ENVIRONMENTAL SUSTAINABILITY INDICATORS AS IMPACT TRACKER: A REVIEW

LAILATULFARIHA MAMAT, NOOR EZLIN AHMAD BASRI, SHAHROM MD. ZAIN AND ELFITHRI RAHMAH

¹Department of Civil & Structural Engineering, Faculty of Engineering and Built Environment, National University of Malaysia (UKM), Bangi, Selangor.

*Corresponding author: lailatul_fariha@yahoo.com

Abstract: Sustainability indicators have been used widely by many organisations to track the impact of human activities toward the earth. Measuring the sustainability was like trying to measure the immeasurable. In this research, five sustainability indicators studied were Environmental Sustainability Index (ESI), Environmental Performance Index (EPI), Bandar Lestari-Environmental Awards, Sustainability Tracking, Assessment & Rating System (STARS) and, University of Indonesia Greenmetric (UI Greenmetric). Their roles, usage and impacts were discussed thoroughly in this paper. As overall, researchers focus on measuring sustainability with a great cooperation from various institutions and organisations members were a lot of help to accomplish the mission of indicators.

Keywords: Sustainability, sustainability indicator, ESI, EPI, STARS, UI Greenmetric, Bandar Lestari.

Introduction

Environmental quality degradation and destruction of natural resources, was difficult to avoid but it should be raised awareness for global citizen. Simple example of environmental quality degradation is the results from human daily activities such as air pollution from fossil fuel used in transportation or water pollution from improper management of household and wastewater drainage. Thus, the appropriate technology and environmental education process must be implemented at all agents regarding local, country, regional and international level with the public awareness raising attitude and behaviour changing, public consciousness and responsibility building.

Background

To sustain was literally 'to keep in existence, keep up, maintain or prolong' (Bell, Morse & Stephen, 2008). Sustainability can therefore be defined as the ability of a system to continue into the future. The key words of this definition suggest a framework for quantification.

Indicators can be tools of change, learning, and propaganda. Their presence, absence, or prominence affects behaviour. The world would be a very different place if nations prided themselves, not on their high GDPs but on their lower infant mortality rates or if the World Bank ranked countries not by average GDP per capita, but by the ratio of the incomes of the richest 10 percent to the poorest 10 percent (Brugmann, 1997). As everyone was busy to pursue advancement, we have to try measure what we value, then only we come to value what we measure. This feedback process was common, inevitable, useful, and full of pitfalls.

In general terms, an *indicator* was a quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions (*e.g.*, of a country) in a given area. When evaluated at regular intervals, an indicator can point out the direction of change across different units and through time. Therefore, indicators were quantitative information, which helps to explain how specific concerns regarding a phenomenal change over time. Many years limited number

of the main economic constraints were used to assess economic activities such as production, rate of employment, rate of inflation, balance of payment, and state debt. Such statistics present a general situation, but it does not explain sources of specific trends and does not necessarily reflect the situation of a particular sector of industry, community or territory (Ciegis *et al*., 2009). In order to manage sustainability, society has to formulate clear and measurable goals of sustainability that should be continually revised and corrected. The level, at which these goals were implemented, might be measured using sustainable development indicators, i.e. definable and measurable parameters, the values and trends of which show the development of an ecological, economic, and social stability of particular region

Indicators necessarily limit themselves to the sphere of the measure. Like models, indicators can reflect reality only imperfectly. However, even within the measurable, the quality of indicators was determined by largely by the way reality was translated into measures and data, be they quantitative or qualitative (Clugston & Calder, 1999).

Even the idea of a sustainable city, an apparent contradiction, has become so popular that prizes were now provided for those cities deemed to be the most sustainable, and indicators play a major role in this process. The central idea behind the use of such indicators was very simple, and essentially they were designed to answer the question: 'How might I know objectively whether things were getting better or getting worse?' (De Sherbinin, 2003).

Sustainability Indicators

Following the wide acceptance of the sustainable urban development notion, finding an accurate way to assess and measure comparative sustainability levels of existing and future developments has become an important issue. There have been various studies which have proposed different methods for sustainability assessment. As for this paper, five sustainability indicators will

be reviewed. There are ESI (Environmental Sustainability Index) and EPI (Environmental Performance Index) which used for measuring various country sustainability performances, Bandar Lestari which used for measuring city sustainability performance in Malaysia and, STARS (Sustainability Tracking, Assessment & Rating System) and UI Greenmetric (University of Indonesia Greenmetric) used for measuring higher education sustainability performance.

