, regional, local)	Administrative records water authorities, water companies, municipalities	UNICEF-WHO UNSD WWF FAO -Aquastat
4	Forests	Forest scientists and engineers Biologists and ecology experts Forest management and protection authorities	Remote sensing, forest inventories (Agriculture/forest authority) Administrative records of forest management and protection agencies. Administrative records of certifying institutions (i.e. FSC)	FAO - FRA UNSD
5	Land, Soil and Subsoil	Agriculture agencies, mining agencies, industry and experts (i.e. agricultural and geologists).	Remote sensing. Agricultural Surveys and administrative data on land use (Agriculture agency)	FAO UNSD
6	Energy	Energy agencies, industry and experts.	Energy Balances Energy administrative data Energy surveys	IEA … UNSD
7	Atmosphere, Air and Climate	Meteorologists, climate change and ozone experts and national agencies.	Emission records, National communications to international conventions Administrative data	IPCC, UNCCC UNEP, UNSD
8	Natural Disasters	Natural disaster experts and national agencies.	Administrative data of emergency and natural disaster agencies. Disaster assessment documentation.	IPCC, UNCCC UNEP, UNSD
9	Human settlements	Housing, urban and rural agencies. Municipalities.	Household Surveys Census Remote sensing	UN Habitat UNEP

3.4 Structuring the columns : Assessment or analytical categories

71. The place where most of the innovation for the revised FDES will probably be is in the columns or analytical categories (originally termed information categories in the 1984 FDES).

72. As discussed in the beginning of this document, the columns hold different informational categories that are somehow necessary to understand what is happening to the environment and possible why, and what is (not) being done about it.

73. Let us be reminded of the original 1984 columns first:

3.4.1 Columns of the 1984 FDES

Components of the environment	**Information categories**			
	Social and economic activities, natural events	**Environmental impacts of activities/ events**	**Responses to environmental impacts**	**Inventories, stocks and background conditions**
1. Flora				
2. Fauna				
3. Atmosphere				
4. Water (c) freshwater (d) marine water				
5. Land/soil (c) Surface (d) Sub-surface				
6. Human settlements				

74. Now, when thinking about how to organize the environmental statistics for each component of the environment, one is actually considering the analytical, assessment and informational needs.

75. Strong emphasis have been thus far placed by the experts in the State of the environment, so perhaps the columns should be structure whose center will be the actual State statistics and there could be additional columns as to offer metrics on what is affecting and or changing the State.

76. Different options for columns will be discussed next.

3.4.2 Pros and cons of different options for column structure

77. The possible new columns, containing different sets of analytical categories, can go in many different directions.

78. Just to provide some illustrations with a synthetic assessment of advantages and disadvantages, here are some listed:

1. P-S-R derivation, such as DF-**S**-R or D-P-S-I-R columns

In this example the different PSR derivations can be examined, for illustrative purposes here is the simple DF-S-R with a stress in the State statistics:

Components of the environment …	Driving Force/ Pressure	**STATE/Impact**	Response

80. Some of the most important pros and cons of this scheme are stated in the following table.

PROS	CONS
Flexible Widely known Widely used	At more disaggregated levels (such as the second or third layers), response contents are difficult to attribute to a specific row or set of rows. (This can be solved by transforming the response column into a sub-row or even a cross cutting issue).

2. Stocks and Flows (natural assets and their changes)

Components of the environment …	Stocks (natural assets)	Flows (changes)

Some of the most important pros and cons of this scheme are stated in the following table:

PROS	CONS
Works very well with natural resources	This could be a possible partial application for it doesn't work well with the topics (rows) of climate, natural disasters, waste, biota or land/soil. Does not work at all within the human response nor with environmental management families of variables

3. Quantity, Quality and Changes of environmental components (water, forests… etc)

Components of the environment …	Quantum	Changes in quantum (per unit of time)	Quality	Changes in quality (per unit of time)
Water	Water availability	Change in t time period	Potable water Recreational water pollution	Change in x-parameter of quality over t time period
Forest	Forest extend	Change in t time period	Forest composition	Change in t time period

Some of the most important pros and cons of this scheme are stated in the following table:

PROS	CONS
It could be more easily applied to bio physical sets of variables	It will not work well with human responses and actions

4. Extent/pattern – Characteristics (physical and chemical) – Biological Components (biodiversity) – Productivity (goods and services). [Used by USA State of Ecosystem and proposed by CANADA]

Components of the environment (Ecosystems)…	Extent/pattern	Characteristics (physical and chemical)	Biological Components (biodiversity)	Productivity (goods and services)

79. Some of the most important pros and cons of this scheme are stated in the following table:

PROS	CONS
Works best when rows are specific ecosystems or biomes	Doesn't work very ell with components or topics (rows) such as climate, natural events or disasters or energy.

