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Can measures of well-being and progress help societies to achieve sustainable development?

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ABSTRACT

The search for sustainability and the growing apprehension with environmental degradation are increasingly attracting researchers from around the world, and bringing the need for developing indicators that include the economy, society and environment. This study compares the emergy indices with 10 known indicators taken from the literature: Gross Domestic Product, Gross Domestic Product per capita, Human Development Index, Happiness Index, Life Expectancy, Democracy Index, Ecological Footprint, Surplus Biocapacity, Wellbeing Index and Environmental Sustainability Index 2002. Correlations are made using the Spearman coefficients to verify correlations between the fractions of renewable natural resources, non-renewable natural resources, resources from the economy and the emergy indices with the known indicators, and indexes emerged with the literature indicators. The analysis of the results is made by illustrative matrices and graphs. The results suggest that the combination of socio-economic and biophysical indicators is essential to provide a better understanding of the limits of economic growth and while ensuring sustainable societal well-being.

1. Introduction

The demand for addressing the multitude of environmental, social and economic issues along with concerns of inter or intra-generational equity, generated several indicators that intend to guide the path to sustainability by identifying trends and pointing out the problems that must be addressed with priority. In recent years, several researchers proposed to evaluate and scrutinize the proposed indicators of progress, aligned or not with sustainable development (SD) goals. Extensive research provided suggestions to enhance the assessment progress indicators and the literature provided comprehensive reviews of the various proposed tools as well as the feasibility of incorporating new parameters within an existing framework of evaluation (Giannetti et al., 2014).

Indicators of progress include monetary tools (Costanza et al., 2009; Stiglitz et al., 2010), biophysical models (Wackernagel and Rees, 1996; Odum, 1996), and composite indices (Esty et al., 2005; Prescott-Allen, 2001) that have been developed from the perspective of different disciplines, such as economics, statistics, ecology, engineering and social sciences. Because of the inadequacy of GDP as an indicator of societal health and for the need for comprehensive metrics to measure progress and well-being under the SD perspective, several indicators were proposed based upon studies conducted by multidisciplinary teams of professionals, scholars, governmental agencies, businesses and nonprofit organizations (Esty et al., 2005; Prescott-Allen, 2001). Some proposals were based on the concern that, due to entanglement and, the lack of awareness of the problems that humanity is going through, it is unlikely that a single indicator can cover the needed dimensions to support the development and implementation of an integrated set of indicators is more appropriate in providing information that could result in the better policies and more effective governance (Henderson et al., 2000). However, multi-indicator indices have been criticized because they can be not only troublesome to understand by the general public and stakeholders (Gasparatos et al., 2008, 2009), but can also allow incomplete or biased interpretations by groups with particular interests or limited knowledge. On the other hand, single number indicators are also criticized as they hide important dimensions and could easily be misused (Henderson et al., 2000; El Serafy, 1993).

In a recent paper, the main measures of progress and their respective advantages and disadvantages in apprehending the significant contributions to national progress towards SD were

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reviewed in a comprehensive manner (Giannetti et al., 2014). The positive and negative aspects of a selected group of indicators of progress were discussed, according to Daly's classification of weak, medium and strong sustainability (Daly, 1990, 2008), and the authors concluded that, in spite of the several indices proposed and used, the problem of dealing with the amount of conceptual problems and data collection remains unsolved. However, most of the authors agreed that the adoption of new measures must ensure the link between the economy and intangible variables related to real progress and well-being. This link requires the monitoring of three variables (environmental resources, social structure, and the economy), which must be converted into useful and unambiguous information in order to evaluate alternative policy options (Giannetti et al., 2014).

Several authors have stood up for the inclusion of many overlapping or articulated dimensions into a cohesive structure (Tiezzi et al., 2004; Costanza et al., 2009) since most current approaches tend to underestimate some contributions to progress. Another option is to reach an agreement on a single standardized system of accounts that can inform, directly or indirectly, if society is moving towards SD or not. However, a problem arises because the monetary and biophysical approaches measure progress and sustainability in different ways. If these perspectives were complementary, they could provide a complete picture of the problem, but one can still argue if they actually cover, directly or indirectly, all important aspects of SD.

Several researchers compared a set of proposed indicators and correlated them for establishing which of them would be the most complete (Giannetti et al., 2009, 2010) and which would cover most aspects of sustainability using the largest possible number of countries (Cohen et al., 2006; Wilson et al., 2007). Some articles proposed new indicators aggregating or combining the existing ones (Common, 2007; Burkhardt, 2008), others evaluated how their construction influences the results obtained (Martins et al., 2006; King et al., 2007).

