Sustainability Indicators: Are We Measuring What We Ought to Measure?

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Abstract

17 Sustainable Development Goals (SDGs) were adopted by the General Assembly of the United Nations (UN) in September 2015 with 169 targets signaling a course towards a sustainable future. Indicators are required for monitoring the level of achievement toward the targets, and to be well received by national governments stakeholders, these indicators should fully take into account circumstances and concerns of each country. Using national sustainability indicators already in place, this study aimed at investigating what national governments have attempted to measure and how such attempts have reflected people's notions of sustainability. A thorough review was conducted of literature on indicators established by 28 countries and international organizations, and to investigate common usage of the term "sustainability," phrases containing that word were searched on Internet websites. Merging outcomes of the review and search revealed that (1) some elements of sustainable development were more regularly used for measuring sustainability than others, and that (2) non-expert people used the term "sustainability" in a wide variety of ways, and the usage did not reflect the meaning intended by sustainability indicators set by the government. From these results, the authors argue that sustainable development indicators at the UN level could include several new indicators that are regularly used by lay people, and also that experts need to convey messages regarding the importance of sustainability in fields that are not being considered by the community.

Key words: monitoring, national sustainability indicator, public opinion, sustainable development goals (SDGs), website search

1. Introduction

The term "sustainable development" (SD) has been used since the late 1980s (IUCN *et al.*, 1980; Barbier, 1987; WCED, 1987). The United Nations Commission on Sustainable Development was established to follow up on Agenda 21, adopted at the Earth Summit in June 1992. Many countries have followed Agenda 21 and established their own national SD strategies and indicators. After the Rio+20 Conference, multilateral discussions related to Sustainable Development Goals (SDGs) under the United Nations were set up, and eventually 17 SDGs and 169 targets were adopted by the United Nations General Assembly in September 2015 (UN, 2015). Guided by these aspirational and global targets, each government is expected to pursue its own national targets taking into account national circumstances (Para. 55, UN, 2015). Indicators are required for monitoring the level of achievement toward the targets (Hák, *et al*., 2016). An Inter-agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDGs) created by the United Nations Statistical Commission, is discussing a proposal for an SDG indicator framework (e.g., UNSC, 2015).

The targets and indicators require consideration of the needs and expectations of all countries, both developed and developing. Meanwhile, this is not the first experience for the countries at developing sustainability indicators. There have already been a lot of work and literature contributing to the measurement of sustainable development. Researchers and international organizations also have made efforts to create SD indicators (SDIs) that would help countries achieve SD. As a result, many countries have developed their own respective SDIs, without harmonizing with each other. It is questionable that the selected indicators are actually the best set of indicators to assess countries' progress towards coherent achievement of SD worldwide. It is thus worthwhile to examine what types of indicators were chosen by countries when they established their own sustainable development or sustainability indicators. It is also important that governmental actions of measuring

national sustainability affect people's perception of what is to be nourished in their countries.

The aim of this study is to investigate what national governments have attempted to measure by using national sustainability indicators already in place, and how such attempts have reflected people's notion of sustainability.

2. Methods

2.1 Overall Design of the Survey

The study consisted of two consecutive examinations. First, a thorough literature review on sustainability indicators established by 28 countries and international organizations was made to find out what indicators had been chosen by a number of countries to assess their level of national sustainability. Second, a search for terms containing the word "sustainability" on Internet websites was conducted in two languages, Japanese and English, to observe how lay people – those who were not experts in sustainability sciences – were using the term in two linguistic areas. A comparison of the results was made to examine whether or not SDIs set by governments reflected people's mindset as to what ought to be measured.

2.2 Sustainability Indicators at the National Governmental Level

This study surveyed SD indicators (SDIs) adopted by national governments, regions, and international organizations. The intention of this survey was to understand the elements of SD as a notion. There have been a number of studies that reviewed SDIs by national governments (Eurostat, 2007; UN, 2008), development of new SDIs by academia, and reviews of SDIs developed by academia (Bell & Morse, 2003, 2008; Hák *et al.*, 2007; International Journal of Sustainable Development, 2007; Mitchell, 1996; Moldan *et al.*, 1997; OECD, 2000; Parris & Kates, 2003; Pearce *et al.*, 1996), but they have mostly focused on indicators developed in western countries. This study is intended to review indicators developed by national governments in both developed and developing countries as well as international organizations, because the main focus is on national governmental decisions.

