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REPORT ON THE AGGREGATION OF INDICATORS OF SUSTAINABLE DEVELOPMENT

Background Paper for the Ninth Session of the

Commission on Sustainable Development -

Division for Sustainable Development
United Nations, New York

I. INTRODUCTION

1. Chapter 40 of Agenda 21 calls for the development of indicators of sustainable development. In particular, it requests countries at the national level, and international governmental and non-governmental organizations at the international level, to develop indicators in the context of improving information for decision-making.

2. The United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 recognized the importance of indicators. The Commission on Sustainable Development, which grew out of the Earth Summit, followed up on this recommendation and approved a work program on indicators at its Third Session in 1995 (CSD III).

3. This program resulted in the preparation of a working list of 134 indicators, as well as methodology sheets for each of them and a framework for their organization. In order to assess the appropriateness and validity of the list, countries from all regions of the world volunteered to test the indicators in an initiative that started in November of 1996. The indicators were tested according to individual countries' own priorities and goals for sustainable development, and implemented on the basis of common guidelines for national testing as developed by the Division for Sustainable Development (DSD) in consultation with its indicator expert group.

4. Since the launch of the testing at the Second International Workshop in Ghent, Belgium in November 1996, several meetings have been convened for Africa, Asia and the Pacific, Latin America and the Caribbean in order to promote and train government policy makers in the CSD indicator approach and use. In January 1998, an International Workshop was organized in Prague, the Czech Republic, to evaluate the progress of national testing and discuss challenges, experiences and interim results. In December 1999, the twenty-two testing countries met at the Barbados International Workshop to exchange experiences and best practices.

5. In March 2000, under the direction of the Division for Sustainable Development and the Department of Economic and Social Affairs (DSD/DESA), a small group of experts were invited to draft the final CSD framework. As a result of that meeting, a draft list of 57 indicators was selected and distributed to all the testing countries for approval.

6. Parallel to these efforts, in October 1998, the DSD launched a study co-sponsored by the European Statistical Office (EUROSTAT) to describe and analyze recent work by a number of international and national organizations, on linkages and aggregation of indicators of sustainable development. The final report, "The Relationship Between Indicators of Sustainable Development", was prepared by EUROSTAT and served as the basis for discussions at the Fifth Expert Group Meeting on Indicators held in New York in April 1999.

7. The present report is based on the recommendations made at the fifth meeting of the expert group on indicators of sustainable development. The report assesses the feasibility of aggregating indicators for sustainable development and it serves as a background paper for the Ninth Session of the CSD, as part of the discussion on information for decision-making and participation.

8. The study's primary objective is to outline and recommend possible approaches and methodologies currently available to derive aggregated indicators of sustainable development, based on the final themes, sub-themes and a core set of indicators of the CSD Framework. All of the initiatives analyzed in the report of Eurostat, "The Relationship Between Indicators of Sustainable Development" have been considered, although only those that were relevant to aggregation have been described. Other relevant initiatives have also been considered.

II. SCOPE OF THE STUDY

9. According to the Merriam-Webster dictionary, aggregation is "a group, body or mass composed of any distinct parts or individuals."[1] The Web dictionary of Cybernetics and Systems define it as a "process by which the properties of a collection are described in terms of the sums of the properties of the units contained in that collection. The most elementary aggregative procedure is counting and establishing a frequency that represents the properties of a set through numbers rather than by the list of elements it contains. Aggregation … yields measures and insights not demonstrable by means of the units aggregated thereby. It is justifiable whenever units are sufficiently independent and similar."[2]

10. A more simplistic definition is that it is the process of adding variables or units with similar properties to come up with a single number that represents the approximate overall value of its individual components.

11. The process of measuring sustainable development calls for simple, elegant and effective measures that do not compromise the underlying complexity. High-level decision-makers (government ministers, foundation executives, and heads of corporations) routinely ask for a small number of indices that are easy to understand and use in decision-making.

12. Taking into account the above definition, there are a number of related measurement initiatives that are not considered in the context of this report, although they seek to derive various forms of aggregated information and data.

13. For example, the UN Statistics Division of the Department for Economic and Social Affairs,[3] has developed a System of Integrated Environmental and Economic Accounting (SEEA). The SEEA is a data system designed to study the interrelationships between the economy and the environment. It allows the organization of environment statistics into physical and monetary terms using classifications, concepts and methods that are compatible with the conventional economic accounts. This system is a useful tool for integrating environmental concerns into mainstream economic policy by providing information for (a) regular monitoring of the interaction between the environment and the economy and of progress toward meeting the environmental goals defined in strategic plans and (b) analysis of alternative development paths and specific policies designed to achieve sustainable development .

[1] Merriam-Webster's Collegiate dictionary. Tenth edition.
[2] Web dictionary of Cybernetics and Systems: http//pespmc1.vub.ac.be/ASC/AGGREGATION.html
[3] United Nations Statistics Division of the Department of Economic and Social Affairs. "Greening the national accounts: Approach and Policy use". New York.

14. A wide range of indicators that can be used to assess whether a country is on a sustainable path can be derived from the SEEA. Examples of such indicators include (a) the value of national wealth - produced and natural capital (the measurement of human and social capital has not yet been fully developed), (b) indicators of economic-environmental performance such as level of pollution, material/residual intensities, cost of environmental regulation over time (c) the cost of depletion of natural resources and valuation of environmental degradation and (d) environmentally-adjusted aggregates such as "green" GDP and capital formation and genuine savings. These indicators assist in formulating and monitoring economic policies more effectively, enacting environmental regulations and resource management strategies and using taxes and subsidies more efficiently."

15. The World Bank has developed various initiatives to explore indicators of environmentally sustainable development that include the links between environmental quality and economic growth and between the use of resources and the quality of the resource stock. In their report "Expanding the Measure of Wealth "[4] they advance the concept of "genuine savings" which in simple terms combines Gross Domestic Investments and net foreign borrowing. It is calculated as the difference between net savings and the sum of rents from all extraction and use of natural resources as well as damages from carbon dioxide emissions. In addition, they have tried to include the concept of social capital, developing a broad range of social indicators that analyze the current state of social development in a country. Although their initiative is innovative, it is not considered in this report, mainly because their aggregation process is based on subtracting net savings (that integrate environmental externalities) from Gross Domestic Investment. It does not aggregate indicators to come up with a specific sustainable development index.

16. The Wuppertal Institute's work on Material Flow Accounts[5] creates a series of environmental pressure indicators and analyzes the impacts as a function of a material unit per product. The work makes a significant contribution to internalizing the environmental costs of production or services and is useful for implementing green accounting. However, it does not contemplate the associated social or institutional dimensions nor does it consider sustainable development in an integrated way.

