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# A new sustainable human development indicator for small island developing states: A reappraisal from data envelopment analysis

Stéphane Blancard [a,*], Jean-François Hoarau [b]

[a] AgroSup Dijon, CESAER, 26 Bd Docteur Petitjean, BP 87999, 21079 Dijon, France
[b] University of La Réunion, CEMOI, 15 avenue René Cassin, BP 7151, 97715 Saint-Denis Messag Cedex 9, La Réunion, France

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ABSTRACT

This paper proposes a transparent and robust measurement of sustainable human development for developing economies. We focus in particular on small island developing states [SIDS] which appear to be highly vulnerable in both economic and environmental dimensions. Hence, our contribution is twofold. First, we introduce some new sustainability components into the standard Human Development Indicator [HDI]. Second, we adopt an endogenous weighting system rather than the more common equal weighting system, determined within the "Data Envelopment Analysis" framework (Charnes et al., 1978). We apply the recent multiplicative optimization approach of Zhou et al. (2010) to construct composite indicators. Then, by implementing this original composite indicator to a set of developing countries including 32 SIDS and comparing the outcomes with standard HDI, we demonstrate that these small islands are not particularly penalized in terms of sustainable human development.



## 1. Introduction

Measuring the level of development and well-being of a Small Island Developing State [SIDS] is an increasingly popular research topic in contemporary development economics. A first constraint is to identify clearly a SIDS insofar as a transparent and consensual definition is lacking in the literature (Hein, 2004). In reality, four main lists of SIDS exist (political, economic, institutional and pragmatic) even if only one of these lists is publicly known[1] (Encontre, 2004). Therefore adopting a homogenous category of SIDS is particularly difficult. From a general viewpoint, they can be nevertheless defined as small islands, peripheral or not, and continental territories with similar characteristics constraining them in their path to implement sustainable development, and members of an island state association.

Among the peculiarities of these economies on which there is a large international consensus (Logossah, 2007), we find (i) geographical features (e.g. small size, remoteness, isolation, exposure to major hazards, fragile ecosystems), (ii) history (e.g. external dependence, close political links to former colonial powers), (iii) social situation (e.g. low intensity and volatility of human capital, labor market instability, insecurity), and (iv) economic structure (e.g. diseconomies of scale, limited local markets, lack of diversification activities, cost of

* Corresponding author.
*E-mail addresses:* sblancard@dijon.inra.fr (S. Blancard), jfhoarau@univ-reunion.fr (J.-F. Hoarau).

[1] Encontre (2004) gives full details about the characteristics of these four groups listed in Table A.1 in Appendix A. These groups are the following:

- a political list of 39 SIDS: 32 countries and 7 territories recognized as SIDS by the so-called Alliance of Small Island States [AOSIS]. AOSIS is a state organization of 43 low-lying coastal and small island countries, with common development and environmental concerns. This list involves all genuine (self-governing or non-self-governing) island entities that are within the membership of AOSIS and collectively enjoying special political recognition within the United Nations. See the AOSIS official webpage for more information: http://www.sidsnet.org/aosis.
- an economic list of 48 SIDS: 34 countries and 14 territories implicitly recognized as SIDS by the United Nations according to the AOSIS. It is a political list in the sense that it encompasses all small island developing economies which are the subject of particular attention and concrete measures from the United Nations system, either internationally or regionally.
- an institutional list of 46 SIDS: 34 genuine island states, 4 continental states and 8 non-self-governing territories that together make up the official list of SIDS according to the United Nations Secretariat.
- a pragmatic list of 29 SIDS: all are self-governing, genuine island states with a population not exceeding five million (except for Papoua New Guinea) and socio-economic characteristics that leave no doubt about their developing country status according to the United Nations Conference on Trade and Development [UNCTAD] classification. Unfortunately, UNCTAD does not provide detailed information on the criteria used to define this group. See http://www.unctad.org/Templates/Page.asp?intItemID=3645&lang=1.

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access to external resources, prevalence of natural monopolies and oligopolistic structures). With some exceptions (Armstrong and Read, 2002; Easterly and Kraay, 2001; Milner and Westaway, 1993; Srinivasan, 1986), most academic works have supported the idea of high economic vulnerability and ecological fragility of SIDS due to these structural handicaps — even compared to other developing countries (Adrianto and Matsuda, 2004; Briguglio, 1995, 2004; Briguglio and Galea, 2003; Guillaumont, 2009, 2010; Kaly et al., 2002; Van Der Velde et al., 2007). Numerous international conferences (the 1992 Rio Earth Summit, the 1994 conference in Barbados, the 2002 Johannesburg World Summit of Sustainable Development, the 2005 Mauritius conference) have thus highlighted the importance of developing specific strategies and actions to promote sustainable development for SIDS.[2]

The presence of both economic and environmental vulnerabilities for SIDS should stimulate academic research to elaborate synthetic development indicators which take into account these two main dimensions simultaneously. Such tools should allow us to evaluate the effectiveness of international development policies, such as those recommended by the "Agenda 21" adopted at Rio Earth Summit in 1992 for instance. Thus, we must depart from the well known traditional indicators of national accounts, especially Gross Domestic Product [GDP]. Indeed, the appropriateness of GDP-based indicators to assess the wealth level of an economy, even using real GDP per capita (in Purchasing Power Parity), has received increasing criticism in academic literature (Jany-Catrice and Gadrey, 2007; Stiglitz et al., 2009). This is even more important when considering the special case of SIDS as many features of small insular economy are not considered by GDP-based indicators.