 Question 6: Can we think of other way to structure the columns or to assess the state and changes on the components of the environment??

4. Possible non-matrix structures

80. A matrix sounds to some of the experts as a somewhat too structured, maybe too limited (two-axial) way of organizing environmental statistics. Thus, it has been suggested that the exploration of a non-matrix revised FDES should be considered. Many different ideas such as trees, tree-dimensional arrays and also alternative simpler ideas have been mentioned during discussions, but so far there a concrete innovative structure has not evolved.

81. A list of components and subcomponents of the environment could be used as a simple, straight forward arrangement of environmental statistics. In this regard, two ideas have been identified while researching and discussing the revised FDES structure. First, a structure based on the classifications of the environmental components could be explored, which could break down the components of the environment according to relevant appropriate classifications. Also, a possible framework consisting of an arrangement of themes, subthemes could be considered.

82. A list constitutes the sole rows of a non-matrix FDES. And, by not having columns that match every single component of this type of arrangements, a thematic-specific logic of classification of the subcomponents beyond the 1 digit is possible, so that different break-downs of each components will be produced, each one of which will be adequate for the specific topic or theme under consideration. This is a great advantage over the matrix-type arrangements that need all the columns to more or less fit every row.

4.1 Illustration of a hierarchical structure

83. A framework based on a hierarchical structure is presented here, in an illustrative and aggregated way for the themes of Water.

Pros:

- Supports the specific sub-themes and break downs of the different domains (ecosystems, natural resources)
- Can link its contents to different concepts and frameworks (stock/flow, DPSIR and others) at the same time.

Cons:

- The actual content of the structure inside each of the components of the environment can and will be different
- Currently the hierarchical structure has 4 levels (the individual data items are foreseen on the 5th level); so it needs to be investigated if this is useful or could be reduced.

84. Finally, other possible value added of this type of classification is that it could be also used to show the links to other frameworks and existing standards (and guidance documents), as in the following example for the Theme Freshwater:

Illustration: Hierarchical structure and its relation to relevant information categories and statistical guidance.

Ecosystem component	Level 2	Level 3	Level 4	Existing UN standards and guidance	Stock	Flow	D	P	S	I	R	Links to other ecosystem component or cross-cutting issues
Fresh water	**Quality**	**State**	Physico-chemical parameters	IRWS	x				x			
			Biological parameters		x					x		Flora and fauna
		Pollution	Physico-chemical parameters by Industry	SEEA-Water Emission Accounts		x		x				Land and soil
			Biological parameters by Industry			x		x				
	Quantity	**Surface Water**	Lakes	SEEA-Water Asset Accounts; IRWS	x				x			
			Rivers	SEEA-Water Asset Accounts; IRWS					x			
			Artificial reservoirs	SEEA-Water Asset Accounts; IRWS	x				x		x	
		Groundwater	Renewable GW	SEEA-Water Asset Accounts; IRWS	x				x			
			Fossil GW	SEEA-Water Asset Accounts; IRWS	x				x			
		Natural flows	Internal flow (precipitation, evapotranspiration)	SEEA-Water Asset Accounts; IRWS		x			x			Atmosphere, Air and Climate
			External inflow and outflow	SEEA-Water Asset Accounts; IRWS		x			x			Atmosphere, Air and Climate

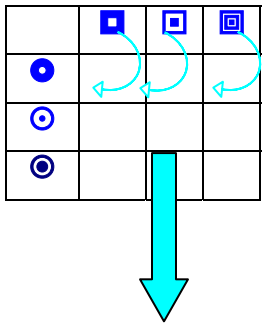
			Transfers between internal ressources	SEEA-Water Asset Accounts; IRWS		x			x			
Fresh water			Extreme events					x	x	x		Atmosphere, Air and Climate
		Abstraction and use	Abstraction by industry	SEEA-Water PSUT; IRWS		x		x				
			Use by industry	SEEA-Water PSUT; IRWS		x	x					
			Consumption and losses by industry	SEEA-Water PSUT; IRWS		x		x				
	Manag ement	**Waste water treatment and sewage sludge generation**	Wastewater treated by type of treatment (primary, secondary, tertiary)	IRWS							x	Human Settlements
			Sewage sludge generation and disposal	IRWS				x			x	Land and Soil, Human Settlements
		Safe sanitation and population connected to wastewater treatment	Population with access to safe sanitation (per type)	IRWS, MDG							x	Human Settlements
		Access to safe drinking water	Population connected to wastewater treatment (per treatment type)	IRWS							x	Human Settlements
			Population with access to safe drinking water (per type)	IRWS, MDG							x	Human Settlements
		Economic and monetary aspects in the water sector	Output and supply of natural water and sewerage services per industry	SEEA-Water Hybrid Accounts; IRWS		x					x	
			Total intermediate consumption and use and actual final consumption of natural water and sewerage services	SEEA-Water Hybrid Accounts; IRWS		x					x	
			Stocks of fixed assets for water supply and sanitation	SEEA-Water Hybrid Accounts; IRWS	x						x	