17. Another interesting initiative is that of Costa Rica's Development Observatory. The initiative establishes a relationship between the state of environmental resources (basically forest, water, biodiversity, land, air, seas and coasts) and the concept of 'human security' (formed by productivity, equity, resilience and stability). The indicators used, especially in the area of human security , are innovative and have been tested in different Central American countries. However, they do not aggregate information into final indices.[6]

18. As the purpose of this report is to outline and recommend possible approaches currently available to aggregate indicators of sustainable development for the CSD framework, only those

[4] The World Bank. "Expanding the Measure of Wealth". Environmentally sustainable development studies and monographs series. No. 17, 1997

[5] Wuppertal Institute. Material Flow Accounts (http://www2.wupperinst.org/download/mfa_papers.html)

[6] Observatorio del Desarrollo. "Human Security and Environmental Change", 1998. www.odd.ucr.ac.cr/

that potentially contribute to this process have been considered. This study is not a complete and critical analysis of all efforts to develop aggregate measures for sustainable development, nor an analysis of the advantages and disadvantages of each initiative. The study primarily examines the aggregation process used by each initiative and looks at its applicability to the CSD indicators.

III. INITIATIVES CONSIDERED

19. The following section provides a brief description of the initiatives that have been considered in this study. For each initiative, the following issues have been described: the organization that led the initiative; its title; the contact person responsible for it; a small description of what were the major components of the initiative; and a critical analysis of its potential contribution to the CSD indicator framework.

3.1. The City Development Index

Organization: United Nations Center for Human Settlements (HABITAT)

Title of the study: Urban Indicators Programme

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Description:

The City Development Index (CDI) is divided into the following five indices:

- Infrastructure index: Formed by the percentage of households connected to services (water, sewerage, electricity, telephone) and the percentage of households with access to drinkable water
- Waste index: Percentage of wastewater treated and solid waste disposal methods (depending on whether there is garbage collection or open dumping)
- Health index: Considers hospital beds and child mortality
- Education index: Includes school classrooms in primary and secondary education
- City Product Index: the product consumption per capita

Potential contribution to the CSD aggregation effort

20. The CDI initiative has 40 key indicators focusing on urban structures. From this list, five indices have been established that aggregate information in five areas: infrastructure, waste, health, education and product consumption. The standardized framework can be applicable across cities and facilitates dissemination of their results.

21. The five indices coincide with several sub-themes contained in the CSD core list. Following is a small description of each index:

22. Infrastructure – The concept of having an infrastructure index is highly innovative. Part of the indicators used for this index have been considered in the CSD core indicator selection, but this distribution does not match with the set up of the CSD sub themes. The aggregation process considers that the connection of homes to telephones has the same relevance as access to drinkable water or to sewerage facilities, which is not necessarily true (nor does it consider the ownership of cell phones).

23. Waste –The waste index considers wastewater, garbage collection and open dumping. The indicators measure solid waste and wastewater, but do not consider toxic, hazardous or radioactive waste. Also, they do not consider recycling and reuse capacities. The indicators used in the CSD framework offer a much broader view of the waste generated.

24. Health – The health index is formed by the number of hospital beds and child mortality. The aim of the index is to measure government investment in health infrastructure using infant mortality as the related determinant. The index could be problematic, however, since it may misinterpret the relevance of hospital beds in determining improvements in infant mortality rates. For the CSD framework, health is the key relevant issue and is integrated in four different sub-themes. It aims to measure the state of health in a country, and not the availability of infrastructure for health.

25. Education – The city development index only considers school classrooms, and differentiates between primary and secondary education. The indicator measures the educational infrastructure, but does not consider access to or completion of educational levels, nor the adult literary rate (although 'adult literary rate' is counted in the list of indicators). In order to have an index that measures a country's educational capacity at a general level, it would be more advisable to aggregate the CSD indicators (completion ratio and adult literacy rate).

26. City Product Index – The city product index measures the log city product but its implications are not relevant for the purpose of the CSD framework.

3.2. Living Planet Index

Organization: World Wide Fund for Nature International

Title of the study: Living Planet Report 1998: over consumption is driving the rapid decline of the world's natural environments

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Description:

a) "The Living Planet Index" is a measure of the natural wealth of the Earth's forest, freshwater and marine environments. It is an aggregation of three different indicators of the actual state of the ecosystem:

- The area of the world's natural forest cover
- The world's population of freshwater species
- The world's population of marine species

b) In 1998, the World Wide Fund for Nature International proposed to measure "consumption pressure". Intended as a measurement of human impact on natural ecosystems, it examined natural resource consumption and environmental pollution. Six different components were used to aggregate the information: grain and meat, marine fish, wood and paper consumption, freshwater withdrawals, carbon dioxide emissions and cement. The index was implemented in 152 countries.

27. In 1999, a different approach to measuring consumption pressure was offered. Instead of aggregating all the information in a consumption pressure index, each of the following concepts were considered separately: grain, fish, wood, carbon dioxide, fertilizer and cement consumption. Because updated data on water withdrawals was unavailable, the index was not aggregated. Instead, a fertilizer consumption indicator was used as a measure of pressure on freshwater ecosystems.

28. An updated report, expected by the end of 2000, will replace the Consumer Pressure Price with the Ecological Footprint (please refer to section 3.5. for analysis).

Potential contribution to the CSD aggregation effort

29. The Living Planet Index is formed using simple and accessible indicators. It can easily be separated and offers a clear idea of the deterioration of natural capital since 1970.

30. The Living Planet Index is a useful tool in providing a broad picture of the earth's natural capital. In the CSD framework, the sub-theme 'forests' includes 'wood harvesting intensity' and

'forest area as a percentage of land area'. An attempt to aggregate all the CSD indicators, using the forest ecosystem measurement could be beneficial.

31. The indices of freshwater and marine ecosystems have also gathered valuable information related to the decline of species in freshwater and in marine ecosystems (information has been compiled for more than 102 species**),** and also in coral bleaching. In the CSD approach, these indices could fall under the theme of 'biodiversity' and 'ocean, seas and coasts' (especially in the coastal zone sub-theme) contributing to a simpler aggregation method for those themes.

3.3. Human Development Report Indices

Organization: United Nations Development Program (UNDP)

Title of the study: The 1999 Human Development Report

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Description:

a) The Human Development Index measures the overall achievements in a country, and is a combination of three indices: Life Expectancy Index, Educational Index and Gross Domestic Product Index.

b) The Human Poverty Index (HPI) measures the distribution of progress and the impacts of its deprivations. It comprises two different indices:

- HPI in developing countries: measures the percentage of people expected to die before the age of 40; the percentage of adult literacy; the percentage of people without access to health services, safe water and sanitation; and the percentage of underweight children under five.

- HPI in industrialized countries: measures the percentage of people likely to die before the age of 60; the percentage of people who are functionally illiterate; the proportion of long-term unemployment (12 months or more); and the proportion of people with disposable incomes of less than 50 percent of the median.

