

# INDICATORS AND INDICES: KEEPING THE GLOBAL ENVIRONMENT UNDER REVIEW

Nafiseh Jafarzadeh <sup>a</sup>

<sup>a</sup> Centre for International & Environmental Law, Macquarie Law School, Macquarie University, Epping Road, Ryde, NSW, Australia.

<sup>a</sup> Corresponding author: nafiseh.jafarzadeh@mq.edu.au

©Ontario International Development Agency ISSN: 1923-6654 (print)  
ISSN 1923-6662 (online). Available at <http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html>

**Abstract:** The dramatic increase in environmental changes and developmental challenges has raised concerns that appear on all social and political agenda. All these challenges and their interactions highlight an urgent need to detect unexpected changes and have more reliable and comprehensive information to reflect improvement or deterioration of the state of the environment. In this regard, explore adequate measures of progress and monitoring towards sustainable development have taken on a new urgency and ‘keeping the global environment under review’, launched by the United Nations General Assembly (UNGA) in 1972.

Since sustainable development is a dynamic process of changes among economic development, environmental quality and social equity it requires an integrated decision-making process in consistent with future as well as present needs. Therefore, the United Nations Commission on Sustainable Development (UNCSD) in 1992 which designed to holistically address the three ‘pillars’ of sustainable development also called for the identification of concrete policy measures and international cooperation for providing information for decision-making. Indeed disclosing information, publishing data and measuring process in order to identify whether policies has been effective assist policymakers to move toward global agreed targets. In particular, policymakers demand for standardised and easily understandable information to make sustainable and appropriate decisions among competing policy options.

The crucial need to have more accurate data and capture a picture of progress generated indicators and indices as a necessary pre-requisite tool for governance. Indicators and indices by simplify and quantify information of complex issues facilitate

communication with decision-makers and the public. Indeed, they provide valuable information for monitoring and enable to make some rough estimates of the state of environment. In this regard, the efforts to develop indicators and indices, as a science and policy tool, have been increased to measure progress towards sustainable development. These initiatives are important and practical steps to better inform governments and societies about the state of the environment and move towards a sustainable future. In the realm of international environmental law, like other disciplines, developing core sets of consistent and relevant indicators have been explored to track environmental performance and determine whether countries are complying with their legal obligations.

However, based on the field and subject there is various range of indicators and indices. Therefore different technical definitions and framework is generated in the various disciplines. On the other hand, inadequacies in the available data, lack of basic statistical information on the environment and also insufficient policy indicators can lead to misinterpretation for policymakers. Therefore, a standardised process involving an integrated approach is required in order to develop measurable indicators and indices and to avoid ambiguity.

This paper is a preliminary investigation into the policy indicators and indices, their current trends and challenges to examine their important role and how standardised indicators and indices could facilitate implementation of, and improved compliance with, international environmental agreements.

**Keywords:** Indicators, indices, international environmental law, science-policy interface, sustainable development.

## INTRODUCTION

Development, changes, sustainability and interactions are the main concerns in our current world crisis. The unprecedented environmental changes in recent decades, include climate change, land degradation, collapse of fisheries, biodiversity loss among others highlights needs to address them. Therefore, the environment has become a key focus of national and international laws and institutions. Growing concerns about environmental changes has made it essential to detect unexpected changes and have more reliable and comprehensive information to facilitate an understanding of whether environmental issues are getting better or worse. Therefore, in order to address these challenges, disclose information and capture a picture of progress, new platforms and methods is required for assessing trends and performances.

In the 1970s and 1980s notable global conferences attempted to take into account environmental issues.<sup>1</sup> Sustainable development generating from the Brundtland Commission's report, with its emphasis on environment and development is one of the best efforts demonstrating inseparable of those two values. Consequently, sustainable development as a concept, as a goal and as a movement spread rapidly and currently is the central priority among different disciplines and dialogues. Thus, this dynamic idea has been identified to address a various range of challenges from urban planning to sustainable livelihood, agriculture and even business. While the concept is board with so much diversity in viewpoint, there is no concrete definition and consensus of sustainable development. However this ambiguity over the concept has not reduced the popularity of the concept (Bell & Morse, 2008).