This article proposes a new synthetic indicator that enables a fair and convenient overview of sustainable development focusing on the features of SIDS. Potentially, there are two ways to do this. We could select some indicators of sustainability in the spirit of the recommendations of the famous Brundtland Report (WCED, 1988) and the 1992 Rio Summit. These proposals from the academic (Nourry, 2008; Pearce et al., 2008, for a recent review of the literature) and institutional arenas (e.g. the Redefining Progress Agency, the World Bank, Global Footprint Network, United Nations) try to encompass the three dimensions of sustainable development – economic, social and environmental – through their integration into a single scalar measurement (e.g. the green national net product, the indicator of sustainable economic welfare, the Genuine Savings or the Ecological Footprint). Unfortunately, these are too sophisticated for SIDS: the lack of reliable statistical data remaining problematic. Alternatively, we could use the methodological basis of the Human Development Indicator [HDI] introduced by the United Nations Programme for Development [UNDP] (UNDP, 2010). The latter is applicable to all countries, but requires substantial modification to make it robust to measuring the sustainable development problem. Indeed, the standard HDI gives some interesting information about the current level of human development but nothing about its sustainability. Ideally, a robust HDI should integrate explicitly the vulnerability components. We chose the latter method.

Our contribution to the HDI literature is twofold. Firstly, we introduce into the standard HDI, defined as the geometric average of three dimensions – longevity, knowledge and standard of living – equally weighted (UNDP, 2010), the impacts of both economic and environmental vulnerabilities. Although economic vulnerability has been widely debated in the literature (Guillaumont, 2010), this is the first application of the concept to the HDI. In relation to environmental sustainability, several studies have tried to build a "green HDI" (Costantini and Monni, 2005; Lasso de La Vega and Urutia, 2001). However, none is sufficiently general to encompass the specific case of the SIDS as economic vulnerability is not taken into account. Our study approximates the environmental dimension with carbon dioxide [$CO_2$] emissions per capita. This proxy has the advantage that it accords with the general recommendations formulated in the context of global climate change (Stiglitz et al., 2009). Ultimately, this contribution allows us to reproduce a "Sustainable Human Development Index" [SHDI] for all developing countries. This should enable a new and more realistic assessment of human development across the world. In particular, this original indicator should reveal the "potential" economic and environmental fragility of the production and consumption systems underpinning the current human development performance of the countries considered. Note that such a tool can also be used as one of possible criteria for geographical aid allocation by international institutions (Guillaumont, 2009).

Secondly, the SHDI presented above still relies on a major methodological shortcoming, namely the use of the weighting scheme that gives equal weight to each dimension (Desai, 1991). Supposing that all dimensions do not contribute with equal importance to human development would seem more realistic. In the literature, there exist several weighting methods based on statistical models or based on public/expert opinion. In the first category, we find the "Data Envelopment Analysis" [DEA] method developed by Charnes et al. (1978). Intuitively, each country can use the weights which place him in the best possible position, making contestation less likely. Several empirical studies have applied this method to the HDI conceptual framework (Despotis, 2005a,b; Zhou et al., 2010, among others) but none considers the aspect of sustainability and the new multiplicative formulation of the UNDP indicator simultaneously. In response to this, we simulate a New Sustainable Human Development Indicator [hereafter BH-SHDI], using the optimization multiplicative approach of Zhou et al. (2010). Our BH-SHDI is performed on a large sample of developing countries[3] including a panel of 32 SIDS for 2010. In this way, we can identify whether the SIDS are affected by some of their particularities in terms of sustainable human development compared to other developing countries. The outcome could have an important operational implication since negative results would reveal the need for special treatment from international institutions.

The rest of the article is organized as follows. Section 2 reviews the concepts of economic and environmental vulnerabilities used to determine the SHDI. To this end, we present two indicators — for economic vulnerability and for environmental sustainability. Section 3 describes the methodological design of the BH-SHDI based on the DEA procedure developed by Zhou et al. (2010). Section 4 provides the simulated results for the whole sample of developing countries, and discusses the findings related specifically to the group of SIDS. Section 5 concludes and proposes some interesting perspectives for future research.

## 2. Insularity and sustainable human development

As mentioned above, the HDI introduced by the UNDP (see Box 1) does not incorporate the features of small islands. This shortcoming highlights a more fundamental problem. The standard HDI measures current development, but not its sustainability.[4] In the international context, there are many economic, social and environmental constraints that can weaken and undermine an ongoing satisfactory human development process (Martins and Winters, 2003; Redding and Venables, 2004). This problem is even more crucial in the case

[2] As mentioned by Adrianto and Matsuda (2002, p. 396), "Vulnerability concept is a part of sustainability constraints together with, for example, the concept of safe minimum standards, quality standards, carrying capacity, ecocapacity, maximum sustainable yield, critical loads, environmental utilization space, etc."

[3] So we depart from the general framework of the standard HDI, which leads us to exclude developed countries from the analysis. Indeed, the changes we introduce have little relevance in the context of developed countries. In particular, the economic vulnerability indicator we use is available only for developing countries.

[4] Sustainability raises the question of whether the current level of human development is likely to be maintained for future generations (UNDP, 2010).