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The SEEA as a Statistical Framework to meet Data Quality Criteria for SDG indicators

Revision 1

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1. Introduction

1. One key aspect of meeting the post-2015 development agenda is the ability of countries to effectively and sustainably monitor progress towards meeting defined sustainable development goals through the use of relevant indicators. Increasing focus on sustainable development requires a more integrated approach to policy decisions, based on a better understanding of the interactions and tradeoffs between different realms of sustainability. This will require an integrated system of information which makes the interactions and interrelations between social, economic and environmental dimensions explicit at different levels of disaggregation. In this context, the System of Environmental-Economic Accounts 2012 (SEEA) captures the environment and its contribution to the economy in a system of information, which is aligned with the system used to measure economic activity (i.e. the System of National Accounts (SNA)). The SEEA Central Framework was adopted in 2012 by the UN Statistical Commission as an international statistical standard.

2. The SEEA and SNA are integrated statistical frameworks which can support the derivation of high quality indicators. By providing a standard set of definitions, classifications and methodologies for integrating information, these statistical frameworks ensure methodological soundness when calculating indicators. In turn, these indicators are supported and supplemented by detailed environmental and economic statistics organized within accounting structures to enable more detailed policy analysis. It is through the use of the accounting structures and principles of accounting balances that basic data is organized and data quality improved.

3. The monitoring experience of the MDGs has shown that high quality data will play a central role in advancing the new development agenda. This was recognized in the Report of the High Level Panel of Eminent Persons on the Post-2015 Development Agenda, which called for a 'Data Revolution' in reflection of the need for better, faster, more accessible and more disaggregated data to bring poverty down and achieve sustainable development. It was acknowledged that the new data demand will require country ownership and government commitment to build statistical capacity[1]. In the long run this will require a transformation of national statistical systems towards the efficient production of integrated statistics across a wide spectrum, and achieved through the adoption of common statistical frameworks and processes. Implementation of the SEEA therefore represents an important step in this longer term process, by developing a set of accounts and related statistics and indicators, which integrate information on the economy and environment.

4. In this context, this paper illustrates how integrated statistical frameworks such as the SEEA can facilitate the production of statistics and indicators which are of enhanced quality. To this end, section 2 discusses the nature of statistical frameworks compared to other conceptual frameworks used for choosing and organizing sustainable development indicators. Section 3 presents a set of data quality criteria for SDG indicators, against which SEEA-based indicators should be assessed for their 'quality'. Section 4 sets out how using the SEEA statistical framework results in a set of indicators which meet these data quality criteria. Section 5 concludes.

[1] The Millennium Development Goals Report, 2014 (United Nations):

2. SEEA: The Statistical Framework for the Environment and its Relationship with the Economy

5. The SEEA was adopted in 2012 by the UN Statistical Commission as the international statistical standard for measuring the environment and its relationship with the economy. Furthermore, the UNSC recognized the SEEA as an important statistical framework for the Post 2015 Development Agenda and the SDG indicators in 2014, requesting that the SEEA be properly reflected in the formulation of the SDG indicators in 2015. Together, the statistical frameworks of the SEEA and SNA provide the necessary methodological foundation to support the production of environmental and economic indicators, and have the capacity to greatly improve the statistical robustness of SDG monitoring.

6. As a statistical framework the SEEA guides the whole production process for environmental related indicators through a systems approach to collecting, harmonizing, organizing, vetting and presenting statistical information. In this regard the SEEA does not recommend any specific indicator, but rather addresses the need for a systematic and methodologically sound approach to compiling environmental-economic statistics, lending rigor to the calculation of many indicators used to assess specific aspects of sustainable development. The focus and value proposition of the SEEA is therefore in ensuring indicators are defined and compiled in a methodologically coherent way, so as to better serve their ultimate purpose of informing policy and supporting progress evaluation. Application of the statistical frameworks ensures component data is validated through checks and balances inherent in the accounting approach, while at the same time ensuring an efficient data collection process whereby data is collected once and used multiple times. In effect,

7. A distinction should be made between statistical frameworks, such as the SNA and SEEA, and indicator frameworks for sustainable development, such as that presented by the Conference of European Statisticians [2] (CES). Statistical frameworks represent internationally standardized definitions, classifications and related methods for compiling statistics which, among other things, support the calculation of methodologically robust indicators. In contrast, indicator frameworks develop organizing principles to facilitate the choice of indicators for different thematic aspects of sustainable development. Such indicator frameworks provide a policy-relevant organizational framework which indicators could be selected. Indicators frameworks are formulated with the purpose of choosing or organizing indicators, while statistical frameworks are designed to define the way in which these indicators are measured.