Potential contribution to the CSD aggregation effort

32. The UN Human Development Report and associated indices are an effective approach to quantifying the social aspects of development, particularly those related to poverty and gender. The indicators are user friendly, can be applied to any country, and their evolution trends through the years offer a clear picture of a country's social inequalities.

33. The indices that are more valuable for the CSD aggregation process are contained in the Human Poverty Index (both in the industrialized and the developing countries). The CSD has three indicators in the poverty sub-theme: percentage of population living below the poverty line, Gini index of inequality and unemployment rate. In the case of aggregating an index, using the HPI index of UNDP to evaluate poverty should be considered since countries are already familiar with it, information already exists for a considerable number of countries and it has already been accepted as an international index.

34. The Human Development Index integrates aspects related to life expectancy, education and adjusted income. It is interesting as a separate index, but those aspects are already considered in separate themes in the CSD approach and its integration would not make the aggregation process easier nor provide any added value to the indicator set. However, it is an interesting index to consider because of its development orientation and it could be useful as a parallel source to the CSD framework.

3.4. Well-being Assessment

Organization: IUCN-The World Conservation Union, PADATA, International Development Research Centre.

Title of the study: The Well-being of Nations: a country-by-country index of quality of life and the environment

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Description:

35. Well-being Assessment is a method of assessing human and environmental conditions and progress toward sustainable development. Its underlying hypothesis is that sustainable development is a combination of human and ecosystem well-being. The hypothesis is expressed in the metaphor of the Egg of Well-being: the ecosystem surrounds and supports people much as the white of an egg surrounds and supports the yolk. And just as an egg can be good only if both the yolk and white are good, so a society can be well and sustainable only if both the people and the ecosystem are well.

36. On the basis of these assumptions, the method treats human and ecosystem well-being as equally important. Information is organized into two subsystems, people and ecosystem, each of which is divided into five dimensions:

- Human Well-being:
  - Health and population
  - Wealth
  - Knowledge and culture
  - Community
  - Equity

- Ecosystem Well-being:
  - Land
  - Water
  - Air
  - Species and genes
  - Resource use

37. The dimensions are designed to combine a wide range of topics into a few major groups of roughly equal importance. They accommodate concerns common to all societies, without requiring a society to address matters of little relevance or excluding issues of interest to some but not to all.

38. Users of the method identify key elements of each dimension and indicators of each element. They decide their own goals for the subsystems, objectives for the elements and performance criteria for the indicators. The criteria enable indicator measurements to be scored using five bands of performance for the indicator concerned. These bands correspond to the Barometer of Sustainability, a graphic 0-100 performance scale with two axes: one for human Well-being, the other for ecosystem Well-being. It is further divided into five bands: good, OK, medium, poor and bad.

39. Participants decide performance criteria on the basis of the range of actual performance, the objective of the element that the indicator represents, and factors such as estimated sustainable rates, observed thresholds, international/national standards or targets, expert opinion, and the consensus judgment of participants.

40. Indicator scores are combined into element scores, and element scores into dimension indices in standard ways: unweighted average, weighted average, or lower/lowest value. The choice depends on how well the component (indicator, sub-element or element) represents the dimension, how reliable the data is, and whether the data is available for all or some of the societies/ecosystems being assessed.

41. The dimension indices are considered to be equal in weight and are aggregated into subsystem indices by averaging them. The Human Well-being Index (HWI) is the average of the human dimensions, except that equity is excluded if it raises the index. This prevents a high score for equity (which measures only how well conditions are shared) from offsetting poor performance in the other human dimensions (which measure the actual condition of people). The Ecosystem Well-being Index (EWI) is the average of the ecosystem dimensions, except that the resource use is excluded if it raises the index. This prevents a high score for resource use (which measures pressures on the environment) from offsetting poor performance in the other ecosystem dimensions (which measure the state of the environment).

42. The HWI and EWI are combined graphically into a Well-being Index - the point on the Barometer of Sustainability where the HWI and EWI intersect. The Barometer provides an immediate picture of the three indices. It can display the performance of groups of societies (countries in a region, provinces in a country, districts in a province) and the status of the 10 dimensions in a single society.

43. Well-being Assessment has been developed and tested by the IUCN/IDRC International Assessment Team, PADATA, and teams in Asia, Africa and the Americas, working on local, provincial and international assessments. *The Well-being of Nations* has developed and applied the method to a global assessment of 180 countries, analyzing and combining 89 indicators.

Potential contribution to the CSD aggregation effort

44. Wellbeing Assessment is an innovative process of combining socioeconomic and environmental data into indices. It provides a comprehensive approach to measuring progress, and through the Barometer of Sustainability, gives a visual picture of the present state. The concept of the egg of well-being clearly shows the interdependence of humans and their environment.

45. The procedure for aggregating indicators to dimensions could be beneficial for the CSD effort to create an index of sustainability. All of the topics covered by the CSD framework would fit in one or another of the dimensions. Some of them, for example Health and Population, Equity, Land, Water, Air and Species, are very similar to the CSD themes.

3.5. The Ecological Footprint

Organization: Mathis Wackernagel & William Rees

Title of the study: Our ecological footprint: reducing human impact on the earth

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Description:

46. The Ecological Footprint measures the corresponding area of productive land and aquatic ecosystems required in order to produce the resources used, and to assimilate the wastes produced, by a defined population at a specific material standard of living.

47. Its calculations are based on the concept of carrying capacity, which is the maximum rate of resource utilization and waste generation that can be sustained indefinitely without progressively impairing the productivity and functional integrity of relevant ecosystems.

48. In order to calculate it, the per capita land area appropriated for the production of each major consumption item is estimated (this is done by dividing the average annual consumption of the item considered by its average annual productivity or yield). Once measured, the total per capita ecological footprint is computed by adding all the ecosystem areas appropriated by individual items in the annual shopping basket of consumption goods and services.

49. The end result is the per capita footprint, which, when multiplied by the population size, will give the national ecological footprint of a country.

Potential contribution to the CSD aggregation effort

50. The Ecological Footprint is an easy tool that offers a clear idea of the over consumption of natural capital and the corresponding pressure on a country's carrying capacity.

51. It does not require extensive data and its calculations are based on a small group of indicators. One of its advantages is that it considers the export of pollution and import of ecosystem services in its calculation.

52. This index could be easily calculated from the data gathering that the CSD framework suggests. Although its aggregation process does not contribute to creating a sustainability index for the CSD indicators, it could be an interesting index to account for as a parallel information source. As it varies conceptually from the sustainability objectives on what should be measured, it its worth maintaining as a separate index (countries could improve their policy making by knowing the impact their decision making will have on the Ecological Footprint index).

3.6. Genuine Progress Indicator and Index of Sustainable Economic Welfare (ISEW)

Organization: Redefining Progress

Title of the study: Genuine Progress Indicator, 1998

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Description:

53. The Genuine Progress Indicator and the Index of Sustainable Economic Welfare are attempts to construct a truly adequate measure of economic well-being. Although it is assumed that no accounting will ever answer all the complexities of matching economic progress and human satisfaction, their efforts are focused on improving the Gross Domestic Product (GDP) and accounting for some of the externalities it does not consider.