ESI & EPI

Three groups were involved in the creation of the ESI. The World Economic Forum's Global

Leaders for Tomorrow Environment Task Force, the Yale University Centre for Environmental Law and Policy, and the Centre for International Earth Science Information Network of Columbia University. The team began with a Pilot ESI, which was published in January 2000. After considerable input and consultation with expert groups, the team produced the 2001 ESI in January 2001 and the 2002 ESI in February 2002. In 2002, the team also launched the Environmental Performance Index (EPI), which included more robust data for both current performance and recent progress on four key environmental parameters for the 23 OECD countries.

The Environmental Sustainability Index (ESI) measures overall progress toward environmental sustainability for 142 countries. Environmental sustainability was measured through 20 "indicators", each of which combines two to eight variables, for a total of 68 underlying data sets. The ESI tracks relative success in each country in five core components:

- Environmental Systems
- Reducing Stress
- Reducing Human Vulnerability
- Social and Institutional Capacity
- Global Stewardship

The ESI score represents an equally weighted average of the 21 indicator scores. Each indicator builds on between 2 and 12

data sets for a total of 76 underlying variables. Air quality, for example, was a composite indicator that includes variables tracking the concentration of nitrogen oxides, sulphur dioxide, and particulates. Given the diversity of national priorities and circumstances, there will never be full agreement on a universally applicable set of weights for the aggregation of the 21 ESI indicators. Indeed, in some countries, water issues will be most pressing; in others, air pollution may be the priority.

Developed countries were likely to put more emphasis on longer-term challenges such as climate change, waste treatment and disposal, clean and sustainable energy supply, and the protection of biodiversity. Developing nations will stress more urgent and short-term issues such as access to drinking water and sanitation, environmental health problems, and indoor air pollution. The uniform weighting settled on 21 indicators because of simple aggregation was transparent and easy to understand. Moreover, when the leading experts were asked from the governmental, business, and non-governmental sectors to rank the indicators, none stood out as being of substantially higher or lower importance than the others. Similarly, when statistical methods (including principal component analysis) used to identify appropriate weights, nearly equal values were suggested across all 21 indicators (Emerson *et al.,* 2012).

The 2012 EPI was grounded in two core objectives of environmental policy; Environmental Health, which measures environmental stresses to human health, and Ecosystem Vitality, which measures ecosystem health and natural resource management. The EPI evaluates countries on 22 performance indicators spanning ten policy categories that reflect facets of both environmental public health and ecosystem vitality. These policy categories include:

- Environmental Health
- Water (effects on human health)
- Air Pollution (effects on human health)
- Air Pollution (ecosystem effects)
- Water Resources (ecosystem effects)

- Biodiversity and Habitat
- Forests
- Fisheries
- Agriculture
- Climate Change & Energy

Each policy category was made up of one or more environmental indicators; some indicators represent direct measures of issue areas, while others were proxy measures that offer a rough gauge of policy progress by tracking a correlated variable.

The two objectives that provide the overarching structure of the 2014 EPI were Environmental Health and Ecosystem Vitality. Environmental Health measures the protection of human health from environmental harm. Ecosystem Vitality measures ecosystem protection and resource management. The results for 2014 EPI were shown in Figure1. These two objectives were further divided into nine issue categories that span high-priority environmental policy issues, including air quality, forests, fisheries, and climate and energy, among others. The issue categories were extensive, but not comprehensive. Underlying the nine issue categories were 20 indicators calculated from country-level data and statistics.

Overall, results were high in Access to Drinking Water, Child Mortality, and Access to Sanitation. Poorer results were found in Air Quality, Fisheries, and Wastewater Treatment. While in most areas, trends suggest improvements, some primary issues like air quality and fisheries show distressing decline over the last decade.

Bandar Lestari-Environment Award

In collaboration with relevant government agencies and community-based organisations in Malaysia, the Department of Environment under the Ministry of Natural Resources and Environment Malaysia has initiated the Bandar Lestari-Environment Award to give recognition to urban centres for their overall commitment and efforts towards environmental sustainability.