In this regard, the main question emerged is that: what should be developed sustain and how? There are various ideas emphasized on people, economy and society (Kates, M. Parris, & A. Leiserowitz, 2005). At the intergovernmental level, the *Commission on*

*Sustainable Development* (CSD) defined sustainability based on four dimensions: economic, social, environmental and institutional. Chapter 38 of *Agenda 21*, articulated the need for institutional arrangements based on the principles of universality, democracy, transparency and accountability (United Nations, 1992). Furthermore, the 2002 *World Summit on Sustainable Development* highlighted expansion of the standard definition rely on three pillars of sustainable development including: economical, social and environmental (United Nations, 2002).

In order to identify what is to be sustained and measure sustainable development, indicators and indices come to put these points into practice. The main catalyst for the idea of applying indicators, particularly in terms of sustainable development, was *Earth Summit on the Environment and Development Conference* in 1992. Based upon chapter 40 of *Agenda 21* (United Nations, 1992), a set of action points agreed on the Summit and strengthen national and international capacity promoted to improve information availability, bridge data gaps and collect usable data for decision-making towards sustainable development (Hunter, Salzman, & Zaelke, 2007), (United Nations, 1992). Furthermore, the Summit established a mandate for the United Nations to adopt a set of indicators of sustainable development to monitor progress towards agreed targets (Bell & Morse, 2008).

Since then, many proposals for indicators and indices have been emerged to quantify and simplify information and communicate to policymakers and the public (Hammond, Adriaanse, Rodenburg, Bryant, & Woodward, 1995). Generally most of them highlighted a suitable framework for indicators linking environment to the economic and social aspects in accordance with the concept of sustainable development. While there is no global consensus on a particular framework, there is a variety of environmental indicator frameworks and various proposed approaches for sustainability indicators frameworks (Department for Environment, 1999). In particular, the diversity of values, the variety of indicators and sustainable development theories provides different conceptual framework to assess relations between human activities and the environment.

Although indicators have been widely employed in environmental science to track changes in complex systems for many years (Bell & Morse, 2008), but their application in law and policymaking is more recent. Therefore, more efforts required to design and develop adequate institutional and policy indicators in order to assess policy processes and governance practices. In the context of applying assessment tools in the process of policymaking, State of the

<sup>1</sup> There are two landmark conferences on environment and development issue. The 1972 *United Nations Conference on the Human Environment*, known as the *Stockholm Conference*, designed to protect and improve the human environment. After publication of *Our Common Future* in 1987 by the *World Commission on Environment and Development*, the 1992 *UN Conference on Environment and Development* (referred to as either *UNCED*, the *Rio Conference* or the *Earth Summit*), linked environment and development and reached *Agenda 21* for sustainable development in the 21<sup>st</sup> century.

Environment (SoE) efforts generated to create more accurate data and measuring progress by employing indicators at national and international levels. Indeed the SOE reports, as a valuable and cost-effective tool provides scientifically based reports by a various range of indicators in order to inform policymakers (OECD, 2003). In particular, indicators can provide valuable information over periods of time by integrating environmental factors to track trajectories. There are many initiatives at different levels, from global to local, to define appropriate indicators and measure progress towards sustainable development. More broadly, from the policy perspective, indicators and indices designed to track current issues and determine priorities, spot current effective policies and reveal successful policy practices. On the other hand, limited data on the environment and inadequacies in agreed targets for the most environmental crisis are some challenges that reflect a global governance problem an urgent need to address them.

## REVIEW OF SUSTAINABILITY INDICATORS AND INDICES

### Concepts and roots

The term indicator often used as boundary in science and policy and indicate different technical definition. In most of the studies indicators are referred to parameters, measures or variables (Burger, 2006). Ferris and Humphrey define an indicator as a characteristic that demonstrates ecological trends and a measure of current state and quality (Ferris & Humphrey, 1999). Indicators and indices are the most powerful instruments providing meaningful information for policymakers and reducing uncertainty in their decisions, planning and management processes. According to the definition by the European Environment Agency (EEA), 'indicator is an observed value which quantifies information by aggregating different and multiple data to represent a phenomenon of study' (Gabrielsen, Bosch, & European Environment Agency, 2003). Indeed, indicators developed to create assessments clear and reduce complexities into understandable formulation. Therefore quantitative (numeric) information earned by indicators and indices, to evaluate changes and trends on specific phenomena over time. This actually is the vital role of indicator sets in order to create effective decisions. Effective indicators enable to reflect current policy priorities, as well as significant issues influencing future sustainability. Moreover, from legal perspective, measuring international commitments require policy indicators and indices to create capacities for international comparability. Policy indicators are the best governance tools to collect

data and interpret and synthesize it into information clear for policymakers.