8. The indicator frameworks mentioned above and the statistical frameworks of the SEEA and SNA are complementary, in the sense indicators frameworks identify and organize indicators which often use the statistical methodology from the statistical frameworks such as the SEEA and SNA. According to the CES Recommendations on Measuring Sustainable Development, approximately 80 percent of the indicators proposed can be derived from these statistical frameworks. Furthermore, the Framework for the Development of Environment Statistics (FDES) complements the SEEA by providing a list of environment statistics by thematic areas. Such a list can support and guide countries in initial data collection activities necessary to begin the compilation of accounts and indicators.

9. Based on the above, this paper will illustrate how the statistical production processes of indicators based on the SEEA standard results in higher data quality due to its conceptual and

[2] "Conference of European Statisticians Recommendations on Measuring Sustainable Development" 2013 http://www.unece.org/fileadmin/DAM/stats/publications/2013/CES_SD_web.pdf

methodological soundness including; 1) the harmonization of basic environmental data through the provision of standard definitions and classifications, and 2) integration of statistics into accounts to properly capture trade-offs and interlinkages, and increase statistical robustness through a series of checks and balances. These statistical processes result in a database of methodologically robust environmental-economic statistics from which a variety of high-quality indicators can be derived. The choice of these indicators and their level of detail should depend on policy needs and theory, on which indicator frameworks can provide guidance.

3. A Set of Data Quality Criteria for Sustainable Development Goals Indicators

10. To illustrate how the SEEA acts as a statistical framework for the derivation of high quality indicators, a proposed set of data quality criteria for indicators was developed against which the SEEA was evaluated in terms of its ability to support indicators which can meet said criteria. Indicators should be selected based on their ability to meet a baseline set of data quality criteria for policy relevance, analytical and methodological soundness, and practicality of measurement, while being conscious of the need to use existing data (which is often flawed for the purpose at hand) in the best way possible. Box 1 presents this set of criteria which was developed through an extensive mapping exercise of existing sets of data quality criteria for indicators, lessons learned from the MDG monitoring process, statistical offices' experience in compiling indicators on sustainable development and principles of official statistics. A more detailed explanation of these data quality criteria as well as the methods used to develop them is available in Annex 1.

Box 1: Data Quality Criteria for Indicators

Policy Relevance and Utility for Users:

1. Accurately describe the phenomena it was designed to measure
2. Be supported by supplementary information
3. Be sensitive and responsive to policy interventions and other underlying causes of change
4. Have the possibility to be disaggregated
5. Be timely and based on data which can be produced in a timely fashion

Analytical and Methodological Soundness:

6. Be based on best practice methodology
7. Be compliant with international standards
8. Be broadly consistent with systems based information

Measurability and Practicality:

9. Be constructed from well-established data sources which are of known quality and adequately documented
10. Be supported by data which is readily available or attainable at a reasonable cost/benefit ratio
11. Be easily accessible to the general public, policy makers and other stakeholders
12. Be managed by a responsible agency

4. Environmental related Indicators derived from the SEEA

14. This section presents how using standards statistical frameworks to derive indicators, such as those from the SEEA accounts, can bolster efforts to meet the above criteria for high quality indicators on the environment and economy. The three broad quality dimensions of the proposed

criteria, namely policy relevance and utility, analytical and methodological soundness and measurability and practicality are used as a structure for this discussion.

4.1 SEEA-based Indicators: Policy Relevance and Utility

15. To produce policy relevant information which meets existing demands, a coherent set of statistics and indicators are required which reach an expected level of statistical quality assurance, and which are consistently and coherently measured over time. Headline indicators should also be supported by supplementary thematic information, which helps to underpin the interactions and interrelationships between different policy issues.

16. The SEEA does not recommend specific indicators to inform policy frameworks, as the choice of indicators should be based on an assessment of what information is required to best inform policy. That said, the particular definitions and concepts used to calculate an indicator can significantly impact the information which is eventually conveyed, as well as its interpretation and use. The SEEA provides an established and flexible framework to define and measure relevant concepts in an internationally agreed and comparable way, providing enough flexibility for application from different policy perspectives..