Rank	Country	Score	10-yr.	Rank	Country	Score	10-yr.	Rank	Country	Score	10-yr.
1.	Switzerland	87.67	+	60.	Jordan	55.78	−	119.	Central African Republic	42.94	+
2.	Luxembourg	83.29	+	61.	Seychelles	55.56	+	120.	Libya	42.72	+
3.	Australia	82.40	+	62.	Montenegro	55.52	+	121.	Zambia	41.72	−
4.	Singapore	81.78	+	63.	Azerbaijan	55.47	+	122.	Papua New Guinea	41.09	+
5.	Czech Republic	81.47	+	64.	Cuba	55.07	+	123.	Equatorial Guinea	41.06	+
6.	Germany	80.47	+	65.	Mexico	55.03	+	124.	Senegal	40.83	+
7.	Spain	79.79	+	66.	Turkey	54.91	+	125.	Kyrgyzstan	40.63	+
8.	Austria	78.32	+	67.	Albania	54.73	+	126.	Burkina Faso	40.52	+
9.	Sweden	78.09	+	68.	Syria	54.50	+	127.	Laos	40.37	+
10.	Norway	78.04	+	69.	Sri Lanka	53.88	+	128.	Malawi	40.06	+
11.	Netherlands	77.75	+	70.	Uruguay	53.61	+	129.	Cote d'Ivoire	39.72	+
12.	United Kingdom	77.35	+	71.	Suriname	53.57	+	130.	Congo	39.44	+
13.	Denmark	76.92	+	72.	South Africa	53.51	+	131.	Ethiopia	39.43	+
14.	Iceland	76.50	+	73.	Russia	53.45	+	132.	Timor-Leste	39.41	+
15.	Slovenia	76.43	+	74.	Moldova	53.36	+	133.	Paraguay	39.25	+
16.	New Zealand	76.41	+	75.	Dominican Republic	53.24	+	134.	Nigeria	39.20	+
17.	Portugal	75.80	+	76.	Fiji	53.08	+	135.	Uganda	39.18	+
18.	Finland	75.72	+	77.	Brazil	52.97	+	136.	Viet Nam	38.17	+
19.	Ireland	74.67	+	78.	Thailand	52.83	+	137.	Guyana	38.07	+
20	Estonia	74.66	+	79.	Trinidad and Tobago	52.28	+	138.	Swaziland	37.35	+
21.	Slovakia	74.45	+	80.	Palau	51.96	+	139.	Nepal	37.00	+
22.	Italy	74.36	+	81.	Morocco	51.89	+	140.	Kenya	36.99	+
23.	Greece	73.28	+	82.	Bahrain	51.83	−	141.	Cameroon	36.68	+
24.	Canada	73.14	+	83.	Iran	51.08	+	142.	Niger	36.28	+
25.	United Arab Emirates	72.91	−	84.	Kazakhstan	51.07	+	143.	Tanzania	36.19	+
26.	Japan	72.35	+	85.	Colombia	50.77	+	144.	Guinea-Bissau	35.98	+
27.	France	71.05	+	86.	Romania	50.52	+	145.	Cambodia	35.44	+
28.	Hungary	70.28	+	87.	Bolivia	50.48	+	146.	Rwanda	35.41	+
29.	Chile	69.93	+	88.	Belize	50.46	+	147.	Grenada	35.24	+
30.	Poland	69.53	+	89.	Macedonia	50.41	+	148.	Pakistan	34.58	+
31.	Serbia	69.13	+	90.	Nicaragua	50.32	+	149.	Iraq	33.39	+
32.	Belarus	67.69	+	91.	Lebanon	50.15	+	150.	Benin	32.42	+
33.	United States of America	67.52	+	92.	Algeria	50.08	+	151.	Ghana	32.07	+
34.	Malta	67.42	+	93.	Argentina	49.55	+	152.	Solomon Islands	31.63	+
35.	Saudi Arabia	66.66	+	94.	Zimbabwe	49.54	+	153.	Comoros	31.39	+
36.	Belgium	66.61	+	95.	Ukraine	49.01	+	154.	Tajikistan	31.34	+
37.	Brunei Darussalam	66.49	−	96.	Antigua and Barbuda	48.89	+	155.	India	31.23	+
38.	Cyprus	66.23	+	97.	Honduras	48.87	+	156.	Chad	31.02	+
39.	Israel	65.78	+	98.	Guatemala	48.06	+	157.	Yemen	30.16	+
40.	Latvia	64.05	+	99.	Oman	47.75	+	158.	Mozambique	29.97	+
41.	Bulgaria	64.01	+	100.	Botswana	47.60	+	159.	Gambia	29.30	+
42.	Kuwait	63.94	+	101.	Georgia	47.23	+	160.	Angola	28.69	+
43.	South Korea	63.79	+	102.	Dominica	47.08	+	161.	Djibouti	28.52	+
44.	Qatar	63.03	−	103.	Bhutan	46.86	+	162.	Guinea	28.03	+
45.	Croatia	62.23	+	104.	Gabon	46.60	+	163.	Togo	27.91	+
46.	Taiwan	62.18	+	105.	Bahamas	46.58	+	164.	Myanmar	27.44	+
47.	Tonga	61.68	+	106.	Vanuatu	45.88	+	165.	Mauritania	27.19	+
48.	Armenia	61.67	+	107.	Bosnia and Herzegovina	45.79	+	166.	Madagascar	26.70	+
49.	Lithuania	61.26	+	108.	Barbados	45.50	+	167.	Burundi	25.78	+
50.	Egypt	61.11	+	109.	Turkmenistan	45.07	+	168.	Eritrea	25.76	+
51.	Malaysia	59.31	+	110.	Peru	45.05	+	169.	Bangladesh	25.61	+
52.	Tunisia	58.99	+	111.	Mongolia	44.67	+	170.	Dem. Rep. Congo	25.01	+
53.	Ecuador	58.54	+	112.	Indonesia	44.36	+	171.	Sudan	24.64	+
54.	Costa Rica	58.53	+	113.	Cape Verde	44.07	+	172.	Liberia	23.95	+
55.	Jamaica	58.26	+	114.	Philippines	44.02	+	173.	Sierra Leone	21.74	+
56.	Mauritius	58.09	+	115.	El Salvador	43.79	+	174.	Afghanistan	21.57	+
57.	Venezuela	57.80	+	116.	Namibia	43.71	+	175.	Lesotho	20.81	+
58.	Panama	56.84	+	117.	Uzbekistan	43.23	+	176.	Haiti	19.01	+
59.	Kiribati	55.82	+	118.	China	43.00	+	177.	Mali	18.43	+
								178.	Somalia	15.47	+