Each indicator has potential to assist states for moving the sustainable development goals forward. They have different stages in the process of problem identification, their impacts and response for a various range of situation. Since policymakers required a broad range of information and data, therefore indicators should reflect all elements of the interactions between human and their environment and also possible responses. Although because of the characteristic of complex systems indicators may have limited in their ability to measure the whole systems (Dahl, 2000) but still they do have an important role in define the complex issues and track progress.

In the context of indices, there have been several efforts to develop indices (composite or aggregated indicators) to provide a broad picture of trends and aggregate a range of variables in order to convey a clear message to policymakers and civil society. All of these efforts are crucial and are practical steps to better inform governments and societies about the state of the environment and move towards a sustainable future. In addition, by increasing modern information technologies, it is critical to apply a system to condense and digest data and reduce information from numerous resources to a concentrated form. Indices by simplify complex data to one number can give meaningful signals to policymakers. In other words, indices by monitor policy measures applied as performance indicators to indicate whether or not nations can meet their agreed targets. In particular, the main purpose to apply aggregate indicators is for raising public awareness and receive a large amount of media attention while try to offer a comprehensive view of sustainable development. Indices are also different in the context of content and structure and widely used in the sustainable development policy debate. Some indices compare the relative progress of countries such as the Human Development Index (HDI) and the Ecological Footprint (EF). Environmental Vulnerability Index (EVI) and the Environmental Performance Index (EPI), are other examples of indices which rate progress against sustainability thresholds and targets to describe national strengths and weaknesses (UNESCO-SCOPE, 2006). Indices particularly provide a baseline for cross-country performance comparisons and facilitate benchmarking to highlight leaders and laggards over the specific issues (Emerson et al., 2010). In particular, indicators and indices have ability to communicate with policymakers and stakeholders in an effective and accessible way and they can also form the foundation of solutions for new and emerging issues.

### Different approaches to measuring sustainability

While the rate of environmental changes exceeds the rate of prediction, dynamic indicators must capture changes to move towards sustainability. The variety of values and different sustainable development theories has created different approaches and models to evaluate interactions between human and environment. Indeed sustainability indicators classified in various frameworks based upon their purpose to measure each dimensions of sustainable development. A number of conceptual frameworks have been proposed for developing indicators and illustrating the links between issues. Such frameworks assist to clarify the necessities for measurement, expectations from measurement and to identify types of requirement indicators.

The Stress-Response (SR) model was the first approach - focused on the environmental dimension of sustainable development promoted by Canadian statistics to present behaviours and responses. Thereafter, Pressure-State-Response (PSR) framework developed by the OECD (The Organisation for Economic Co-operation and Development) to consider greater details or specific features (OECD, 2003). This model also applied by the CSD to build sustainable development indicators but abandoned due to the lack of connection between pressure and state indicators. Hence, the CSD focused on the other dimensions of sustainability and extended the framework with replacing pressure with driving-force indicator and providing Driving force-State-Response (DSR) framework. However, the DSR model was not able to highlight the complex linkages among issues and the classification create uncertainties between the indicators and policy issues (OECD, 1995). Meanwhile, the EEA created the Driving force-Pressure-State-Response (DPSIR) model that describes all changes in different conditions and highlights their dynamic relationships (Hammond, et al., 1995). In this model state or condition indicators measure the quality of the environment and reflect the ultimate goals of environmental policies. Pressure indicators highlight the roots of changes and track the impacts of human activities on the environment. The earned results by these indicators reflect the policy effectiveness and provide feedback about whether policies can meet targets. In particular, pressure indicators are useful in assessing policy performance and formulating policy targets in meeting national targets and international commitments.

Since environmental issues influence the environment change, impact indicators applied to describe changes on the global environment. Finally, the effectiveness of environmental measures, mitigation plans and implemented policies are being

evaluated by response indicators. Therefore the DPSIR indicators measure progress toward regulatory compliance and identify the cause of the various issues. Gradually the DPSIR framework became further formalized and widely adopted at different levels. Currently most sets of indicators applied by national and international bodies are based on the DPSIR model or its subset (European commission, 2010). Nonetheless, different variations based on the PSR framework, are a common use reference framework to classify indicators and indices among states, which reflects an essential need to introduce a standardised model.