17. For example, policies to reduce the burden placed on national water resources and promote sustainable water use may wish to monitor water use efficiency. There are a variety of indicators which could be deemed appropriate, but each provides significantly different information and policy implications. In particular, water consumption, water use and/or water abstraction (i.e. withdrawals) might all be used to assess the burden placed on water resources by the economy. As each term implies a distinctly different concept, clarity on how each is defined is crucial. An overarching measurement framework such as the SEEA provides the *overall coherent and mutually consistent statistical framework* across a large and multi-dimensional range of thematic statistical domains of sustainable development. Furthermore, because the SEEA is a System of accounts which covers many environmental systems, its application to water allows for consistent integration of this information with other forms of environment statistics (e.g. energy and land statistics).

18. The use of an accounting approach means that an information pyramid is established, by which headline indicators are supported by a coherent and consistent set of supplementary statistics and accounts. This supplementary information supports policy by describing and explaining the underlying causes of change in the measures of the indicators. At the ‘top level’, summary information derived directly from the accounts in the form of aggregates and indicators can be used by decision makers to frame discussions on a range of issues pertaining to the environment. For example, aggregates such as total air emissions, total water abstraction and/or total solid waste generation are immediate outputs of the SEEA physical flow accounts. Therefore, the system based measurement framework can provide a “big picture” perspective of mutually coherent and consistent basic statistics, accounts and headline indicators.

19. For example, to establish a big picture perspective for policy aiming to increase the output and contribution of the mining sector to the economy may collect and produce time series on total extractions (both in volume and value terms) and value added. However, to incorporate further considerations such as the impact of extractions on the depletion of the stocks of mining resources, the cost efficiency of extraction and/or the residuals being created, other statistics will need to be taken into account. The challenge is that data on stocks of mineral and energy resources may be collected very differently to statistics on output by mining industries, and similarly for emissions. The SEEA provides the necessary structure through the physical flow accounts, the asset accounts, and the

emissions accounts (among others) to structure and link these statistics within one comprehensive system of information.

20. Yet another way of describing the overall data quality provided by the system-based statistical framework is that the accounts provide the structure to integrate disaggregated data (e.g. of food, water and/or energy) by economy activity, with industries categorized by ISIC and households identified separately (as well as imports/exports). This allows for disaggregation of economy-wide aggregates to understand the structure and distribution of different physical and monetary flows relating to the important policy nexuses, and how data are distributed between different economic activities and their interaction with the environment. A structural understanding of the economy's relationship with the environment can significantly support policy decisions. To continue the previous example, an improvement in water use efficiency may be due an overall reduction in water use by all economic activities (i.e. relative to production), or due to a shift in the economy's structure away from water intensive industries (e.g. agriculture) to services. By providing the structure to attribute water flows by ISIC (and households), an understanding of the impacts of such structural shifts is facilitated. In Box 2, the various dimensions of disaggregation of SEEA related statistics and indicators are summarized.

Box 2: Disaggregation Dimensions of SEEA-based Statistics and Indicators

As detailed in the SEEA Applications and Extensions, macro level statistics and indicators derived from SEEA accounts can be disaggregated along a number of dimensions:

- *Industry Level Disaggregation:* in accordance with standard industry classifications (ISIC). Industry disaggregation aids understanding of how structural changes in the economy affect environmental pressures and the use of environmental resources. It is also useful in understanding the contribution of different industries to common environmental issues (such as CO_2 emissions) when reviewing the integration of environmental and industry specific policies.

- *Institutional Sector Disaggregation:* such levels of disaggregation help to distinguish government responses from those of the corporate sector or household sector. This could be relevant to a range of issues, including understanding expenditure on environmental protection, which sectors pay environmental taxes and who receives resource rent.

- *Disaggregation by Product or Asset Type:* can help in understanding issues such as the extraction of resources in relation to their availability/sustainability of use. Another example is disaggregation by type of energy product, which can be useful in understanding the fuel mix and other compositional issues in the analysis of energy supply and demand.

- *Spatial Disaggregation:* When national level indicators hide important regional variations, spatial disaggregation is a necessary component in understanding the relationship between, for example, the location of natural resource stocks, settlement areas and economic activities. The SEEA Land Accounts present a method of assessing shares of land use and land cover within a country. Furthermore, the SEEA Experimental Ecosystem Accounts play an important role in integrating information on ecosystems using a spatial approach

21. Another key advantage to policy of using an SEEA accounting approach to organize environmental information, in a manner consistent with the economic information contained in the

SNA, is that the accounting framework can be used as a basis for the development of environmental-economic models to support the evaluation of tradeoffs and future scenarios. The coverage of the accounting framework is such that a wide range of relevant data can be integrated into one analysis, and the use of the same definitions, classifications, spatial units and time boundaries means data can be more easily integrated into the model without having to make too many adjustments to account for inconsistencies across datasets.