54. In the case of the Genuine Progress Indicators, its contents are the following:

- Crime and family breakdown
- Household and volunteer work
- Income distribution
- Resource depletion
- Pollution
- Long-term environmental damage
- Changes in leisure time
- Defensive expenditures
- Lifespan of consumer durables and public infrastructure
- Dependence on foreign assets.

Potential contribution to the CSD aggregation effort

55. These methods attempt to create new indicators that measure sustainable growth, not only traditional economic growth. They are easy to interpret and their comparison with the GDP highlights the controversy of the different models of growth and progress depending on the

assets considered. However, their calculations are subjective and the process is still evolving. But it is a good starting point for considering alternative methods of measuring growth and ultimately, an alternative indicator to GDP.

56. In the case of the Genuine Progress Indicator (GPI), through the aggregation process, a cost to growth ledger is added and it accounts for the aspects of the economy that lie outside of the monetary exchange system. It assigns value to the life-sustaining functions of households, communities and the natural environment so that the destruction of these, and their replacement with commoditized substitutes, gets subtracted from wealth creation. Aspects such as defensive expenditures are also subtracted.

57. In the CSD framework, the indicators considered to evaluate the economic structure are still based on GDP measurements. Although the deterioration of natural resources is contemplated in other themes, it could be interesting to consider adding some aspects of internalization of externalities.

58. Although there are some issues that the CSD framework does not consider (like leisure time, household or volunteer work, etc.) other factors are considered and could be useful for aggregation (for example, how crime, defensive expenditures or dependence on foreign assets is subtracted from generation of capital).

59. However, both the ISEW and the GPI are still controversial in their aggregation methods. They could both be good indices to consider parallel to the CSD efforts, but their techniques of aggregation are not helpful in defining a CSD index.

3.7. Policy Performance Indices

Organization: European Commission, DG 34/F3 (Eurostat/Environment Unit)

Title of Study: A European System of Environmental Pressure Indices

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Description

60. The project aims at a comprehensive description of environmental, economic and social "policy performance". The environmental sub-index is characterized through the following ten indices of environmental pressure:

- Air pollution
- Climate Change
- Loss of biodiversity
- Marine environment and coastal zones
- Ozone layer depletion
- Resource depletion
- Dispersion of toxic substances
- Urban environmental problems
- Waste
- Water pollution

61. Each of these ten "policy fields" is described by six pressure indicators, and the indices are an aggregation of these indicators. While EUROSTAT regularly publishes the sixty indicators ("Towards Environmental Pressure Indicators", see http://www.e-m-a-i-l.nu/tepi/tepiorde.htm), research on aggregation, and on the extension to CSD-style Sustainable Development indicators, is done at the European Commission's Joint Research Centre (http://esl.jrc.it/envind/index.htm).

62. The ultimate goal of the initiative, which cooperates closely with the "Dashboard" project of the IISD-based Consultative Group on Sustainable Development Indices (CGSDI), is to replace the current lead indicators (such as GDP, inflation and unemployment rates) by a "Policy Performance Index" composed of three environmental, social and economic sub-indices. The aggregation procedure is as follows: physical indicators such as CO_2 emissions are aggregated to 10 sub-indices. These indices are then aggregated into three major indices (environmental, social and economic performance), and finally are condensed into an overall Policy Performance Index (PPI).

63. The weighting system proposed is to distribute – based on surveys among experts, stakeholders or the general population – a given "point budget" at each level of aggregated information (at the highest level between environment, social and economic aspects; at second-highest level e.g. between poverty, health system, children care, pension schemes, education, gender, equality dimensions, etc.).

Potential contribution to the CSD aggregation effort

64. One interesting contribution of this initiative is a clear distinction between "weighting" (i.e. assigning relative importance to environmental, social and economic performance) and "valuation" (i.e. the judgment of the current situation or trend). The valuation of indicators and indices is communicated using a simple color code from green ("very good") to yellow ("acceptable") to red ("very bad, critical"), and is based on a standardization of the indicators through comparison to other countries, e.g. the fifteen EU Member States. In order to ensure credibility of the aggregation procedure, it is intended to reveal the different weights that stakeholders assign to a particular area, and to use Sensitivity Analysis for evaluating if such differences significantly influence the overall index value. For example, although the perceived relative weight of environmental, social and economic indicators will differ between environmentalists and industry experts, these differences might have little influence on the overall value of a PPI.

65. The overall product is a set of three circles segmented into different indicators, with different colors depending on the policy performance of each indicator/index and varying in the size of the segment, thus reflecting the importance of each issue for politics. In an Internet-based version of the PPI, the user will be able to access additional, disaggregated information by clicking on the segments for each indicator.

66. The initiative is an ambitious attempt to weight the different aspects that relate to sustainable development and to form one single index for decision-making. The indicator set of the prototype version resembles the CSD set but is considered preliminary, and currently equal weight is assigned to each index component (although the expert survey-based weighting procedure has been tested in an earlier German study). The constituency of the stakeholder groups needed to establish proper weights could be controversial. It is an interesting initiative, that the countries using the CSD framework may wish to consider if they wish to assign weights to the sub-themes and themes.

3.8. Pilot environmental sustainability index

Organization: World Economic Forum in collaboration with the Yale Center for Environmental Law and Policy (YCELP) and the Center for International Earth Science Information Network (CIESIN)

Title of the study: Pilot Environmental Sustainability Index: An initiative of the Global Leaders for Tomorrow Environment Task Force.

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Description:

67. This initiative has created an index based on five major components. Each component consists of different factors (there is a total of 21 factors) and each factor has a series of variables (there is a total of 64 variables).

68. The components were derived from an analytical exercise aimed at systematically identifying the factors that consider environmental sustainability, consistent with recent research. It describes the following issues:

- Environmental systems
- Environmental stresses and risks
- Human vulnerability to environmental impacts
- Social and institutional capacity
- Global stewardship

69. The model has been implemented in 56 countries and it is currently being expanded to include 100 countries. Australia, Austria and Canada were found to have the best environmental sustainability index while the Ukraine, Vietnam and Zimbabwe were found to have the lowest.

Potential contribution to the CSD aggregation effort

70. The Environmental Sustainability Index (ESI) is similar in its structure to the CSD framework. It contains three major levels of data (components, factors and variables) that correspond to three areas of the framework (themes, sub-themes and indicators).

71. The way in which the components were selected, however, varies considerably from the CSD themes. The focus is based primarily on analyzing the interrelation between human activities and the environment, with little attention paid to social or economic development.

72. Despite this, the initiative has been successful in gathering a considerable amount of information on a relatively large number of countries. In the process of aggregating the data, no weighting is assigned to the different variables in order to give a value to the factors. This creates a considerable amount of controversy since the assumption that every variable has the same effect in development could lead to confusion and possible misinterpretation. Hence, policymakers would find it difficult to define action priorities based on the data.