We used the results of a survey of SDIs by Tasaki *et al.* (2010) and an additional survey of two reports on SDIs. In total, 1,848 indicators from 28 countries and international organizations (Australian Bureau of Statistics, 2006; CEC, 2007; Council for Economic Planning Development, 2002; Council for Sustainable Development, 2005; Czech Republic, 2004; Danish Government, 2002; Department for Environment, Food and Rural Affairs, 2004, 2006; Federal Government of Austria, 2002; Federal Government of Germany, 2002; Finnish Environment Institute, 2006; INEGI *et al.*, 2000; Ministère de l'écologie, 2004; Ministère de l'Environnement, 2002; National Economic and Social Council, 2002; Ministry of Finance of Norway, 2006; National Roundtable on the Environment and the Economy, 2003; NESDB, 2005; Nguyen, 2003; Plan Bleu Regional Activity Centre, 2009; SFSO, 2004a,b; Secretaría de Ambiente y Desarrollo Sustentable, 2006; Statistics New Zealand, 2002; Statistics Sweden & Swedish Environmental Protection Agency, 2001; Swedish Government, 2006; Task Force Développement Durable, 2005; UNEP Regional Office for Latin America and the Caribbean, 2002; UNDESA, 2007; UNDG, 2003; UK Government, 1996, 1999; U.S. Interagency Working Group on Sustainable Development Indicators, 2001). These indicators were categorized into the 77 subcategories used by Tasaki *et al.* (2010), which are subcategories under the UNCSD categories of economic, environmental, social and institutional (UNCSD, 2001). Several indicators belonged to more than one category and the number of indicators in the 77 subcategories amounted to 2,086.

2.3 Analysis of Words Associated with "Sustainable"

Contrasting to the survey in the previous section, which was made at a governmental level, the second stage of the research consisted of a survey aiming at investigating how people in general were using the term "sustainable" to find out what people intend to sustain. Aggregating those objects chosen by people to be sustained produced an image of actual sustainable development. Two languages, Japanese and English, were chosen for the case studies, because Japan has not created sustainable development indicators at the national level, and thus it was considered to be worthwhile to examine how Japanese people utilized the term "sustainability" in their daily lives, and also to be able to compare the results of the two languages and find commonalities and differences.

One of the few studies that conducted a similar search of general usage of the term "sustainability" was a work by Barkemeyer *et al.* (2009), which compared 115 newspapers around the world to compare the frequency of appearance of the terms "sustainability," "sustainable development," "corporate social responsibility," etc. This study, however, did not cover Japanese-language newspapers, so it was another reason for this study to focus on Japan. A study by Kajikawa *et al.* (2007, 2008) covering scientific journal literature in English, and searching for the term "sustainable" and "sustainability" in titles and abstracts, found out that articles on "sustainability" started to increase around 1990, and continued to increase up to 2005. As newspaper articles only started increasing after 1999, it can be said that there is a time gap of a decade between when ideas are taken up by academia and the community in general (Tasaki *et al.*, 2014).

First, we searched for phrases with "sustainable xxx" on the Internet in titles of books and newspaper articles. Different search results were obtained depending on the search engine. The first step was to determine which search engine to be used for this study. We examined search results among four widely-used search engines, and selected Google to conduct our search, as it had the most hits in both Japanese and English.

The search was conducted in April 2012. As for Japanese, we searched for phrases with "*jizoku-kano*," "*sasutenaburu*," "*sasutinaburu*"and "*sasuteinaburu*" (all meaning "sustainable" in Japanese). Phrases with "sustainable" were searched for in English- language websites. The top 1000 phrases were listed for in both Japanese and English. After deletion of duplicated phrases, we found 236 phrases in Japanese and 247 phrases in English. Words associated with the phrases found were categorized according to the SDI categorization explained in the previous section of this paper.

3. Results

3.1 Counts of Categories of Sustainable Development

The results of categorizing SDIs and words associated with "sustainable" are listed in Table 1. The indicator sub- categories listed in the column on the left- hand side of the table are those included in the national SDIs reviewed in the previous section. The total numbers of indicators found in the national SDIs are shown in column (A), whereas total numbers of countries that included the indicator are shown in column (B). The other columns list the results of the website search. The number of Japanese word search hits is in column (C), and results of the English search are in column (D). The common logarithm was taken for the figures in (C) and (D) as the figures had different orders of magnitude when compared between the two columns. The sum of (C) and (D) is shown in column (E).

3.2 Sustainability Indicators at the National Governmental Level

In the economic category, "energy use," "transportation" and "economic performance" were the three most common subcategories. Indicators in the "energy use" subcategory focused on energy consumption, supply and intensity; and several focused on energy resources, energy efficiency, and energy price. "Transportation" indicators included travel distance, accessibility, traffic congestion, traffic energy consumption, share of specific transportation mode, noise and emissions. Most countries commonly apply GDP as an indicator of "economic performance," but they also concurrently use other macroeconomic indicators to visualize qualitative performance.