22. In sum, in using the SEEA as an overarching framework for economic-environmental and well-being related issues, policy needs are met coherently through the provision of headline aggregates and indicators, supplementary and disaggregated statistics and accounts. As such, the bigger picture is presented for multi-purpose analytical and policy use when using SEEA as statistical framework.

4.2 SEEA-based Indicators: Analytical and Methodological Soundness

23. The use of system-based statistical frameworks improves the methodological soundness and thus the overall quality of indicators. Statistical frameworks such as the SEEA provide the framework under which indicators can be compiled based on a series of steps. This starts with the harmonization of basic data, often involving manipulation of existing data to fit standard classifications, so as to integrate it into the accounting structure. The accounting structure then provides a series of checks and balances to ensure the consistency of figures being produced. Using the SEEA as an umbrella framework to compile relevant statistics means environmental and economic statistics are consistent and multi-dimensional, such that they can be easily combined in the calculation of mutually coherent indicator sets.

24. Adoption of the SEEA acts as a vehicle for harmonization of environment and economic statistics across different agencies responsible for their collection. Data collection processes in countries often tend to be fragmented, with responsibility dispersed across multiple agencies. This often creates methodological inconsistencies when calculating an indicator as the component data items are collected and compiled by different agencies which use different methodologies. This results in inconsistencies in, for example, the definitions, classifications, time boundaries and geographical scope of the component statistics. Implementation of the SEEA provides an impetus to harmonize sectoral and thematic data. This does not necessary imply that existing data activities are overridden, but rather than efforts are made to adjust the existing data so that it can be integrated with other types of statistics are the level of SEEA accounts. Box 3 provides an example of how compilation of SEEA-based accounts drove harmonization of the underlying basic data in the Netherlands. The strength of the accounting approach in integrating diverse data sources which were originally intended for other purposes is illustrated well in the case of National Accounts, which successfully brings together administrative data (among others) into accounts to produce economic statistics.

Box 3: Harmonization of the basic statistics needed to compile Environmental-Economic Accounts in the Netherlands

The compilation of the physical flow account for energy requires several different data sources to be integrated into an accounting framework. First, basic energy statistics, usually in the form of energy balances, cover the major energy flows needed to compile physical supply and use tables. In addition, several other data sources are needed to adjust basic energy data to ensure it is aligned with the concepts and classifications of SEEA and SNA. Statistics Netherlands has compiled physical flow accounts for energy for a number of years. The compilation process for physical flow accounts in the

Netherlands is relatively straight-forward as some of the basic statistics already (partly) concur to concepts and classifications of SEEA;

1. First, Dutch energy balances are partly compiled on an ISIC basis. Thus the Netherlands already has very detailed information on energy supply and energy use for mining, manufacturing and energy producers on an ISIC two digit level. This data can be directly structured into the supply and use framework. It is only for the case of services, construction and agriculture that additional data sources are needed to disaggregate energy use and energy supply to a detailed ISIC level;
2. Second, the energy data must be adjusted to concur with the resident principle of the SNA and SEEA. Accordingly, data is needed on international transport. The Netherlands has harmonized the traffic statistics on road transport such that they can be directly used for the compilation of the physical flow accounts for energy. Registries for motorized vehicles provide information on total kilometers driven by Dutch vehicles, which concurs with the resident principle. In addition, traffic statistics also provide information on kilometers driven outside the Netherland by Dutch vehicles, and on kilometers driven within the border of the Netherland by non-residents. All this information makes it relatively easy to correct for the resident principle. Close cooperation with the department responsible with the traffic statistics was necessary to accomplish this harmonization.

25. Furthermore the SEEA accounting framework takes a systems approach to recording environmental-economic information. As such, when integrating basic statistics into the accounts, the accounts' structure provides a mechanism to test the robustness of the statistics when viewed alongside each other within the system as a whole. For example, takes place when comparing data measured in different units (e.g. volume data related to value), and also through checks and balances inherent in the accounting system. The SEEA Central Framework is characterized by two integral identities; the supply and use identity and the input-output identity. They are based on the law of the conservation of mass and energy which states that the mass and energy of a closed system will remain constant. The implication for accounting is that, in theory, mass and energy flows must balance across natural inputs, products and residuals.

26. By way of an example, within the Physical Supply and Use Table, the supply and use identity implies that for each product measured in physical terms (e.g. cubic meters of timber), the quantity of output and imports (total supply of products) must equal the quantity of intermediate consumption, household final consumption, gross capital formation and exports (total use of products). When combining all of these different data items from a variety of sources, the equality between supply and use should hold. Otherwise the implication is that there are inconsistencies between figures being produced by different agencies which must be identified and a process put in place for reconciliation.