73. However, at present, the initiative is aimed at maintaining the transparency of the pilot model while including a weighting system for the variables. Through the introduction of an interactive spreadsheet, the ESI will offer the possibility of performing an individual evaluation of the variables. The spreadsheet will have the following properties:

- It will allow the ESI user to alter the values of the variables for a country and observe the impact on ESI (for purpose of scenario analysis or model sensitivity analysis).
- It will allow the ESI user to change the weighting algorithm at different levels of analysis: The user will be able to experiment with different weights for each of the 65 variables included in the ESI, or at the level of the 21 aggregated factors, and also to individually assign different values and observe the effect on the aggregated index.

74. In addition, it will also allow the ESI user to compare this index to other common indices, such as the HDI, WWF consumption pressure index, the Index of Human Insecurity, etc.

3.9. The Dashboard of Sustainability

Organization: IISD/Consultative Group on Sustainable Development Indicators

Title of the study: The Dashboard of Sustainability

Contact:

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Description:

75. This approach uses a virtual instrument panel or dashboard that consists of three displays, corresponding to three clusters of indicators that measure the status of the environment, the economy and the social well-being of a nation. The information is presented in the form of dials

and the overall state of the nation is reflected in a composite status index that is a color bar bridging the three dials.

76. The three different dials are labeled "Environmental Quality", "Economic Performance" and "Social Health". Each dial is comprised of three indices, which are:

- A needle: pointing to a value that reflects the current performance of that system
- A Graph: reflecting the change in that performance over time
- A Gauge: showing the amount remaining of certain critical stocks

Potential contribution to the CSD aggregation effort

77. This tool is in the process of being created and has not yet been formally tested. The idea of the dashboard is interesting because it is visual and lays out the information in a very simple and comprehensive way. The system of red alerts, signaled when the needle surpasses a pre-established level, could be highly beneficial for policy-making and an interesting tool for the analysis and identification of risks.

78. However, the indicators used in the methodology at this stage are still very basic. While it could be useful in providing a general overview of progress towards sustainability it provides insufficient detail at present to be an effective tool for policymakers.

79. For example, at first, the 'Economic Performance' area was a combination of the GDP growth rate and other measures such as inflation, productivity and debt servicing. But due to the complexity of the index and to the fact that it has not yet been developed, only GDP growth is currently being used to measure economic performance. While it is useful to have a general picture of economic growth, it does not indicate whether economic growth is sustainable or not.

80. In the case of Social Health, the index is based on the UNDP's Human Development Index, subtracting the GDP-linked components. It considers: population growth, unemployment, poverty gap index, crime rate, housing affordability, nutritional status of children and democratic participation (as a voting rate).

81. It is an approach that includes most of the themes that the CSD framework uses. However, in order to measure Social Health more broadly, its components should be expanded. For example, neither 'education' nor 'equity' is considered as a major aspect of social health, and the only Health indicator used is children's nutritional status.

82. The Environmental Quality Index (EQI) is an aggregation of seven key environmental pressure measures: greenhouse gas emissions, water quality, air quality, dispersion of toxic substances, soil degradation, waste disposal and urban sprawl. This index is the most elaborate in the dashboard system. However, no detailed information is available to explain how the different key environmental pressure measures are aggregated into the EQI. Depending on the aggregation

technique, this index could be beneficial for the CSD framework as a parallel index that measures environmental tendencies.

83. Another contribution of this initiative is the visual display of the dashboard. If the CSD framework decides to analyze the themes separated by different areas, a dashboard containing the four areas that the CSD framework is considering could be beneficial to provide policymakers with a useful visual adaptation of the different trends.

IV. CONCLUSIONS RELATED TO THE INITIATIVES ANALYZED

84. Based on the above analysis of the initiatives considered, the following conclusions can be drawn:

85. There are a lot of initiatives that have aggregated information into indices for various dimensions of sustainable development and their processes can be useful for the CSD aggregation process.

86. In general, these initiatives have compiled a considerable amount of information on the different social, economic and environmental areas. It is important to consider the information provided by these initiatives and that the pilot countries involved in the CSD testing process are aware of this compilation of information.

87. The environmental area is by far the most developed in integrating indicators through aggregation processes into useful indices. However, the general indices used seem to lack international consensus as to their validity in measuring the environmental situation as a whole and it is unclear which one of them offers the better solution.

88. In the economic area, the Genuine Progress Indicator (GPI) and the Index of Sustainable Economic Welfare (ISEW) are not indices established through a consistent methodology and their aggregation systems are rather subjective. While they could be useful alternative indices for evaluating economic consequences, attention must be paid to their subjectivity. Indexes that improve on GDP are still necessary and further research in this area should be encouraged.

89. The social area is also not as developed when it comes to defining broad impact. The most representative index by far is the Human Development Index, although it is still viewed with skepticism by some for its lack of sensitivity in some of its components. In addition, its use at the country level as an instrument for actually influencing and monitoring national policy-making needs to be further studied.

90. The institutional dimension covered in the CSD Work Programme is not taken into account by the majority of the initiatives. There is no general index addressing institutional issues. It will be important to do further research in this area.

91. In general, there is not enough public information available about the aggregation processes. The concrete methodological details of the aggregation process that the various initiatives used are not reflected in most of the reports. In order to understand their procedures, it was necessary

to contact most of the people responsible for them. It would be useful if the organizations in charge of the initiatives included as many methodological details as possible in their reports.

92. The key question that remains in order to establish an aggregation system is the weighting system, how to prioritize each component and finally, how to add them up into one index. Initiatives such as the Environmentally Sustainable Index (ESI) that provide a method by which policymakers can assign their own weightings and priorities, are very interesting due to the flexibility they allow.

V. CONCLUSIONS AND RECOMMENDATIONS FOR CREATING A SUSTAINABILITY INDEX FOR THE CSD FRAMEWORK

5.1. Introduction

93. As demonstrated by the initiatives analyzed, creating an index for sustainability is a significant challenge due to the large number of dimensions and factors that have to be taken into account. In order to use an aggregation technique for the CSD framework, it is necessary to review the different theoretical steps of aggregation and consider the possibility of adapting them to the indicators selected.

94. One of the major complexities when aggregating information into indices, is how to establish a weighting system that integrates data without loosing its meaning or becoming too subjective. The complexity of defining a weighting system increases when evaluating sustainable development due to the different areas that it comprises. In addition, establishing a weighting system at an international level that can be applied to every country complicates the process further due to the fact that every country has different priorities and faces a different set of problems.

95. One possible way to avoid having to reach an international consensus on weights for each of the indicators, is to allow every country to establish its own national weighting system defined by its own priorities and vulnerabilities. On the other hand, however, the result would be multiple priorities with no way of comparing results across countries. Such comparisons could be useful for policymakers since it would provide information on the effectiveness of policies implemented in different countries.