■ Top 10 Trend Performers   ■ Lowest 10 Trend Performers   + Country Improvement in Performance   − Country Decline in Performance

Figure 1: Ranking for 2014
(Source: 2014 Environmental Performance Index Summary for Policymakers)

The Bandar Lestari-Environment Award was in line with the eight principles of the National Policy on the Environment. This awarding exercise intends to encourage Local Authorities to come forward in sharing their best practices and latest innovative approaches

in managing their cities and to build up smart intercity partnerships.

In the first cycle of the Bandar Lestari-Environment Award, which was launched on the 5th of June 2003, only six State Capitals participated in the program. In its second cycle has since expanded to include Local Authorities of various sizes in term of area of jurisdiction, population size and operating budget. Thus, for the second cycle the Local Authorities were grouped into three Categories in order to create a level playing field. Bandar Lestari-Environment Award incorporates several issues of importance to sustainable development. These include:

- Physical conditions
- Ecological well-being
- Urban environmental services
- Good governance
- Active community participation

The Bandar Lestari-Environment Award intends to recognise Local Authorities that keep abreast of innovations and practices in creating and maintaining a healthy environment for human habitation, thus the concept of Bandar Lestari-Environment Award also promotes:

- Facilitating the sharing of environment: development information, expertise and building inter-agency partnership.
- Building environmental planning and management capacities.
- Leveraging environmental resources and
- Managing risks for achieving sustainable development.

The award was not designed as a competition and participation was on a voluntary basis. Generally, a sustainable city was a city that was able to provide the basic needs of its inhabitants beside the necessary infrastructure of civic amenities, health and medical care, housing, education, transportation, employment, good governance, and take care of the population's needs, as well as a city that enhances the economic, social, cultural and environmental well-being of current and future generations.

Several elements were selected to denote the sustainability of a city for the Bandar Lestari-Environment Award. These include physical conditions, ecological efforts, environmental governance, level of awareness and urban environmental services.

Objectives:

- Facilitating the sharing of environment: development information, expertise and building inter-agency partnership.
- Recognise the work carried out by the administrators of local authorities with regard to environmental sustainability.
- Raise awareness regarding environmental sustainability at the local level and mobilise support within communities.
- Disseminate innovative approaches and examples of good practices towards environmental sustainability.

In the first cycle of Bandar Lestari-Environment Award, invitations to participate in the program were sent out to all State Capitals through the Local Government Department of the Ministry of Housing and Local Government. For 2003/2004, six state capitals voluntarily submitted their entries for their entries for the Award. These Pihak Berkuasa Tempatan were Penang Municipal Council, Shah Alam City Council, Malacca Historic City Council, Kuantan Municipal Council, Johore Bahru City Council and South Kuching City Council.

In the second cycle the Bandar Lestari programme was expanded to include the smaller local authority. Local Authorities were divided into three categories in order to create an even playing field. These categories were Category 1, which encompass state capitals and cities. For this category eight State Capitals took part in the exercise. Category 2 includes cities and municipalities. In this category 14 local authority were involved. Category 3 encompasses district councils and for this category nine local authority joined the program.

Five valuation criteria:

- Ecological initiatives

- Physical environment

- Urban environmental services

- Education and awareness

- Environmental governances

There were two categories of award. The first was the overall award (Award Recipient), which goes to the local authority with the highest score. The second award was the Special Mention Award for selected initiatives, which were considered good practices that could be emulated by other local authorities.

The Kuantan City Council was the recipient of the Bandar Lestari – Environment Award 2003/4. Five aspects of the Kuantan City Council were highlighted below, which could be emulated.

The Kuantan City Council was committed to providing a comfortable, clean and safe environment for its citizens. The indexes on air, water, sand noise pollution have been maintained at minimal and controlled levels. The methods adopted to control pollution include:

- Provision of advice to and rising of awareness among the public.