27. A large part of the SEEA's potential to deliver high quality and methodologically sound indicators for sustainable development lies in its compatibility with the System of National Accounts. The SEEA applies the same accounting concepts, structures, rules and principles used in the SNA to environment information. This allows for the integration of environment statistics (which are often measured in physical terms) with economic statistics (generally measured in monetary terms) within a single framework. By using the same accounting conventions, SEEA-based statistics can therefore be combined and/or related to statistics from national accounts to calculate important ratios. These ratios offer a methodologically consistent way to measure tradeoffs between the economy and environment.

28. For example, environmental efficiency indicators compare trends in economic activity, such as value-added, income or consumption with trends in specific environmental flows such as

emissions, energy and water use. For example, target 6.4 of the SDGs calls for improvements in water-use efficiency across all sectors. This can be assessed using information on water use from the SEEA with information on GDP from the SNA. The need to improve efficiency *across sectors* requires disaggregation of the economy-wide indicator by sector. By applying the same accounting conventions and using ISIC as the basis to record water use by economic activity, the lines of disaggregation are the same for the environmental statistics in the SEEA and economic statistics in the SNA, allowing for greater methodological coherence in disaggregation.

29. Another example is air pollution emission intensities which can be calculated from the SEEA and relate emissions of greenhouse gasses or air pollutants to economic activity, expressed in tonnes per unit of GDP. Furthermore, other resource efficiency indicators can be calculated to understand the intensity with which natural resources, such as energy and other materials, are used in production and consumption. Such indicators can be calculated at the economy wide level and compared internationally, as well as derived by industry type or by primary energy source using the SEEA framework. A more detailed discussion of this is available in the SEEA Applications and Extensions.

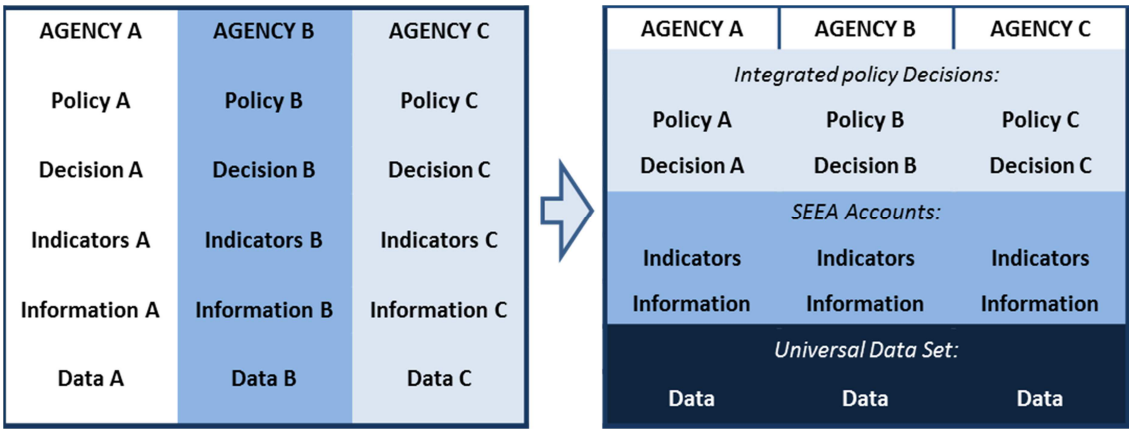
30. In sum, the compilation of environmental-economic statistics under the statistical framework of the SEEA results in higher quality statistics for the calculation of indicators. Reconciling statistics within the accounting framework provides scope to improve their robustness, among other things by cross-checking numbers when viewed within a systems perspective. The result is a time series of basic statistics at policy and analytically relevant levels of timeliness and periodicity, which are coherent and consistent over time, and which can be used to derive methodologically sound indicators. This particularly applies to ratio indicators derived from the accounts, as aligning the methodologies used to calculate both the numerator and denominator help avoid distortions in final numbers. The methodological soundness of indicators based on the statistical frameworks of the SEEA and SNA is therefore a key strength.

4.3 SEEA-based Indicators: Measurability and Practicality

31. The use of an accounting framework such as the SEEA in the production of environmental indicators can serve as a vehicle for achieving efficiencies in the production process for these indicators, by creating scope for consolidation of data collection activities and promoting the efficient and multi-use of existing information sets in data poor environments.