Question 6: Can you think of other advantages and disadvantages of a non-matrix type of framework?

Question 7: Can you propose what a complete FDES will look like if structured in a similar way as this water example?

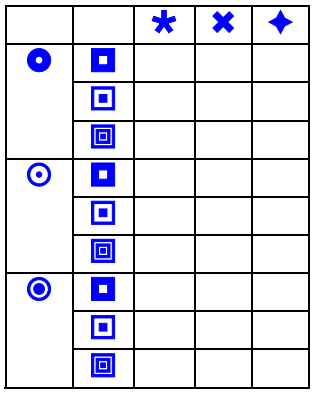
Annex 1. Structural note on the two-dimensional matrix and its potential expansion

1. Bear in mind that even in this straight forward arrangement of a matrix, it is important to bear in mind that any proposed "columns" can be easily transformed into sub-rows, and vice versa, as shown in the following image:



By converting the former columns to sub-rows,

a third dimension can be added to a 2-dimensional matrix:



… the new columns can again be restructured within each row and sub-rows, as needed.

2. Also keep in mind that for structuring the same contents, the more disaggregated the rows, it needs less dissagregation in the columns, and vice versa

Annex 2 : Three ways of assessing the environment using the ecosystem approach: USA, MEA and CANADA's.

USA STATE OF THE NATION'S ECOSYSTEMS, 2008	MILLENIUM ECOSYSTEM ASSESMENT, 2005	STATISTICS CANADA'S PROPOSAL 2010		
"ROWS" : ECOSYSTEM – CATEGORIES				
		Aquatic	Marine	Open ocean
				Coastal
Coast and Oceans	Island			Estuaries
	Marine			Seagrass algae beds
	Coastal			Coral Reef
				Shelf
			Wetlands	
			Tidal Marsh/Mangrove	
			Swamps	
Fresh Waters	Inland Waters		Lakes/Rivers	
			Groundwater	
Forest	Forest	***Terrestrial***	Forest	Tropical
				Tempered Boreal
	Mountain			Austral (added)
Grasslands and Shrub lands			Grass/Rangelands	
	Drylands		Desert	
			Tundra	
	Polar		Ice Rock	
Farmland	Cultivated		Cropland	
Urban and sun-urban landscape	Urban		Settled	
		Atmosphere		
		Subsoil Assets		
Core National indicators				

"COLUMNS" : ANALYTICAL or ASESSMENT CATEGORIES		
USA STATE OF THE NATION'S ECOSYSTEMS 2008	**MILLENIUM ECOSYSTEM ASSESMENT 2005**	**STATISTICS CANADA'S PROPOSAL 2010**
1. Extend and Pattern • Extend • Pattern	Assessment within each alpha category is specific and adequate. Nevertheless, there is a general structure for assessment in each: 1.Main messages (synthesis) 2. General assessment (flora, fauna, pollution, etc), use of appropriate sub types of ecosystem and case studies. 3. Analysing the three ecosystem services status and trends (provisioning, regulating and cultural) 4. Analysis of drivers of change in ecosystems and policy options.	**A. Extern and Pattern**
2. Chemical and Physical Characteristics • Nutrients • Pollution • Physical streams/flows • Degradation (erosion, saliniz, etc.)		B. **Stability**
3. Biological Components • Plants and Animals • Communities • Ecological productivity		**C. Diversity**
4. Goods and Services • Food, Fiber and Water • Recreational and Other		**D. Productivity** (goods and services)

Note: The USA 2008 State of Ecosystem actually present national indicators transposing this matrix, that is using the assessment categories as rows and the different ecosystems in the columns. Here it is presented in the same order than MEA and CANADA to enable comparison among the three initiatives.