- Regular inspection and investigation of emission sources.

- Enforcement of laws.

- Locating factories and industries away from rivers and residential areas.

- Creation of buffer zones in industrial areas with planting of trees.

- Control for discharge of wastewater.

Ecological Initiatives

- The mangrove swamps along Sungai Kuantan, which covers a total area of 339 hectares, has been in existence for more than 500 years. The mangrove areas contain a variety of wildlife species that become an attraction to visitors. Capitalising on this natural asset, the Council has initiated and maintained efforts in conserving the mangrove swamps as a recreational area. In addition to serving as a key tourist spot, the mangrove also serves to enhance environmental education and awareness to visitors.

- The waterfront along Sungai Kuantan, located adjacent to Taman Esplande, headquarters of the Kuantan Municipal Council, and Hospital Tengku Ampuan Afzan (HTAA), was upgraded and beautified. A total RM4 million was spent for upgrading the 1.3 km long riverbanks. It was now one of the popular recreational areas for Kuantan residents as well as for tourists from outside Kuantan.

- The Kuantan Municipal Council has been implementing regular tree-planting programs in the city centre, not merely for landscaping purposes, but also for alleviating the urban heat effects within the city. The road dividers and pedestrian paths were planted with appropriate grass, trees and flowers for aesthetics and environmental reasons.

- With technical assistance from the private sector, the Council was currently in the process of implementing an integrated electricity saving program. The program, initiated in September 2005, was expected to generate an annual savings of RM200,000 to RM400,000. The program will be carried out with minimal impact to its inhabitants.

Urban Environmental Services

The progressive growth of Kuantan has caused traffic congestion within the city. In addition, the increasing number of vehicles has resulted in lack of parking spaces. The Council and relevant agencies were highly conscious of this problem. Mitigating measures taken include:

- Enlargement of roads towards the city centre.

- Construction of slip roads at roadsides.

- Introduction of 'timing' traffic light system.
- Construction of new road networks towards the city centre:
- Re-organisation of traffic flow
- Relocation of government offices away from the city centre and
- Provision of a pedestrian mall at Lorong Tun Ismail

In the long term, transportation and traffic problems will be further alleviated through continuous upgrading of existing roads, construction of appropriate road networks and multiple level intersections, provision of multiple floor parking facility, upgrading of existing roads, construction of appropriate road networks and multiple level intersections, provision of multiple floor parking facility, upgrading and encouraging the use of public transport systems, and separation of pedestrian and motorcycle paths within the city centre.

Environmental Governance

A special entity was established within the Council for handling environment related issues i.e. The Committee on City Beautification and Environment. The National Environmental Policy has been adapted to the local level and the use of guideline documents was routine. Examples include the Standard for Island Planning and Physical Development, Standard for Golf Course Planning and Development, Guidelines for Planning of Toxic and Solid Waste Disposal Site, Guidelines for Planning of Natural Topography Conservation, Standards for Planning of Open and Recreational Spaces, and Guidelines and Standard for Planning and Development of Lakes.

Education and Awareness

City Council raises awareness and educates the public on environmental issues through seminars, courses, talks, 'gotong-royong' and other activities. In particular, through the hard work and serious effort by the Kuantan Municipal Council and Alam Flora, with the support and cooperation of its citizen, the 3R Programme (Reduce, Reuse, Recycle) has been successfully implemented in schools, housing areas and commercial offices. The rate of recycling has increased substantially from 0.4% in 2001 to nearly 37% in 2004. This already exceeds the target set by the Federal Government in the 3R Programme for year 2005, i.e. 25%.

The second cycle of the Bandar Lestari-Environment Award consists of an overall Award for each of the three categories as well as several Special Mention Awards. The recipient of the Bandar Lestari-Environment Award 2006/2007 for Category 1 was North Kuching City Hall for showing outstanding achievement in fulfilling the criteria of the award program.

Sarawak River, which meanders through several districts before flowing through North Kuching make up a section of the Kuching Water Front. Keeping the river free of rubbish and debris has been a major challenge for this local authority. In 1992 North Kuching City Hall took over the management of this river within the local authority's boundary from the Department of Irrigation and Drainage (JPS). Rubbish and debris were prevented from entering the City's section of the river by the installation of a series of rubbish traps before the local authority's boundary and at the river mouth to prevent trash from the sea entering the river. The traps used by the local authority were locally constructed using mostly bamboo. In addition to the rubbish trap the local authority also engaged a contractor whose employee physically removes unwanted items from the river. This contractor was also responsible for disposing the collected material. In 1992, more than 40% of the unwanted item collected from the river consisted of domestic waste. This figure went down to only 4% by 2006. The local authority attributed this reduction to their continuous education and awareness on maintaining a clean environment. One of the local authority's unique awareness programme dubbed "catch them young" was a program for children at the kindergarten level where they learn about reducing waste.