In the environmental category, "climate change," "ecosystems" and "agriculture and livestock" were the three most common subcategories observed. Most indicators for "climate change" focused on CO_2 and greenhouse gas (GHG) emissions, and some countries chose indicators segmented for industry and household sectors. Indicators of temperature and of emissions per GDP or per capita were also found. "Ecosystem" indicators included those for protected regions, the number of inhabitants of specific species, and diversity. Most of these indicators represented ecosystem states or land use in terms of area, not how human activities were balanced with the ecosystem. As for the subcategory of "agriculture and livestock," there were many indicators of agricultural land use, and several indicators focused on organic agriculture and the material balance of nitrogen and phosphorus.

In the social category, "mortality, life expectancy, and health," "education" and "work" were the three most commonly observed subcategories, being used by more than two-thirds of the countries reviewed. Many indicators in the "mortality" subcategory included life expectancy, mortality rate, and causes of death from specific diseases. The rate of smoking and degree of satisfaction with health were some unique indicators. The "education" subcategory covered both compulsory and lifetime education, as well as labor training.

Many indicators related to the unemployment rate in the "work" subcategory were found, and a few of them used the long- term unemployment rate and working poor.

Institutional category: "Environmental management and policy" was the most common group of subcategories, and many indicators focused on management systems such as the ISO 14000 series. "Science and technology" was the second most common subcategory, taken up by 20 countries reviewed. Many countries applied indicators such as "expenditure on research and development" and "patent registrations".

3.3 Comparison of Words Associated with "Sustainable"

The categorization was based on the words associated with phrases containing "sustainable." The absolute number of total hits was on the order of 31.8 million for Japanese and 158.8 million for English. Hits in English exceeded those in Japanese for almost all words, but this result is unsurprising as there is a much larger English-speaking population than Japanese-speaking population worldwide.

By comparing (A)(B) with (C)(D)(E), it is easily recognized that some subcategories measured by SDIs were not found in the website searches. The reason is quite simple, that people wish to sustain only things that are judged as good or positive. "Disaster," "poverty," "gender inequality," etc., are subcategories that were measured by SDIs, but not hoped to be "sustained." Some other subcategories included similar concepts. For instance, "sustainable ecosystem" is almost the same as "unsustainable endangerment of species."

On the other hand, there were some other subcategories in (A)(B) that did not appear in (C)(D)(E). Subcategories such as "air quality," "water quality," "coastal zones," "international cooperation," etc., are important elements of sustainable development, but they are not used with "sustainable" in ordinary circumstances. This could be because good air and water quality or cooperative relations of countries themselves embody the concept of SD.

A comparison of (A), (B) and (E), particularly focusing on the top three subcategories in each, raised

Table 1 Categorization of sustainable development indicators (SDIs) and search hits of associated words.

Category	Indicator sub-categories	(A)	(B)	(C)	(D)	(E)
Economic	Energy use	100	26	6.2	7.1	13.3
	Transportation	93	21	5.4	6.9	12.3
	Economic performance	63	25	6.2	6.0	12.2
	Waste generation and management	58	21	4.8	5.7	10.5
	Capital and investment	39	19	5.7	5.7	11.4
	Financial status	27	17	5.9	5.4	11.3
	Material use	26	14	5.7	6.0	11.6
	Trade	25	15	-	-	-
	Eco-business	22	10	-	-	-
	Household financial status	15	8	6.1	5.6	11.8
	Recycling	14	13	-	-	-
	Business and industry	12	9	6.8	7.0	13.8
Environmental	Climate change	74	27	-	-	-
	Ecosystem	63	21	5.4	5.1	10.5
	Agriculture and livestock	55	19	5.1	7.2	12.3
	Air quality	54	24	-	-	-
	Water quality	45	24	-	-	-
	Water quantity	40	18	5.8	6.5	12.3
	Forests	39	17	5.7	6.5	12.2
	Land use	38	17	5.0	5.7	10.7
	Resources	27	15	5.5	6.0	11.5
	Chemicals	27	14	-	-	-
	Coastal zone	27	13	-	-	-
	Endangered species	21	14	-	-	-
	Fisheries	21	13	4.6	6.1	10.6
	Soil	19	14	4.9	6.1	10.9
	Ozone layer depletion	14	13	-	-	-
	Urbanization	14	8	4.6	4.8	9.4
	Radioactivity	10	7	4.2	4.7	8.9
	Disaster	8	6	-	-	-
	Noise	8	6	-	-	-
	Commune with nature	5	4	5.2	6.9	12.2
	Landscape	3	3	5.2	5.6	10.8
	Desertification	3	3	-	-	-
	Environmental aggregated indicator	2	2	6.0	6.1	12.1
	Perception of environmental pollution	1	1	-	-	-
	Water cycle	1	1	-	-	-
	Biosecurity	1	1	-	-	-
Social	Mortality, life expectancy and health	108	25	-	-	-
	Education	94	25	5.5	5.7	11.2
	Work	78	25	6.4	5.8	12.2
	International cooperation	62	18	-	-	-
	Poverty and dependence	54	19	-	-	-
	Gender inequality	37	15	-	-	-
	Social relationship and participation	36	12	5.0	4.7	9.7
	Housing	33	16	5.9	7.0	12.9