32. As previously mentioned, responsibilities for the collection of environmental and economic data are often dispersed among different agencies, each employing their individual practices and methods for the collection and compilation of data. The result is that each agency collects the data specific to their policy agenda, based on definitions and classifications most appropriate to their needs. This level of fragmentation can occur at the agency and/or geographical level. By adopting the SEEA as the national accounting framework for the environment, there is impetus for data from different agencies' collection initiatives to be consolidated into one set of information which can be understood and used by all. Figure 1 illustrates how the implementation of the SEEA at national level allows for the development of a common interface for environmental economic information and the use of data for multiple purposes. In developing a universally used set of environment data, cost efficiencies and lean reporting processes are promoted. Box 4 provides an example of how implementation of the SEEA acted as an impetus to developing the necessary institutional arrangements to achieve this in Brazil.

Figure 1: SEEA to foster integration of environmental data collection and policy decisions



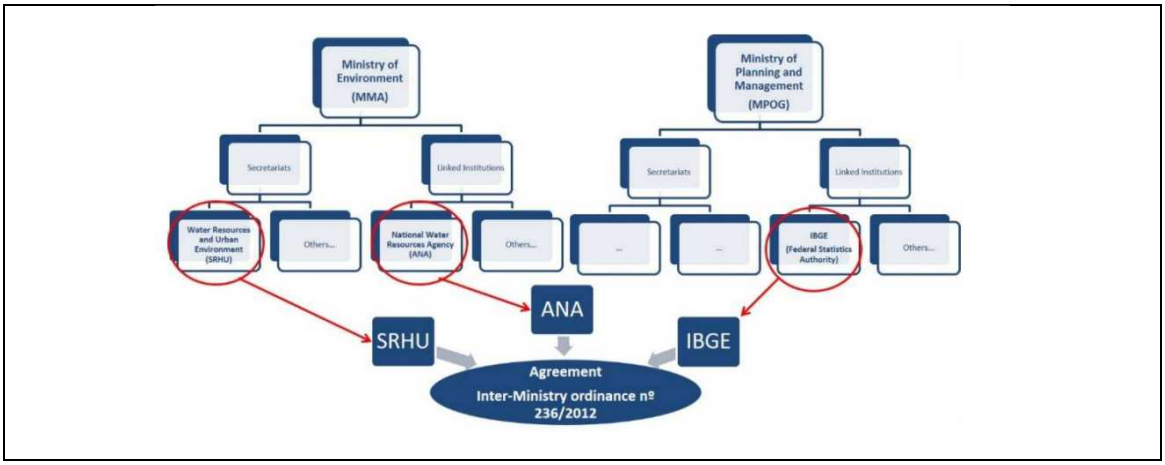
Box 4: Inter-Organizational arrangements for SEEA data - the case of Brazil

In Brazil water resources data are dispersed across several institutions. In connection with national efforts to implement the SEEA-Water, a concrete agreement for cooperation was reached in 2012 between the National Institute of Geography and Statistics (IBGE); the National Water Agency (ANA); and the Secretariat for Water Resources and Urban Environment of the Ministry of Environment (which coordinates water resources policy). A Committee which has the mandate to develop water accounts in Brazil was created (see figure below).

The Water Accounts Committee has so far consolidated historical physical water information for 2000 to 2013;

- The ANA is responsible for managing the National Hydro-Meteorological Network with water quality and quantity data, coordinating the National Water Resources Information System (GIS technology) and publishing the Brazilian Water Resources Report. The Report has been published annually for the last 5 years, and is the result of a multi institutional partnership. It presents water statistics compiled from over 50 state water resources and environment institutions and about 10 federal institutions.
- IBGE plays an important role in this partnership, conducting a number of national surveys related to manufacturing, water supply, wastewater treatment and 183 agriculture activities. Adjustments to these surveys are necessary to improve data collection for water accounts.
- The Ministry of Environment coordinates the process of environmental data collection.

This collaborative process among institutions related to water, statistics and environment, has improved data quality and provided the institutional arrangements and processes necessary produce water accounts.



33. Compilation of the accounts requires a 'stocktaking' exercise of existing data collection initiatives, statistical methodologies and IT systems, which are often fragmented and dispersed across multiple agencies as an initial step. Adopting a systems approach based on the SEEA as an overarching framework is an important step in streamlining the statistical production process and institutional arrangements.