North Kuching City Hall boasts a library that offers its patrons more than just books that they can take out. This library also compliments other libraries in different parts of Kuching City. A unique feature of the library was its garden. A section of the Library's compound has been turned into an ethnobotany garden with over 300 well documented native species. The main aim of this garden is to increase visitors' awareness on the functions of plants in their environment, learn the history of the plants as well as learn about their cultural significance.

Special Mention Award for Category 1 awarded to Kota Kinabalu City Hall under category of Education and Awareness Initiative; Kota Kinabalu City Learning Centre (KKCLC) was located in Kingfisher Park, Kota Kinabalu. The Centre was equipped to cater to the needs of various groups. Halls of different sizes are equipped with LCD Projectors and sound systems. KKCLC was often used as a conference and seminar venue due to its convenient location and ample parking facilities. In addition, many programmes for the community and conducted by Kota Kinabalu City Hall were held at this centre, such as drawing competitions and handcraft making demonstration. KKCLC has an information centre for visitors who would like to know more about the activities offered by the centre. There were also several corners for special interests users. For example, there was a recycling corner where visitors can obtain more information on recycling and a handcraft corner where locally made handcrafts were exhibited.

Special mention award for the category Ecological Initiative; Urban Forest Rimba Sama Jaya goes to South Kuching City Council. The Sama Jaya Forest Park was located within Tabuan Jaya. This 18 hectare of mostly Kerangas forest was managed based on a Forest Park Concept where the wilderness theme and all the facilities and activities were integrated into the existing natural forest environment. The main objective of the park's existence was to promote the concept of the multiple uses of forests which include as facility for outdoor recreation, a venue for nature conservation education, the creation of reserve & refuge for urban wildlife, and as the green lung for Kuching City among others. The various facilities which include a Visitor Centre, Activity Centre, Jogging and Cycling Track, Bamboo museum, and Forest Biology Museum were handicap accessible.

STARS

The Sustainability Tracking, Assessment & Rating System (STARS) was a voluntary, self-reporting framework for helping colleges and universities track and measure their sustainability progress. It was designed to:

- Provide a framework for understanding sustainability in all sectors of higher education.

- Enable meaningful comparisons over time and across institutions using a common set of measurements developed with broad participation from the campus sustainability community.

- Create incentives for continual improvement toward sustainability.

- Facilitate information sharing about higher education sustainability practices and performance.

- Build a stronger, more diverse campus sustainability community.

STARS were intended to engage and recognize the full spectrum of colleges and universities; from community colleges to research universities, and from institutions just starting their sustainability programs to long-time campus sustainability leaders. STARS encompass long-term sustainability goals for already high-achieving institutions as well as entry points of recognition for institutions that were taking first steps toward sustainability.

The current version of STARS 2.0 incorporates feedback, suggestions, and lessons learned from the launch of STARS 1.0 in January

2010. The summary was shown in Figure 2. While STARS was the most thoroughly vetted and extensively tested campus sustainability framework for North American institutions, it was by no means perfect. The current version of STARS was intended to stimulate, not end, the conversation about how to measure and benchmark sustainability in higher education. AASHE welcomes your feedback and participation in continuing to refine and shape the system.

Given the diversity of higher education institutions, each STARS credit should be appropriate for most institution types. In order to accommodate this diversity, some STARS credits does not include detailed specifications, but were instead flexible or open. In other cases, credits include an applicability criterion, so that the credits only apply to certain types of institutions. By following this approach, institutions were not penalized when they do not earn credits that they could not possibly earn due to their circumstances.

Additionally, STARS was designed to incorporate the full spectrum of sustainability achievement, and upper levels of achievement represent highly ambitious, long-term goals. Therefore, there were some credits for which few, if any, institutions will achieve full points currently. To help ensure that the system works as intended, Association for the Advancement of Sustainability in Higher Education (AASHE) strived to ensure that each credit was objective, measurable, and actionable.