Common (2007) proposed the Happy Life Years index (HLY) as an approach for measuring the progress of a nation, based on non financial figures. This index results from the product between the life expectancy (LY) and the Happiness Score (H). H varies from zero to one, according to citizen's sense of happiness measured with the use of a questionnaire. Development efficiencies were determined by dividing the HLY by the energy use per capita, the Ecological Footprint (EF) and the greenhouse gas emissions for 90 countries. Martins et al. (2006) compared the Human Development Index (HDI) with the Environmental Sustainability Index (ESI-2002) using data from 139 countries, and observed that some developed countries well ranked by HDI occupy intermediate positions in ESI-2002, and that the contrary occurs for Latin American countries. These authors proposed an amendment to HDI by the inclusion of a new dimension, based on ESI-2002, regarding environmental aspects.

The lack of concerns on the limited reserves necessary to support welfare and wellbeing of the established progress/wellbeing measures was evaluated by Tiezzi et al. (2004), who suggested the ratio emergy/ISEW (Index of Sustainable Economic Welfare, proposed by Daly et al., 1989) as an indicator for decision making because it shows how much social or environmental degradation is related to the use of resources to support the local lifestyle. Cohen et al. (2006) showed the importance of natural capital stocks as a resource base for the economy of 134 countries. The loss of natural capital is compared with emergy indices establishing the relationship between the Environmental Sustainability Index (ESI) and the percentage of natural capital as a significant breakthrough. Countries with high or low ESI appear to be protecting their natural reserves while countries with moderate ESI would be depleting their natural capital stock. The authors also compared the percentage loss of natural capital with GDP and found that countries with very high or very low GDP have a low environmental load, while countries with intermediate GDP extensively over-exploit their natural capital. King et al. (2007) proposed a new indicator called Emergy Total Well-being (ETWI) by multiplying the HDI by the countries' percentage of renewable resources. Countries with high ETWI would have a high HDI and a high usage of renewable natural resources. This index was compared with HDI, EF, WI, ESI-2002, the Index of Human Well-Being (HWI) and the Index Environmental Wellness (EWI) for 120 countries. Human well-being and environmental well-being have an inverse relationship, and the WI is not related to the ETWI, although the two combine human and environmental welfare.

Niccolucci et al. (2012) analyzed the trends of the EF and biocapacity per capita data for 150 countries, between 1961 and 2007, to assess different paths of development. They found that, in all countries, biocapacity is decreasing, but for some the loss is faster. Combining EF and biocapacity with HDI, EPI (Environmental Performance Index) and ESI-2005, the authors highlighted the key role of biocapacity. HDI, EF and biocapacity results were also compared by Moran et al. (2008) for 93 countries, who found that to achieve a minimum sustainability in a country, the ratio EF/biocapacity should be equal or less than 1.0, provided that HDI $\geq$ 0.8. The only country in this condition was Cuba.

Considering the increasing number of initiatives involving sustainability measures, Wilson et al. (2007) compared six global indices: EF, Surplus biocapacity (SB), ESI-2002, Wellbeing Index (WI), HDI and GDP per capita to examine whether the global indices can be used to guide societies on the SD journey. He divided the information of 132 countries into quintiles and analyzed for inconsistencies among results provided by indices, by highlighting the different interpretations of the sustainability of nations by each indicator used. The variability within the results pointed to a lack of clear directions in approaching SD. Siche et al. (2008) compared SD indicators for twelve countries and discussed the need to develop indicators that include environmental, economic, social, ethical and cultural aspects. These authors observed that ESI-2005 and ESI-2002, in spite of having originated from discussions in academic and policy scales, disregarded the consumption of resources and location in developed countries in the highest rankings while EF and emergy indices ranked the those same countries in the lowest position. The results of the application of ESI-2005 were also criticized by Giannetti et al. (2009), who analyzed the construction of environmental indices based upon expert opinion with paraconsistent logic. They questioned the reliability of the experts' opinions and evaluated the uncertainties due to disagreements among experts, which clearly indicated that the approaches used to measure and monitor SD are insufficient and that there is lack of a solid scientific foundation for sustainability.

Giannetti et al. (2010) compared the results obtained for Mercosur countries using emergy indices and metrics proposed in the literature, including the Ecosystem Services Product (ESP) and the Subtotal Ecological – Economical Product (SEP) proposed by Costanza et al. (1997). Indicators were divided into three groups according to the sustainability dimensions addressed (economic, social and environmental), and the analysis showed that some indicators could be grouped for a more comprehensive result.

All studies revealed that the existing indicators are proxies and may not represent progress in a proper way, either because they are too simple or because they mix so many variables that the final number loses significance.

Bearing in mind that human progress, welfare and well-being are totally interlinked to SD, the objective of this work was to compare measures of well-being and progress in order to identify