Category	Indicator sub-categories	(A)	(B)	(C)	(D)	(E)
	Economic inequality	26	16	-	-	-
	Information	30	14	6.1	5.8	11.9
	Population change	32	12	5.3	5.4	10.7
	Culture, leisure, and time	25	14	6.1	6.1	12.1
	Working conditions	23	12	-	-	-
	Child living conditions	25	11	-	-	-
	Crime	21	11	-	-	-
	Sanitation and drinking water	20	11	-	-	-
	Social exclusion (incl. the disabled)	17	9	-	-	-
	Literacy and numeracy	16	11	-	-	-
	Generation inequality	13	8	-	-	-
	Regional inequality	13	8	-	-	-
	Race/immigrant inequality	11	7	-	-	-
	Services and public facilities	10	8	5.5	6.3	11.8
	Food safety	10	3	5.2	4.6	9.8
	Nutritional status	9	6	5.5	6.7	12.2
	Social aggregated indicator	8	6	6.0	6.1	12.1
	Social security	8	5	5.4	5.5	10.9
	Peace/conflict	4	2	4.7	5.8	10.5
	Alcohol	3	3	-	-	-
	Childcare	3	3	-	-	-
	Family	2	2	5.6	5.1	10.7
	Spiritual	1	1	-	-	-
Institutional	Environmental management and policy	63	14	-	-	-
	Science and technology	35	20	6.0	6.3	12.3
	Morality and compliance	17	9	-	-	-
	Strategic implementation of SD	16	8	-	-	-
	International institutions	3	3	-	-	-
	Legal administration	2	2	-	-	-
	Sustainable development networks	2	2	-	-	-
	Administration and management	2	1	5.8	7.4	13.2
Ideas, Others	Regional development	-	-	6.2	7.4	13.6
	Lifestyle	-	-	6.1	7.1	13.2
	Future, timespan	-	-	-	-	-
	Action, practice	-	-	6.2	6.2	12.4
	Development, vision	-	-	-	-	-
	System	-	-	5.4	5.5	11.0
	Others	-	-	-	-	-
Total		2086	28	7.5	8.2	

Notes: (A): Number of sub-categories found in national SDIs
(B): Number of countries that chose indicators categorized in (A)
(C): Number of hits by word search in Japanese, shown in the common logarithm ($\log_{10}$). For instance, "4" is listed when 10,000 hits were found by the web search.
(D): Number of hits by word search in English, shown in the common logarithm ($\log_{10}$).
(E): (C)+(D)
Shaded cells are the top three ranking items in the column for each category.

another interesting observation. Some subcategories of the top three national SDIs were widely used in websites. On the other hand, some other subcategories, such as "business and industry," "communing with nature" and "housing" were ranked near the bottom in national SDIs, but widely used in websites. Some other conceptual ideas such as "regional development," "lifestyle" and "action and practice" that attract people's attention with respect to sustainability were also not much measured by national SDIs.

A comparison of the searches in Japanese (C) and English (D) is helpful toward recognizing the way Japanese people acknowledge the concept of sustainability. Japanese websites that mentioned the term "sustainable" were mostly associated with words categorized in "business and industry," "financial status," "work," "regional development" and "action, practice." This result suggests many of these words are related more with economic activity than with environmental protection or social justice. On the other hand, websites in English used "sustainable" associated with words categorized in "energy use," "transportation," "agriculture and livestock," "communing with nature," "housing," "administration and management" and "regional development." The usage in English held a better balance between economic activity, environmental and resource conservation, and social stability.

4. Discussion

The integration of the two exercises revealed many new ideas for developing national and international SDIs further.