AASHE defines sustainability in a pluralistic and inclusive way, encompassing human and ecological health, social justice, secure livelihoods, and a better world for all generations. STARS attempts to translate this broad and inclusive view of sustainability to measurable objectives at the campus level. Thus, it includes credits related to
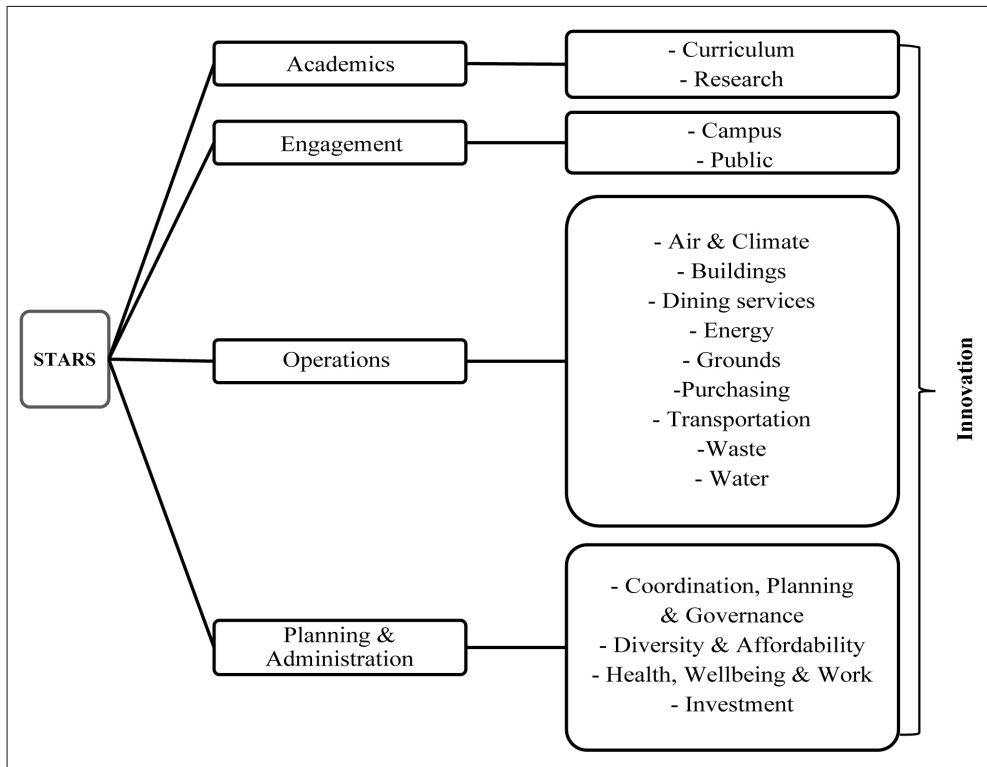

Figure 2: Summary of STARS Components

an institution's environmental, social, and economic performance.

With the adoption of a fourth main category, the total number of points available for STARS has been changed from 300 to 200. This important difference should be kept in mind when comparing point values between STARS 1.0 and 2.0. Whereas STARS 1.0 weighted the three main categories equally, category totals in STARS 2.0 vary. However, a 50/50 split can be found between categories focusing on academics and engagement and those focusing on operations and administration.

UI Greenmetric

The UI GreenMetric World University Ranking was an initiative of University of Indonesia, which was being launched in 2010. As part of its strategy of raising its international standing, the University hosted an International Conference on World University Rankings on 16 April 2009. It invited a number of experts on world university rankings such as Isidro Aguillo (Webometrics), Angela Yung-Chi Hou (HEEACT), and Alex Usher (Educational Policy Canada). It was clear from the discussions that current criteria being used to rank universities were not giving credit to those that were making efforts to reduce their carbon footprint and thus help combat global climate change.

A number of top world universities, for example, Harvard, Chicago, Copenhagen has been taking steps to manage and improve their sustainability. There were also cooperative efforts among groups of universities. A grading system which includes information on sustainability at 300 universities exists under the title the United States Green Report Card. This was excellent, however, the results were given in terms of a grade (A to F) rather than a ranking and the number of universities included was relatively circumscribed. The need for a uniform system that would be suitable to attract the support of thousands of the world's universities and where the results were based on a numerical score that would

allow ranking so that quick comparisons could be made among them on the criteria of their commitment to addressing the problems of sustainability and environmental impact.

The ranking has a number of primary objectives:

- It was open to global participation.

- It was accessible to HEIs in both the developed and developing world.

- It should contribute to academic discourse on sustainability in education and the greening of campuses.

- It should encourage university-led social change with regard to sustainability goals.

Green Metric was not based on any existing ranking system. It was however developed with awareness of a number of existing sustainability assessment systems and academic university rankings. Sustainability systems that were referred to during the design phase of Green Metric included: The Holcim Sustainability Awards, GREENSHIP, The Sustainability, Tracking, Assessment and Rating System (STARS) and The College Sustainability Report Card.

Meanwhile, university academic ranking systems that were studied during the design phase of Green Metric included: the Times Higher Education World University Rankings(THE) sponsored by Thompson Reuters, the QS World University Rankings, the Academic Ranking of World Universities (ARWU) published by Shanghai Jiao Tong University (SJTU), and the Webometrics Ranking of World Universities (Webometrics), published by Cybermetrics Lab, CINDOC-CSIC in Spain.