According to multidisciplinary and integrated nature of sustainable development sustainability, indicators may apply in more than one theme; and require some additional information to create more explicit results. Therefore, issues or theme models are useful structure to facilitate measurement in the context of sustainable development. Such thematic models are on the basis of policy relevance, and highlight the importance of integrating cross-cutting issues, such as environmental degradations, poverty, education, consumption and production patterns and sustainable development pillars. Indeed, thematic frameworks enable the link between indicators and policy processes to provide reliable information to decision-makers; and facilitate both raising the awareness of and communication with the public (Department of Economic and Social Affairs of the United Nations, 2007). In particular, there are a various range of models to measure sustainable development; for instance, capital frameworks and accounting models - which calculate sustainability in monetary terms that beside their advantages can be criticized from different perspectives. In addition, there is also an increasing trend to develop issue-specific sets of sustainability indicators at the international, regional and national level. These efforts could have a significant role in effective implementation of international environmental laws and agreements.

Indeed, the need for measuring and monitoring practices and meeting agreed targets is driven through international mandates explicitly. In this regard, numerous treaties attempt to encourage states to provide adequate environmental information and develop their own sets of indicators. For instance, in context of international environmental law, the United Nations Millennium Development Goals (MDGs) were developed as an outcome of the *United Nations Millennium Summit*<sup>2</sup> in 2000 is a first

<sup>2</sup> *Millennium Summit of the United Nations*, GA Res 54/254, UN GAOR, 54<sup>th</sup> sess, 93<sup>rd</sup> plen mtg, Agenda item 49 (b), UN Doc A/RES/54/254 (23 March 2000).

attempt to set realistic quantitative targets to make governments responsible for their performance. Goal 7 of the MDGs to 'ensure environmental sustainability' requires measurement against its four global targets. Since according to the current literature (G. Jones, Collen, Atkinson, & Bubb, 2010), some of the targets have not been met, the two UN conventions – the *United Nations Convention to Combat Desertification* (UNCCD)<sup>3</sup> and the *Convention on Biological Diversity* (CBD)<sup>4</sup> decided to set new measurable targets. They have agreed 10-year Strategic Plans with specific goals to achieve these new targets at both the global and sub-global levels. In the case of the CBD, in 2010, Parties have adopted a Strategic Plan for the 2011-2020 period to: 'take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services' (Secretariat of the Convention on Biological Diversity, 2010). Therefore, a revised set of indicators is being formulated to measure progress against the 20 targets (The Aichi Biodiversity Targets) in the updated and new Strategic Plan. A set of impact indicators is also developed by the UNCCD in 2007 to provide information on the trends in affected areas (Orr, 2011). Such important efforts in development indicators should be expanded among other multilateral environmental agreements and conventions in fulfilment of their specific obligations to measure progress toward internationally agreed targets. Nevertheless, there are disagreements regarding characteristics and effectiveness of the sustainability indicators and their classifications (Bell & Morse, 2008).

### Selecting Indicators

The process of selecting indicators based upon existing criteria is the most important stage in the indicators' development process, which affects the final results. As reviewed above, the main purposes to use indicators and indices are based upon their ability to: A) measure state of the environment and sustainability and make it manageable; B) support policymakers; C) build consensus by presenting different alternatives and D) facilitate implementing of international agreements by provide feedback on

processes. Therefore, in order to take into account these purposes, selecting and designing effective set of indicators is the key and important process. There are lists of technical criteria that highlight characteristics of effective sustainability indicators (Ciegis, Ramanauskiene, & Startiene, 2009; Niemeijer & de Groot, 2008). The useful indicators are policy-relevant, accessible and user-driven, meaningful to audiences, reliable and scientific soundness, flexible and sensible to changes. Although it is not simple to achieve a set of indicators that meet all these criteria, but in particular, the main criteria for selection of indicators include: (a) be simple to apply: indicators to capture complexities should be straightforward to measure and provide understandable and scientifically sound information (b) be sensitive to changes: the ideal indicators display high sensitivity to a particular stress (c) limited in number: indicators based on the purpose of the study must narrow down to a range of manageable and appropriate indicators (d) be based on a sound scientific basis: Powerful indicators have a strong scientific and conceptual basis to contribute to create credible results (e) quantifiable and measurable: indicators should based upon reliable and update information and data to facilitate policy implementation towards sustainability