The first "top-down" survey conducted for indicators set up at national governmental levels utilized three or four key categories shared among experts — economic, environmental, social, and institutional — to establish their respective national sustainability indicators. Thus, indicators were selected in a balanced manner from those four categories. The most commonly used indicators were; "energy use," "transportation" and "economic performance" for the economic category, "climate change," "ecosystem" and "agriculture and livestock" for the environmental category, "mortality, life expectancy and health," "education" and "work" for the social category, and "environmental management and policy" and "science and technology" for the institutional category.

On the other hand, the second "bottom-up" survey conducted for phrases with "sustainable" resulted in lists of associated words, many of which were not measured by the national SDIs. Particularly in Japan, many of the phrases with "sustainable" were used merely to express something that was expected to continue. Words such as "job," "economy," "commodity," "energy," "information," "environment" and "way of living" were the most commonly associated words used in Japan. English websites associated it with "community," "agriculture," "design," "transport," "building" and "forest," many of which were related to society or citizens' daily lives. In both languages, the associated words had little connection with the notion of maintaining a good balance with a sound environment.

A comparison of the two approaches is helpful toward understanding the gap that exists between what national governments try to measure and how citizens interpret the term "sustainable." From the standpoint of experts, we could suggest this gap to indicate a "misuse or misunderstanding of the term by lay people." Meanwhile, from the standpoint of lay people, we may be able to draw out suggestions as to what citizens hope to be measured by national governments.

As for what the people want to be sustained, the SDIs tend to judge sustainability by degree of balance among environment, economy and society, while ordinary citizens tend to think simply to sustain something without any consideration of balancing with other aspects. Those positive values which people wish to sustain should be classified separately in SDIs from negative elements that hamper sound sustainability.

Results from the Japanese website search indicate that Japanese people tend to consider "sustainability" from the economic dimension. Japan has yet to develop its own SDIs. When there is a chance to start the process of creating Japanese SDIs, we should consider indicators that emphasize environmental and social aspects of sustainability, as well as taking into account both "national and regional" and "individual and household" levels of indicators so that the Japanese people's recognition of sustainability will be enhanced and the scope of their own ideas on sustainability widened.

As people's perceptions are formulated through information they receive, education and information provision can play an important role. The differences in results between English and Japanese suggest that differently-focused information is being disseminated in the respective countries, and that obstacles to achieving sustainable development for the international community as well as for each government might not be shared properly. The same implications can be applied to explaining differences in the results between experts and non-experts. The results of our study imply that it would be meaningful to reconsider and examine what information regarding SD should be disseminated as public policy, including information on how one indicator (issue) is related to another. Another result was that conceptual ideas such as "regional development" and "lifestyle" were not in the categories measured by national SDIs. This implies that people tend to think of overall conditions rather than individual categorical conditions with respect to sustainability. Simple presentation of a set of SDIs is therefore inappropriate and we should reconsider the current ways of communicating with ordinary citizens.

5. Conclusions

This article deals with two types of reviews that resulted in a two-way examination of SDIs. A thorough

survey of national and international indicators suggests that national governments have attempted to measure several key indicators for each of the four categories, namely economic, environmental, social and institutional categories. Maintaining a good balance among the four categories was a condition for achievement of sustainable development. Meanwhile, the choice of indicators was somewhat ad hoc, meaning that the chosen indicators did not always have consistency with each other. The website search for phrases with "sustainability" revealed a tendency among lay people to use the phrase for things they wished to sustain into the future. Ideas related to "business and industry," "communing with nature" and "housing" were widely used in websites but were ranked near the bottom in national SDIs. On the other hand, subcategories related to "air quality," "water quality," "coastal zones" and "international cooperation" were not associated with "sustainable" in ordinary use.

As the United Nations adopts new sets of targets and indicators for sustainable development, it is important for indicators to reflect not only expert knowledge of researchers and governmental officials, but also ideas of non-expert citizens. Although existing SDIs established by national governments around the world have selected indicators quite similar to each other as well as to the UN choices, these official indicators should not be far from perceptions of all the other ordinary citizens. By looking into the discourse of lay people, experts can learn more about what ought to be measured by SDIs. Continuous dialogues among people and improved provision of information regarding SD would play an important role in filling, or at least understanding, the gaps in perception. They would also contribute to producing an indicator set more suitable to a particular country.

Further research on why the different perceptions revealed by this study arose may help us to fill the perceptual gaps between experts and non-experts, as well as between people speaking different languages, and ultimately to formulate a global vision as there is for SDGs.

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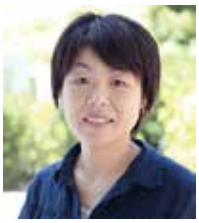

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