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Analysis

Standard Ecological Footprint Method for Small, Highly Specialized Economies☆

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ABSTRACT

The negative impact of human endeavour on the biosphere has becoming increasingly clear in recent decades. This has spurred a surge in the creation of sustainability indicators. One of the most used sustainability indicators of recent years is the Ecological Footprint (EF). The EF uses trade flows to estimate environmental impacts of consumption. The purpose of this study was to test EF's ability to deal with a small but highly specialized economy. For this we used Iceland as a case study but the Icelandic economy is dominated by strong specialization, with fisheries dwarfing all other sectors. Global Footprint Network's standard methodology was utilized with only the addition of local data being used where these data proved more robust than international databases. The results from the two editions of the GFN calculation models, 2008 and 2014, yielded a footprint of 56.59 and 25.26 gha, per capita, respectively, for Iceland. Three main reasons were identified for the drop in the footprint between the two editions, all within the fishing grounds footprint: A much improved coverage of extraction rates, changes in fish species trophic levels and changes to aggregate errors for traded cod and halibut. A correction of CO_2 intensities for exports also had a big impact but resulted in a rise in the EF for the latter edition. The study highlighted the rapid development of the methodology as a major strength while the method's main weakness was revealed as the uncertainties associated with the marine footprint. Local consumption figures from the Icelandic Directorate of Health indicated that a further drop in the marine footprint is in store with increased accuracy of the method, mainly to do with accurate allocation between export and consumption footprints. Although the indicator's accuracy has been much improved in recent years, additional improvements are thus still needed. The extremes of the Icelandic economy highlight errors to the extent that the huge footprint the calculations yielded make the country an outlier in a global context. The indicator seems in this respect not accurate enough yet to be able to deal with such a degree of specialization, especially where the main sectors are very large in relation to the population – at least not when the sector in question is the marine sector. The upside of this is that highly specialized economies may in this way be very useful for identifying and correcting inaccuracies within the methodology for their sector of specialization.

1. Introduction

The negative impact of human endeavour on the biosphere has becoming increasingly clear in recent decades (IPCC, 2013; Kubiszewski et al., 2013; Niccolucci et al., 2012; Barnosky et al., 2012; Rockström et al., 2009; Turner, 2008; MEA, 2005). In response, the concept of sustainability - or sustainable development - has been getting ever more attention. The call for humanity to live within the means of nature's capability to provide goods and services has arguably never been louder. Since the United Nations Conference on the Human Environment in Stockholm in 1972, often considered the starting point of modern political and public environmental concern (Baylis and Smith, 2005), the concept has been bouncing around in ecological debate, being both argued for, and against, by environmentalists. Various definitions of sustainable development saw the light of day, but the most famous and most quoted today must be the Brundtland report (Our Common Future, WCED, 1987) definition:

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> "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Since the publication of the report and then the United Nations Conference on Environment and Development (UNCED) in 1992, the sustainability concept has become the centre of environmental debate (Feitelson, 1998) and great efforts have been put into the implementation of the concept (or aspects thereof) into global, national and regional policy through international environmental agreements (e.g. the Kyoto protocol, the Aarhus convention, the Paris agreement, etc.), national environmental policy plans (i.e. in the Netherlands, UK, Canada, etc.) and attempted implementation of Agenda 21, the UNCED 92's action plan aimed at achieving sustainability. Sustainability has thus been incorporated into the agenda of most governments worldwide (Rametsteiner et al., 2011).

1.1. Sustainability Indicators

It is clear that in order for sustainability to be anything more than a fancy word, ways to measure sustainability and progress towards it are needed. For this purpose, sustainability indicators are used. In Agenda 21 plans were made to develop sustainability indicators to form a basis for decision making (UNCED, 1992). This spurred a surge in sustainability indicator creation and development, resulting in a variety of indicators, measuring and monitoring a multitude of different variables. The role of these indicators has been defined by Ott (1978) as a way to:

> "…reduce large quantity of data to its simplest form, retaining essential meaning for the questions that are being asked."

McGlade's (2007) definition is for the most part in agreement, although she adds the necessity of being relevant for policy-making and easily understood by the public:

> "The main purpose of any sustainability indicator framework is to provide a comprehensive and highly scalable information-driven architecture that is policy relevant and understandable to members of society and will help people decide what to do."

The United Nations echo this in their *Guidelines and Methodologies for Indicators of Sustainable Development* (2007):

> "Indicators perform many functions. They can lead to better decisions and more effective actions by simplifying, clarifying and making aggregated information available to policy makers. They can help incorporate physical and social science knowledge into decision making, and they can help measure and calibrate progress toward sustainable development goals. They can provide an early warning to prevent economic, social and environmental setbacks. They are also useful tools to communicate ideas, thoughts and values."