34. The implementation of the SEEA can be undertaken at different levels of maturity of the national statistical system. At the initial stage, preliminary SEEA accounts are compiled using data which is already being collected. The application of an accounting framework allows for the identification and filling of the data gaps by using the properties and identities of the accounting system and existing (albeit scarce) information. Moreover, the accounting structure allows countries to focus their data collection efforts on the data items which are most significant, as in many countries there are a number of entries in the accounts which are not significant in practice. Therefore, populating the tables and accounts in a meaningful way will not require data entries for all cells. The cells for which data is not available should be estimated using the accounting structure to ensure the tables remain comprehensive.

35. Progressively, with the successive rounds of compilation of the accounts, the established institutional and technical capacity will allow for improvement in data quality and greater national ownership of monitoring and reporting for sustainable development. Implementation of the SEEA can benefit countries with limited statistical capacity, as its structure and role in consolidating data collection efforts means the SEEA can be of significant value in data poor environments.

36. Finally, deriving indicators from the SEEA can also address issues related to timeliness. The national implementation of the SEEA contributes towards leaner reporting, locking agencies' data collection and compilation efforts into a consolidated production process which helps to facilitate annual reporting on the environment. Furthermore, reliable estimates and approximations using coefficients from the accounting framework can be calculated, which can be used as inputs into preliminary indicator calculations to enable the timely production of information.

37. It is important to view the above discussion in the context of the longer term efforts to improve national statistical systems' capacity to meet information requirements for the post-2015 development agenda, along with a strengthened national ownership of the global reporting system. The above mentioned gains in efficiencies and improvements in production processes and institutional arrangements, catalyzed by the implementation of the SEEA, should be viewed as a potentially important step in these broader efforts.

5. Summary and Conclusion

The sustainable development agenda requires a robust monitoring process, and indicators chosen should strive to meet quality criteria of policy relevance and utility, analytical soundness and measurability and practicality. This paper sets out a set of twelve detailed data quality criteria to this end, and illustrates that indicators based statistical frameworks such as the SEEA are particularly robust. Indicators derived from the SEEA can be more useful in terms of policy relevance, as they are supported by organized information which promotes a detailed understanding of the drivers of change. They are also more methodologically sound, as the statistical framework provides the overall umbrella for a multi-dimensional system which integrates environment data with economic data. Through the application of these statistical frameworks, harmonization of basic data, methodological consistency and coherence across the statistical production process for statistics, accounts and indicators is established. Finally, implementation of the SEEA can create efficiencies in the data production process, meaning the production of indicators is more sustainable in data poor and rich environments alike.

Annex 1: A Set of Data Quality Criteria for Sustainable Development Goal Indicators from a Systems-based Perspective

1. A mapping process and a detailed analysis have been undertaken across a range of publications in order to group proposed sets of criteria for the selection of indicators, and to match lessons and principles learned from the MDG monitoring process with these criteria. While there was a significant degree of variability in the focus and content of the publications analysed, there was a great deal of overlap in terms of the key criteria to which it was suggested indicators should adhere. Publications analysed included, among many others, the reports of the Conference of European Statisticians[3] and the Sustainable Development Solutions Network[4]. In order to develop a harmonised set of criteria, the criteria from all publications were grouped based on key ideas. Each group was then harmonised in terms of language and detail, to develop the set of twelve key criteria detailed below.

2. This list of criteria for indicator selection has been drawn up with the purpose of providing input in the selection process for sustainable development indicators from a systems based perspective. The criteria are grouped into three main categories: Criteria which enhance the indicator's policy relevance and utility to the user; criteria to ensure analytical and methodological soundness in the compilation of indicators, and; criteria which consider the practical measurability and attainability of indicators. Each group is discussed in turn.

1. Policy Relevance and Utility for Users

3. A set of indicators should be coherent and mutually consistent over time to adequately inform policy and meet user needs in terms of coverage, content and detail. An indicator represents a summary measure of information relevant to policy formulation, as well as a method of simplifying the communication process for key policy priorities and raising the profile of these issues in the public debate. It is therefore important that indicators provide enough information to be policy relevant, in a manner which is understandable to a range of stakeholders who are not statistical experts. In addition

user needs must be factored into the choice of statistical framework to determine a coherent and consistent set of indicators, the use of language and terminology as well as the presentation of information. More specifically, an indicator should;