### CONCERNS AND CHALLENGES

Despite the benefits that indicators and indices, as policy tools, provide at different levels and also numerous attempts to development of indicators, some challenges hamper the use of them. In particular, development of useful indicators and indices is not a sole process, and it requires a range of collaborations among states and international bodies to set binding targets, priorities and link measurement methods to practical policy options in order to bridge gaps. The main challenges are facing sustainability assessing tools, particularly indicators and indices are listed as following.

#### Lack of a universal definition

As mentioned above, there are various terminologies for indicators and indices but a standard definition does not exist. The absence of concrete definition and consensus of sustainable development, can lead to misinterpretation for policymakers. Indeed lack of clear terminology for sustainable development and also their indicators can create difficulties in comprehension among policymakers and the public as well.

#### Data gaps

Data availability and accessibility is a critical issue. Since indicators and indices are fully depend on adequate and available information, uncertainties and inadequacy of data is a key challenge. Despite the

<sup>3</sup> *United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa*, Opened for signature 17 June 1994, 33 ILM 1328 (entered into force 26 December 1996).

<sup>4</sup> *Convention on Biological Diversity*, Opened for signature 5 June 1992, 31 ILM 818 (entered into force 29 December 1993).

accelerating rate of environmental changes, the collection of data and standardised monitoring systems remain relatively undeveloped. There are significant data gaps and little coordination among data collection efforts. Moreover, not all countries have equal capacity to implement data collection and develop indicators and indices as policy tools to track towards sustainable development. Therefore, in many cases data is scarce, not update or disjointed and 'comparability across jurisdictions is poor and severely limited' (Esty & Ivanova, 2002).

Most of the existing indices cover relatively short timescales and quantitative data and good time-series data for comparisons are scarcely available (Vačkář, ten Brink, Loh, Baillie, & Reyers, 2011). Most importantly, choosing which environmental issues to assess and measure is an early critical component in the process. The selection of the globally important issues which might vary at different levels requires a reliable database with a consultative group across the states. Therefore, poor quality information and monitoring hamper practical assessment of the most critical issues. In particular, the accuracy and quality of indicators and indices are based upon the improvements in data gathering and enhance international comparable statistics.

### **Setting targets**

In order to move towards sustainability, objectives and targets should be defined and assessed. Indicators to measure performance and distance to targets require quantified thresholds agreed in the legal and political arena. In the context of compliance and setting of targets, lack of quantitative or vague targets hamper efforts and make monitoring and reporting progress even more scattered, unsystematic and informal (Moldan, Janousková, & Hák, 2011). Unclear objectives and thresholds create wrong measuring, reporting and monitoring process with less reliability. Since targets are often based upon international environmental laws when there are no international agreements for some environmental issues, targets are derived from standards and guidelines designed by international organisations, national governments, the scientific literature and expert opinion. In order to create standardised indicators and robust systems to measure sustainability global targets should be defined by international environmental laws and treaties.

### **Frameworks for developing indicators**

In the context of sustainable development, due to its multidimensional nature there is no single measure that could cover all components of the concept. Therefore sustainability indicators and indices with a various range of themes developed to measure the statues of progress towards sustainability. In this

regard, there is no consensus on a universal framework for sustainable indicators and no widely-accepted or standardised scope of indices. There are a number of models that is not clear which of them is the best framework for developing indicators. Absence of consensus on measurement, weighting and robust procedures for selecting indicators reduce the validity of information provided by indicators.

### **POSSIBILITIES FOR IMPROVEMENT**

Despite the significant progress in the field of environmental statistics, nationally and internationally, consideration of ways to improve the indicator selection process is required. Moreover, internationally agreed targets and objectives should be determined early to track conditions at reliable process. Global indicators must be improved and linked to scientifically rigorous targets, to detect trajectories and changes at the national level. In case of governance significant methodological work is required to develop measurable and sufficient internationally accepted indicators on different aspects of governance.