Sustainability indicators can now be counted in their hundreds (Singh et al., 2009),of varying sizes and scopes, all aimed at quantifying the human impact on the natural resource base, or aspects thereof, and helping to define a "safe zone" for humanity to operate in. Examples of these are: Index of Sustainable Economic Welfare (ISEW), Measure of Economic Welfare (MEW – precurser of ISEW), Genuine Progress Indicator (GPI), Dashboard of Sustainability (DS), City Development Index, emergy/exergy, System of Economic Environmental Accounting (SEEA), Human Development Index (HDI), Life Cycle Analysis (LCA), Sustainable National Income (SNI), Environmental Net National Product (ENNP), Environmental Policy Index (EPI), Living Planet Index (LPI), Material Flow Analysis (MFA), Environmentally-adjusted Domestic Product (EDP), Genuine Saving (GS), Environmental Vulnerability Index, Environmental Performance Index, Ecological Footprint and The Physical Quality of Life Index (PQLI), to name but a few. It is outside the scope of this paper to make any comparison between these indicators/indices but such comparisons can be found in, e.g., Böhringer and Jochem, 2007; Mori and Christodoulou, 2012; Olafsson et al., 2014; Singh et al., 2009). The only indicator we will focus on here is the Ecological Footprint (EF) (Rees and Wackernagel, 2004; Wackernagel and Rees, 1996; Wackernagel et al., 2002).

1.2. Ecological Footprint

Since its conception EF has enjoyed considerable popularity, with professionals and laymen alike, and according to Binningsbo et al. (2007) it has in recent years become the most widely used sustainability indicator in the world. Although EF has been used to estimate sustainability at various levels – product (Limnios et al., 2009; Frey et al., 2006), business (Bagliani and Martini, 2012), sectoral (Kissinger, 2013; Herva et al., 2008), municipal (Cano-Orellana and Delgado-Cabeza, 2015; Scotti et al., 2009), regional (Cui et al., 2004; McDonald and Patterson, 2004), etc. – its most common use is on a national level (Salvo et al., 2015; Galli et al., 2012; Wang et al., 2012; Medved, 2006; Haberl et al., 2001). The Global Footprint Network (GFN), an NGO whose principal aim is furthering and spreading the methodology, furthermore calculates every year the EF for over 200 countries in what they call the National Footprint Accounts (NFA) (footprintnetwork.org, 2017). The EF sets itself aside from many sustainability indicators by focusing on primary production. The EF attempts to assess sustainability by asking two questions: How much primary production takes place on Earth in any given year and how much of that production is being consumed by humans? If the consumption is less than the production the EF assumes the population under investigation is living sustainably. If the population is consuming more than earth is producing a state of "overshot" is reached – i.e. the population is not living sustainably.

In the GFN publication The Ecological Footprint Atlas 2008 (Ewing et al., 2008) it is stated that results for countries with populations counting less than one million people are not reported in the National Footprint Accounts since "…smaller economies are more prone to distortion". No further explanation is given for this inability of the indicator to deal with smaller economies. Older GFN publications of the NFA thus only include nations with populations over one million. Smaller nations are not included due their data being less reliable and more prone to distortion (Ewing et al., 2008). In the latest version of the NFA this is no longer the case and nations as small as Nauru, the world's least populated country after Vatican city, with its population of 10,301 (worldometers.info, 2017), is presented and so is the British overseas territory of Montserrat, with a population of 5179 (worldometers.info, 2017).With this GFN no longer disqualifies countries due to the size of the population but rather the emphasis is now on data quality, and only those countries whose data quality meet the quality standards of GFN are included in the accounts (footprintnetwork.org, 2017).

Iceland is one of the countries not included in the NFA. With a population of 338,349 in 2017 (hagstofa.is, 2017) Iceland is certainly larger in terms of population than many of the countries that are included. Personal communication with GFN reveals that when putting together a new edition of the NFA the researchers.

"…assess a level of confidence in the final results for each country." (Global Footprint Network, 2017).

By way of deduction this must mean that confidence in the results for Iceland are not high enough for the country to be included in the accounts. This is surprising, since the country has a well-developed infrastructure and comprehensive data collection systems, with the Icelandic statistics office Statistics Iceland being a part of the European Statistical System. A possible explanation may be found in the size of the country's trade flows in relation to its economy, but this can be a source of bias because - according to the Ecological Footprint Atlas 2009 - the resources used and the waste generated in making exported goods are not fully documented (Ewing et al., 2009). Again, this is not explained any further.

Iceland's trade flows are certainly large in relation to the economy.