Selected criteria that were generally thought to be of importance by the universities concerned with sustainability. These include the collection of a basic profile of the size of the university and its zoning profile, whether urban, suburban, rural. Beyond this we want to see the degree of green space. The next category of information concerns electricity consumption because of its link to our carbon footprint.

Then we want to know about transport, water usage, waste management and so on. Beyond these indicators, we want to get a picture about how the university was responding to, or dealing with the issue of sustainability through policies, actions, and communication. In the first version of the methodology, used in 2010, 23 indicators were used within the five categories to calculate the ranking scores. In 2011 34 indicators were used. Then in 2012, we leave the indicator of "smoke free and drug free campus environment" and used 33 indicators to evaluate the green campus. In 2012, we also categorize the indicators into 6 categories including education criteria. One change being considered was the formation of a new category for sustainability education and research.

Discussion

A significant attempt to define the sustainable university was made in 1990 with the Talloires Declaration to voice their concerns about the state of the world and create a document that spelled out key actions universities must take to create a sustainable future. Recognizing the shortage of specialists in environmental management and related fields, as well as the lack of comprehension by professionals in all fields of their effect on the environment and public health, this gathering defined the role of the university in the following way; universities educate most of the people who develop and manage society's institutions. For this reason, universities bear profound responsibilities to increase the awareness, knowledge, technologies, and tools to create an environmentally sustainable future.

All human activities of livelihood have caused environmental impacts in various facets whether air pollution from fossil fuel in the industrial process and transportation or wastewater drainage from household, factory or agricultural activities impacted by the quality of soil, water and air as well. Results in the environmental quality degradation and destruction of natural resources, it was

difficult to avoid, but it should be raised awareness for global citizen. Therefore, the appropriate technology and environmental education process must be implemented at all agents regarding local, country, region and international level with the public awareness raising, attitude and behaviour changing, public consciousness and responsibility building.

The roles and usage of sustainability indicators were discussed as follow:

i. Role of sustainability indicator:

- Goal: what was specifically sought to be achieved. Progress toward a goal was determined through the use of measurable indicators. An example of a goal was: Reduce mercury emissions from electric utility steam generating units.

- Indicator: a summary measure that provides information on the state of, or change in, the system that was being measured. An example of an indicator for the above goal was: Mass of mercury emitted per unit of energy delivered.

- Metric: the measured value(s) used to assess specific indicators. It defines the units and how the indicator was being measured. An example of a metric for the above indicator was: Grams of mercury per kilowatt-hour.

ii. Usage of indicators:

- Anticipate and assess conditions and trends.

- Provide early warning information to prevent economic, social and environmental damage.

- Formulate strategies and communicate ideas.

- Support decision-making.

The sustainability committee seeks and sets the overall practices, procedures, processes and resources for developing, implementing, achieving, reviewing and

maintaining university policy of achieving a sustainable environment. It was implemented via an iterative and continuous process where environmental sustainability will always be continuously improved and evaluated by regular audits through adequate environmental documentation and benchmarking. Working on this formula, consistent and positive changes on sustainability can be accurately addressed, the exploitation of resources will be more meaningful, the investments were manageably directed, while the technology and Research and Development can be fully deployed.

Campus sustainability assessments serve several functions. The first was to help an institution understand where it stands with regards to sustainability objectives. These objectives may include self-defined sustainability policies or goals; externally defined, voluntary declarations, charters or environmental/sustainability management systems; widely accepted sustainability indicators or metrics; and mandatory regulations. Besides that, the function was to identify problem areas and develop strategies for improvement. Assessing institutions 'state of sustainability' helps identify relative strengths and weaknesses. A campus sustainability assessment can provide detailed information to inform specific solutions and strategies for change. Last but not least, the function was to help build a 'culture of commitment' [30].

Conclusion

There were various indicators existed, that have been used for a country, town and also school. However, the depth of application depends on the decision maker. It is possible to say that all the methods mentioned were important alternatives to calculate the sustainability of the environment, but they need to be refined in order to think in a new better alternative derived from them.

Evaluating the objective ability of a community to sustain itself and thereby the planet's ecosystem, the global economy and

its quality of life within the context of shifting local perceptions of 'quality' requires levels of scientific sophistication and local values clarification that has been rarely available to a local community. This was a worthy effort upon which great progress might be made in one city with tens of millions of dollars. Informing local residents and institutions about our imperfect understanding of this desirable, but complex state called 'sustainability' and finding out what they most want to sustain was an equally noble yet essentially different task.

Sustainable development, thus requires the participation of diverse stakeholders and perspectives, with the ideal of reconciling different and sometimes opposing values and goals toward a new synthesis and subsequent coordination of mutual action to achieve multiple values simultaneously and even synergistically.

Assessments were good for building diverse stakeholder commitment to sustainability because it provides the campus community and other stakeholders with the opportunity to participate in a visioning and decision making processes that ultimately affect them.

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