In addition, in the context of data quality and timeliness of environmental data, adequate environmental information systems should be produced and introduced across the countries to keep the environment under continuous observation and surveillance. Time-series data which particularly performance indicators and indices are based on should be available for several decades to enable provide a comprehensive analysis of the state and progress towards sustainability. In addition, the quality of information and data should be assessed and in case of missing data alternative methods should be applied. In this regard, the effects of selected methods on the final results should be considered. As long as no meaningful and sufficient data exists, it could not be expected that there would be coherent indicators and consistent and reliable reports.

In context of coherence, despite the important progresses differences remain among and within countries which provide different information sources on the same item where further works for development of indicators to overcome these difficulties suggested. According to existing diversity among composite indicators, it is suggested that standardised approach and cluster analysis should be taken to robust indicators and indices (Jafarzadeh, 2011). These approaches should take the various composite indicators to identify similarities among indices across their multiple dimensions. Therefore, these approaches and standardisation techniques facilitate comparisons across states and also all measuring processes can then be harmonised to

achieve a consistent set of sustainability indicators and measuring system.

In particular, the following practices may be used to overcome existing barriers: (a) improving environmental statistics and facilitating the storage and flow of information for all sectors of states (b) developing indicators' construction to be relevant to policy targets and referring to agreed objectives (c) increasing institutional and government capacity (d) improving coordination especially in transferring technologies to developing countries. All existing challenges and gaps need to be filled to improve environmental governance and guide us towards sustainability.

### CONCLUSION

In order to move towards sustainability adequate indicators across economic, social and environmental dimension are required, to aggregate detailed data and quantitative information. In recent days, the increased focus on information-based decision-making has led to enhance efforts and develop sustainability indicators. Since sustainable development is a multidimensional concept involve with a various range of complex information, therefore measuring sustainable development require a systematically and integrated approach based on a set of quantitative or qualitative indicators and indices, to evaluate systems and their relationships. A number of conceptual frameworks have been designed to classify indicators and improve measuring practices. Each of them has advantages and disadvantages to use, but the main dilemma come from the lack of a universal and consistent classification to develop indicators. Moreover, lack of clear terminologies for both sustainable development and indicators can create difficulties in comprehension among decision-makers and stakeholders. Therefore, it is essential to follow a harmonised approach to prevent indicators from becoming a meaningless buzzword and provide a standard definition to avoid ambiguity.

In addition, policy indicators play a vital role to measure international commitments towards global agrees targets. Thus, they are powerful tools to define complex policy problems and manage decisions in the realm of international environmental law. Nonetheless, there is a limitation of the policy indicators which can lead to misinterpretation for policymakers. Therefore, more efforts required to improve capacities in development of policy indicator sets nationally and internationally. Furthermore, in terms of data availability and accessibility despite some major efforts over the last decade, reliability and transparency of data still is a big concern at the different levels. Since indicators and indices dependent on meaningful data collected either by

national statistical services or through international processes, create possibilities to improve data gathering and accounting is an essential task.

This study demonstrates that keeping the global environment under review and creating a global monitoring system, should be consider as a universal approach. Such approach requires bridging gaps and implements mechanisms at the global level to assist states to design their own national indicators in fulfilling their reporting obligations and to create high-quality records. Facilitate more international support mechanisms such as information exchange, sharing of experiences, transferring technologies and introducing the best practices particularly among developing countries, could be reasonable to develop indicators, and consider as high priority on the policies and political agenda. In particular, there is a critical need to apply more synergise and consistent approach to link the science and policy gaps together in disclosing of environmental information, transparent data collection, monitoring and reporting systems.

### REFERENCES

- [ 1 ] Bell, S., & Morse, S. (2008). *Sustainability indicators measuring the immeasurable?* (2<sup>nd</sup> ed.). London: Earthscan.
- [ 2 ] Burger, J. (2006). Bioindicators: A Review of Their Use in the Environmental Literature 1970–2005. *Environmental Bioindicators*, 1(2), 136 - 144.
- [ 3 ] Ciegis, R., Ramanauskienė, J., & Startienė, G. (2009). Theoretical Reasoning of the Use of Indicators and Indices for Sustainable Development Assessment. *Engineering Economics*, 3(63), 33-41.
- [ 4 ] Dahl, A. L. (2000). Using indicators to measure sustainability: recent methodological and conceptual developments. *Marine Fresh Resources*, 51, 427-433.
- [ 5 ] Department for Environment, F. a. R. A. (1999 ). Criteria for Sustainable Development: The Framework and Models *Quality of Life Counts: Indicators for a Strategy for Sustainable Development for the United Kingdom*: Department for Environment, Food and Rural Affairs.
- [ 6 ] Department of Economic and Social Affairs of the United Nations. (2007). *Indicators of sustainable development: guidelines and methodologies* (No. UN Doc E.08.II.A.2). New York: United Nations.
- [ 7 ] Emerson, J., Esty, D. C., Levy, M. A., Kim, C. H., Mara, V., Sherbinin, A. d., et al. (2010). *2010 Environmental Performance Index*. New Haven: Yale Center for Environmental Law and Policy.