5.2. Criteria for Aggregation

In order to create an aggregation process the following criteria can be helpful:

96. Aggregation can be done using scientifically sound weighting factors, which means they are reproducible, internationally recognized and relatively objective (e.g. CO_2 equivalents by the International Panel on Climate Change – IPCC), or by using societal values developed by the social sciences (for instance, through representative panels or Multi Criteria Decision Making methods). However, they are also being done subjectively by some institutions. These two types of weighting factors should never be combined in the same step of aggregation. It is

recommended to combine them in a sequential way: first, those based on scientific results and then those based on subjective value judgments.

97. The aggregation process must be completely transparent. As base information is lost through the process, the user should be able to know how the data was transformed and should also be able to go back to the raw data if necessary. One method of generating indicators, results in subjective scores while the other seems to involve highly simplified assumptions about complex environmental, societal or economic processes. This must be studied prior to the aggregation process. Increased transparency is essential for decision makers to understand the usefulness of the CSD indicator set and the aggregation method used when making policy choices and for receivers to understand what this tool does and does not say about the system being studied and consequent limitations in the result.

98. Different types of indicators are found in the cause-effect chain. Aggregation should occur with independent indicators placed at the same step in the chain. For instance, one could aggregate the use of fertilizers (CSD 24) and of pesticides (CSD 25), but not together with biological oxygen demand (CSD 34) or biodiversity of species (CSD 38), which are one and two steps ahead in the cause-effect chain. Some indicators describe potential impacts on sustainability and others describe actual impacts. These clearly should not be mixed.

99. Prior to aggregation, indicators should be converted into intensive magnitudes and standardized to the same reference. The aim of standardization is to better understand the relative proportion or magnitude for each indicator of a theme or sub-theme. More specifically, standardization could involve dividing the indicator score by the overall magnitude of that indicator for a certain area (or mean of areas) and a certain time period. In doing so, all indicator scores would be expressed in the same dimension of time and space. This would in turn increase the comparability of the results and prepare the indicator set for aggregation.

100. When determining the weighting factors required to aggregate indicators from different categories or themes (which are difficult to compare scientifically), social sciences should be factored in. Some possible methods include panels (like the Delphi panel) using multi-criteria analysis, monetary data, or distance-to-target methods.

101. The distance-to-target method appears to be the preferred method. The target reference of an indicator theme can be built out of legal or internationally agreed data (meaning desirable limits to certain indicators, such as political targets).

102. Other generic weighting sets could be based on population surveys (e.g., the Eurobarometer) or the Delphi-method. While the first uses social preferences and values of the population directly, the second derives priorities of environmental/sustainability experts and/or social actors.

103. The principles of sustainable development could also be used since widespread consensus on the concept exists. Thus, these principles could serve as a solid basis for evaluation. Some potential criteria include: time aspects of the indicator (short-term vs long-term); spatial aspects

of the impact (global, regional or local effects); depth and complexity of the impact cause-effect chains; degree of irreversibility; or transgression of sustainable levels; etc.

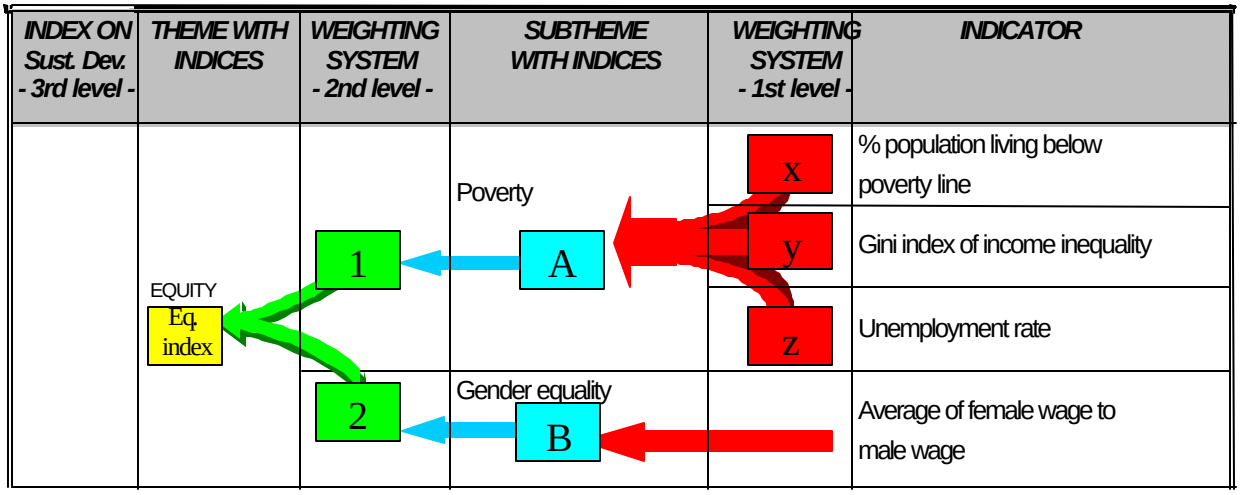
104. Information that could also provide a good basis to assist those defining the weighting of societal factors are associated with the international human rights conventions, and international laws and conventions. Such information could provide a reference point to possible weighting considerations. The human right to enjoyment of the highest attainable standard of physical and mental health, the conventions of the Rio Earth Summit in 1992, the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, the International Convenant on Economic, Social and Cultural Rights, the Convention on Rights of the Child, Statement of Forest Principles, etc., are some examples to examine.

105. Finally, an aggregation process should be followed by a sensitivity analysis in order to determine the stability and effect of different assumptions on value judgments to the final results.

5.3. An Alternative Aggregation System for the CSD framework

106. In order to complete an aggregation process for the CSD framework, the following levels of weighting should be considered (see Figure 1):

Figure 1. Aggregation process for the CSD indicator framework



107. First Level: Assign weights to the indicators in order to have an index for each sub - theme. With the current indicator list, the following weightings will have to be completed:

- weighting of four indicators:
  - Waste Generation and management
- weighting of three indicators:
  - Poverty
  - Healthcare delivery
  - Energy use
  - Agriculture
- weighting of two indicators:
  - Mortality
  - Population change
  - Forests
  - Coastal zone
  - Water quality
  - Ecosystem
  - Economic Performance
  - Financial Status

108. Second level: Assign weights to the sub-themes in order to have an index for each theme. With the current sub-theme list, the following weightings will have to be completed:

- weighting of five sub-theme indices:
  - Health
- weighting of four sub-theme indices:
  - Land
  - Consumption and Production Patterns
  - Institutional Capacity
- weighting of three sub-theme indices:
  - Equity
  - Atmosphere
  - Economic Structure
- weighting of two sub-theme indices:
  - Education
  - Ocean, Seas and Coasts
  - Fresh Water
  - Biodiversity
  - Institutional Framework

109. Third level: The third level will be the most complex. Assigning a weighting factor to each of the themes is not an easy process and the valuation could be so subjective, that the final index could lose its relevance.