1. *Accurately describe the phenomena it was designed to measure*: The measurement framework and selected indicators should provide a representative picture which is clearly linked to the sustainable development target and provides robust measures of progress towards the target.
2. *Be supported by supplementary information:* The indicators should be supported by metadata and supplementary data to provide context, thus ensuring users robustly interpret the information contained in the indicator. Indicators are useful summary measures to frame policy debates. In addition to the key signals provided by indicators, policy decisions should be supported by an information system which facilitates an integrated understanding of the underlying causes of change and trade-offs between these causes.
3. *Be sensitive and responsive to policy interventions and other underlying causes of change:* Indicators should be responsive to changes in the state of the issue it is designed to measure, and be sensitive to policy interventions at the appropriate level (global, regional, national and local). In some cases the indicator should also be anticipatory, providing an early warning of changes.
4. *Have the possibility to be disaggregated:* Preference should be given to indicators that can be disaggregated by characteristics of the individual or household (e.g. gender, age, income, race, etc), economic activity and spatial dimensions (e.g. geographical region, metropolitan areas, etc.) where applicable and relevant. Sustainable Development Goals strive to be universal in nature, applying across countries and regions, and reaching all population groups. Targets can therefore only be considered achieved if they are met for all relevant groups. Indicators should therefore have the capacity to provide information to this end[5].
5. *Be timely and based on data which can be produced in a timely fashion:* The interval between the period to which data refer and the date the data are released should be as short as practicable. Timeliness is a crucial element to ensure indicators are a useful management and policy planning tool.

2. Analytical and Methodological Soundness

4. Indicators should, to the greatest extent possible, be derived through a coherent methodological approach which is based on international standards of best practice and consistent over time. The process of compiling indicators, referring to all activities of data collection, data processing, assessment and compilation, should be methodologically coherent. In particular, all data components feeding the calculation of an indicator should be collected in a coherent manner and based on the same standards, definitions and classifications. Indicators should therefore;

6. *Be based on best practice methodology:* The methodology behind the indicator (data sources, method of computation, treatment of missing values, compilation and presentation) should be theoretically well founded and based on international standards of best practice. The methodology should be well documented and readily available.
7. *Be compliant with international standards*: Statistical agencies in each country should use internationally agreed definitions, classifications, standards and recommendations to promote the consistency and efficiency of statistical systems.

8. *Be broadly consistent with systems based information:* Indicators represent summary measures which provide important signals for policy design and monitoring. More detailed information is needed to understand the causes of the changes to design appropriate policies. As such indicators should be embedded within larger information systems (accounting frameworks, monitoring systems, environmental-economic models, etc.). Such systems provide an analytical framework for bringing together information in a methodologically coherent manner to ensure the coherence of resulting indicators. Furthermore, such systems strengthen the capacity for comprehensive disaggregation of indicators.

5. It is important to note that it is insufficient that statistics pertaining to a particular topic are embedded within one coherent system of information, but rather, information systems should also be coherent with each other. For example, while environmental indicators such as 'resource use' should be based on environmental data harmonized within a common framework, ratio indicators such as 'resource use efficiency' of the economy will require that this information system for the environment is methodologically coherent with the system for economic information. In order to adequately support integrated policy decisions, information across statistical areas must be methodologically coherent to allow for the analysis of the trade-offs and interactions between the cornerstones of sustainable development.

3. Measurability and Practicality

6. The universal nature of the SDG agenda implies that the supporting indicators and their timely measurement should be attainable for all countries. This requires practical consideration of the indicator production process, and the capacity of statistical offices in data poor environments to meet the demand for indicators. Data requirements should not be overbearing, and indicators should be simple to compile and interpret. As such, indicators should be:

9. *Constructed from well-established data sources which are of known quality and adequately documented:* To the greatest extent possible, indicators should be constructed from well-established sources of public and private data.

10. *Supported by data which is readily available or attainable at a reasonable cost/benefit ratio*: It should be possible to measure the indicator in a cost effective and practical manner in all countries. This requires a regular data collection mechanism which has been developed, or can be developed, at reasonable cost and in full consideration of national statistical capacity.

11. *Easily accessible to the general public, policy makers and other stakeholders:* Indicators should be freely available, as well as simple, clear and easy to understand. To achieve this, user needs and statistical literacy considerations must be factored into the choice of statistical framework, the use of language and terminology, and the presentation of information.

12. *Managed by a responsible agency*: For each core indicator, there should be a *national agency* responsible for annual, high quality reporting of the indicator with due consideration to cost effectiveness, lean reporting and national monitoring methods. At the *international level,* there should be an agency responsible for undertaking related analysis, as well as providing guidance and/or assistance to countries to strengthen their capacity to produce the indicator.

7. The final criteria should be considered in the context of increasing recognition that country ownership of the evidence base needed to support and monitor national development programmes is an important component in ensuring their sustainability going forward.