- [ 8 ] Esty, D. C., & Ivanova, M. (2002). *Revitalizing Global Environmental Governance: A Function-Driven Approach*. New Haven: Yale School of Forestry & Environmental Studies.
- [ 9 ] European commission. (2010). *Guide to Statistics in European Commission Development Co-operation*.
- [ 10 ] Ferris, R., & Humphrey, J. (1999). A review of potential biodiversity indicators for application in British forests *Forestry*, 72(4), 313-328.
- [ 11 ] G. Jones, J. P., Collen, B., Atkinson, G., & Bubb, P. (2010). The Why, What, and How of Global Biodiversity Indicators Beyond the 2010 Target. *Conservation Biology*, 25(3), 450-457.
- [ 12 ] Gabrielsen, P., Bosch, P., & European Environment Agency. (2003). *Environmental Indicators: Typology and Use in Reporting*: European Environment Agency.
- [ 13 ] Hammond, A., Adriaanse, A., Rodenburg, E., Bryant, D., & Woodward, R. (1995). *Environmental indicators: a systematic approach to measuring and reporting on environmental policy performance in the context of sustainable development*.
- [ 14 ] Hunter, D., Salzman, J., & Zaelke, D. (2007). *International Environmental Law and Policy* (3rd ed.): Foundation Press.
- [ 15 ] Jafarzadeh, N. (2011, 8-10 May ). *International Environmental Law and Environmental Performance Reporting Practices* Paper presented at the Moving Toward a Sustainable Future: Opportunity and Challenges, Coloumbia University.
- [ 16 ] Kates, R. W., M. Parris, T., & A. Leiserowitz, A. (2005). What is Sustainable Development? Goals, Indicators, Values, and Practice. *Environment: Science and Policy for Sustainable Development*, 47(3), 8-21.
- [ 17 ] Moldan, B., Janousková, S., & Hák, T. (2011). How to understand and measure environmental sustainability: Indicators and targets. *Ecological Indicators, In Press, Corrected Proof*.
- [ 18 ] Niemeijer, D., & de Groot, R. S. (2008). A conceptual framework for selecting environmental indicator sets. [doi: DOI: 10.1016/j.ecolind.2006.11.012]. *Ecological Indicators*, 8(1), 14-25.
- [ 19 ] OECD. (1995). *Environmental indicators : OECD Core Set* Paris.
- [ 20 ] OECD. (2003). *OECD environmental indicators: development, measurement and use*. Paris.
- [ 21 ] Orr, B. J. (2011). *Scientific Review of the UNCCD Provisionally Accepted Set of Impact Indicators to Measure the Implementation of Strategic Objectives 1,2 and 3*: Office of Aried Lands Studies, University of Arizona.
- [ 22 ] Secretariat of the Convention on Biological Diversity. (2010). *Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets "Living in Harmony with Nature"*. Montreal.
- [ 23 ] UNESCO-SCOPE. (2006). *Indicators of sustainability: reliable tools for decision making*. Paris: UN Doc SC.2007/WS/9.
- [ 24 ] United Nations. (1992). *Agenda 21* (No. UN Doc A/CONF.151/6/Rev.1). New York.
- [ 25 ] United Nations. (2002). *Report of the World Summit on Sustainable Development* (No. A/CONF.199/20). New York.
- [ 26 ] Vačkář, D., ten Brink, B., Loh, J., Baillie, J. E. M., & Reyers, B. (2011). Review of multispecies indices for monitoring human impacts on biodiversity. *Ecological Indicators*, doi:10.1016/j.ecolind.2011.04.024.