There are different possibilities to aggregate data at this level:

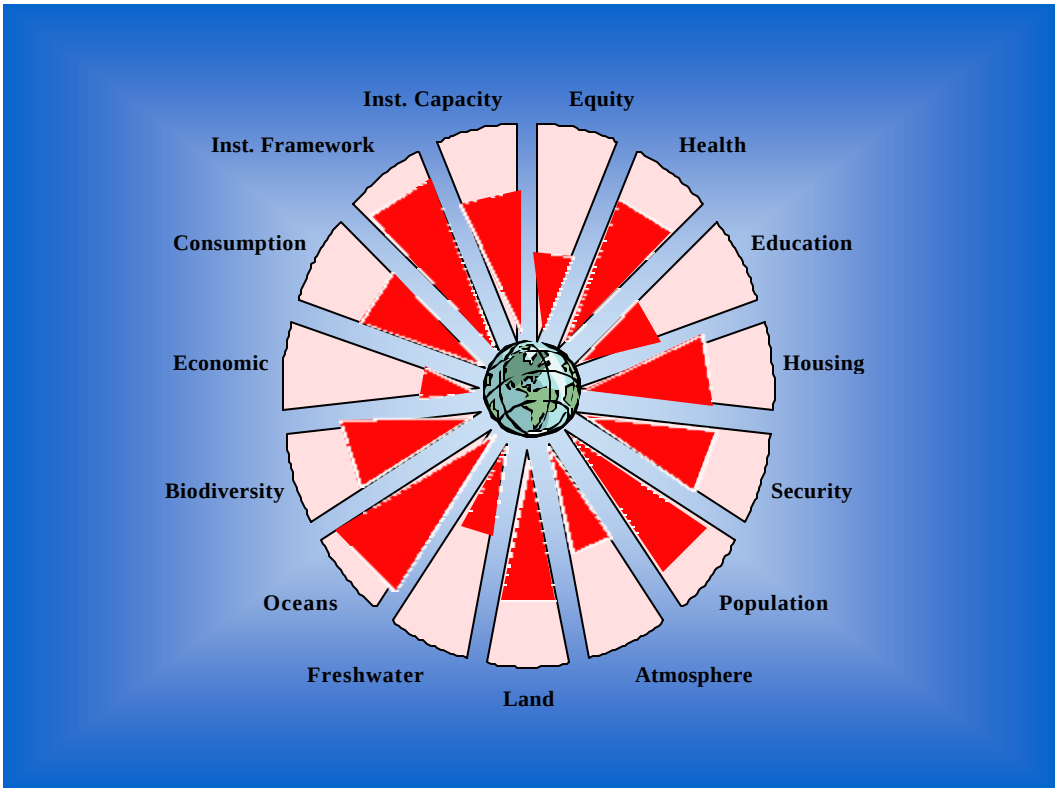
a) Equal weighting system

110. This alternative is based on establishing the same weighting for all the themes with two possible outcomes:

a.1.) Create a single, comprehensive sustainability index with an equal weighting system by compiling all the thematic values. This option is not recommended because adding up all the themes in the same degree could create confusion in defining which are the principal priorities and what policies should be implemented in order to progress towards sustainable development.

a.2.) Consider each theme as a separate value and create a visual chart of its implications. This alternative would be similar to the one presented by the European Commission (DG34) and Eurostat (see section 3.7.), in the report entitled "A European system of Environmental Pressure Indices (ESEPI)" (see Figure 2).

Figure 2. Relevance of Themes for sustainable development



b.) Establishing weighting factors

111. This alternative would be based on assigning weighting factors to each separate theme and could have three different outcomes:

b.1. Standardize the weighting at an international level: Achieve consensus in assigning the weighting at an international level, so the same weighting can be applied to every country and all the national performances towards sustainable development can be compared on the same basis. This option has many advantages due to how the countries can benefit from the comparability between their results and value the impacts and the effectiveness that certain policies had in the overall index. However, achieving this consensus is highly complex and rather unrealistic due to the fact that every country has different priorities and vulnerabilities and the weighting should reflect that.

b.2. Each country assigns its own weighting system according to its own priorities: This would allow the index to reflect individual country necessities, and would offer a better information set that, ultimately, would improve policies aimed at sustainable development. However, this approach will not provide the international benchmarks of progress that would allow policymakers to evaluate the effects of policies implemented in different countries.

b.3. Create a national weighting system and propose international consensus for comparison such as the one being undertaken by the Environmental Sustainability Index (ESI) (see section 3.8.). The CSD framework could be organized to enable every country to establish its own weighting system that could be changed according to its evolving necessities on one hand, and come to an agreement in establishing a common weighting system for international comparison, on the other hand.

c.) Consider The mes in different areas or groups.

112. Another alternative would be to integrate the 15 themes selected into major groups of impacts, establish weighting systems between each group, and create four different indexes (environmental, social, economic and institutional). This alternative is similar to the one developed by the IISD (see section 3.9.) for the Dashboard of Sustainability. In order to adjust it to the CSD framework, the following four groups would be assigned:

- Social: integrate equity, health, education, housing, security and population.
- Environmental: integrate air, land, ocean, seas and coasts, fresh water and biodiversity.
- Economic: integrate economic structure and consumption, and production patterns.
- Institutional: integrate institutional framework and institutional capacities.

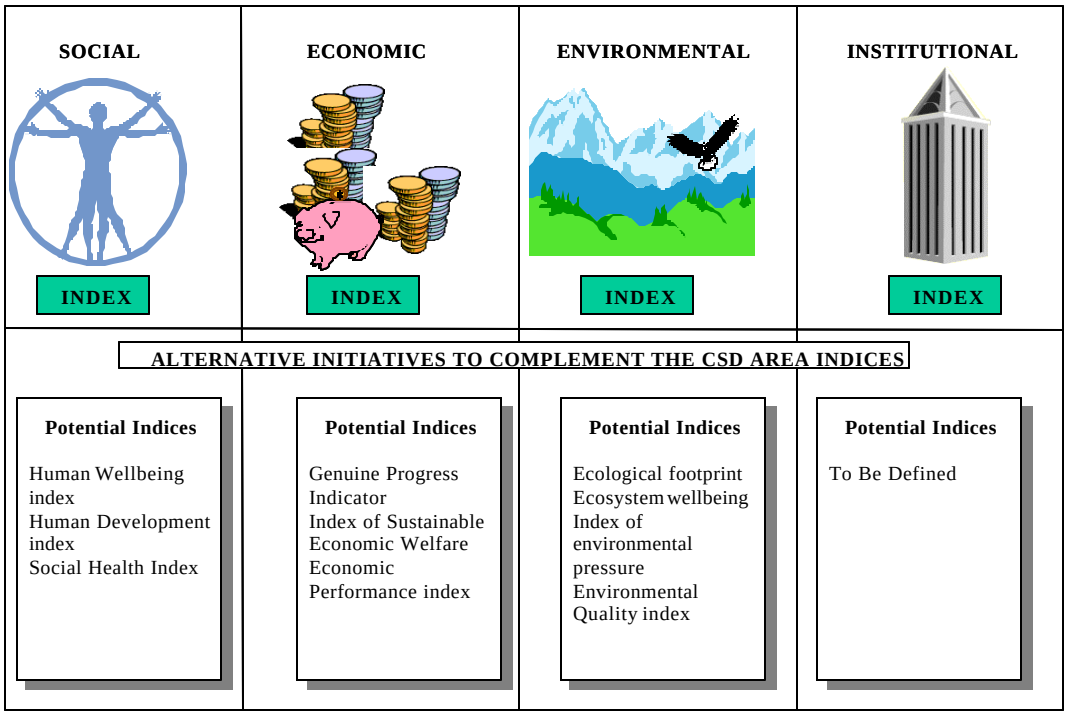
113. Should this alternative be implemented, it is recommended that further research be undertaken on the linkages that exist between areas and eventually, a report outlining the implications.

114. Once the major groups are formed, the index will reflect the results of the CSD indicators aggregated between each area field. In addition, alternative indexes of other international

initiatives for each area could be assigned to allow policymakers a simple and effective reference point, not only of the results of the CSD indices, but also of other initiatives and their implications. Based on the analysis of the major initiatives that are currently being implemented, the following are some of the ones that could be useful for this purpose (see figure 2):

- Social
  - Human Well-being indicator.
  - Social Health Index
  - Human Development Index
- Environmental
  - Ecological Footprint
  - Environmental Quality Index
- Economic
  - GDP
  - Index of Sustainable Economic Welfare
  - Genuine Progress Indicator
- Institutional
  - To be defined

Figure 3. Potential indices for the CSD indicator Framework



Annex I. Initiatives considered

Aggregation Initiative	*Organization*	*Contact Person*	*Brief Description*	*Contribution to CSD framework*	*Comments*
City Development Index	Habitat	Jay Moor phone: (+254) 262-4264 Email: jay.moor@unchs.org www.undp.org/un/habitat/guo/uip.htm (Kenya)	Formed by five indices: Infrastructure, Waste, Health, Education and City Product	The rationale of assigning the weighting system to aggregate each individual index	The five indices measure aspects of the themes, but relevant issues are left out. The overall aggregation considers all the indices to have the same weighting.
Living Planet Index	World Wide Fund for Nature International	Mr. Jonathan Loh phone:41-22-3649585 Email: JONATHAN.LOH@wwfnet.org www.panda.org/livingplanet/lpr/index.htm(Canada)	Formed by two major indices: The Living planet Index (which consists of natural forests, freshwater species and marine species) and the Ecological Footprint.	The index used to value natural forests and biodiversity is very simple and straightforward. A lot of information gathered. CSD should question whether to use these values.	They have decided to change their Consumer Pressure Index for the Ecological Footprint.
Human Development Report Indices	United Nations Development Program (UNDP)	Richard Jolly phone: 212-9063661 e-mail: hdro@undp.org www.undp.org/hdro/99.htm (New York)	Four basic indices: Human Development Index, Human Poverty Index and GENDER	Interesting index measurements to consider them parallel to the CSD Framework (specially the Human Poverty Index).	The rest of the indices (Gender, Development, etc.) are not applicable for the scope of the CSD framework because they have a different focus
System Assessment Method	FAO and World Conservation Monitoring Center	Mr. Robert Prescott-Allen phone: (250) 474-1904 E-mail rpa@padata.com http://iucn.org/themes/eval/english/samwon.htm (Canada)	It is based in the Wellbeing of Nations, introducing the "Egg of Wellbeing" formed by Ecosystem Wellbeing and Human Wellbeing	Some of the dimensions are chosen are similar to the CSD framework and could help aggregate Themes into indices.	Aggregation uses several techniques (unweighted averages, weighted, and lowest value) and it could be controversial.
The Ecological Footprint	Mathis Wackernagel & William Rees	Mathis Wackernagel phone: 415-7811191 Email: wackermagel@rpgrogress.org www.newsociety.com/oeffs.html (USA)	Measures the land and aquatic area required to produce resources and assimilate their wastes	Interesting to consider as a parallel index to the CSD in order to measure environmental performance of countries	They do not consider any social nor economic indicators to evaluate the linkages.

Aggregation Initiative	***Organization***	***Contact Person***	***Brief Description***	***Contribution to CSD framework***	***Comments***
Genuine Progress Indicator and Index of Sustainable Economic Welfare	Redefining Progress and Herman Daly	Mathis Wackernagel phone: 415-7811191 Email: wackermagel@rpgrogress.org www.rprogress.org/pubs/gpi1999/gpi1999.html www.uwc.ca/pearson/ensy/ecofoot/ecofoot.htm (USA)	Indicators that attempt to improve the Gross National Product measurements including environmental and social values	Interesting to consider as a parallel index to the CSD indicators	Their aggregation method is controversial and still being developed.
Policy Performance Indices	European Commission. Eurostat (DG34) and Eurostat	Jochen Jesinghaus phone: 39-0332785287 email: jochen.jesinghaus@jrc.it http://esl.jrc.it/envind/ (Italy)	Policy Performance Index is proposed as an aggregation process of 10 different indices.	The initiative establishes weighting systems based in consensus and international standards. It also evaluates the relevance that different stakeholders assign to each value.	It has not been tested yet. Could be controversial in how group consensus is built.
Pilot environmental Sustainability index	Yale Center for Environmental Law and Policy (YCELP)	Daniel C. Esty Phone: 1-203 4323123 Email: epcenter@pantheon.yale.edu www.yale.edu/envirocenter/ and Marc Levy phone: 1-(845) 365-8988 Email: marc.levy@ciesin.org www.ciesin.org/programs.html (USA)	Index based in five components (environmental systems, environmental stresses and risks, human vulnerability to environmental impacts, social and institutional capacities and global stewardship)	They have a total of 64 variables and information from 56 different countries. It Is going to be expanded to one hundred countries. They are establishing an interactive weighting system that will allow selecting personal weights.	Their focus is the interaction between humans and the environment.
The Sustainability Dashboard	Consultative Group on Sustainable Development indicators, IUCN	Dr. Peter Hardi phone: (204) 958-7731 Email: phardi@iisd.ca http://iisd.ca/cgsdi/dashboard.htm (Canada)	Information panel formed by three dials labeled as "Environmental Quality", "Economic Performance" and "Social Health".	The way information is processed in a dashboard panel is very useful to have a visual idea of sustainability progress.	Their indicators and aggregation on Economic Performance and Social Health are very general and simplistic. We do not have information on the aggregation of their Environmental Quality Index.