Evaluation of Sustainable Development Using Ecological Footprint and Other Indicators

エコロジカル・フットプリントをはじめとする指標による持続可能型開発の評価

Wu Qing *[1)]、Dinil Pushpalal[1)]
1) Graduate School of International Cultural Studies, Tohoku University
*wuqingkuaile@hotmail.com

.

1. INTRODUCTION

Ecological Footprint (EF) is the top to bottom counterpart of the Life Cycle Assessment, which is now broadly utilized for evaluating environmental load of countries, regions and masses. On the other hand, Human Development Index (HDI) is a broad indicator than GDP to measure level of living standards through life expectancy, education and literacy, and the ability to purchase needed goods and services. Available data of countries indicates that there is a considerable correlation between EF and HDI. In this paper the authors will reveal indicators other than HDI which needed to evaluate sustainable human development, taking EF as the principal determinant.

2. METHODOLOGY

2.1 Sustainable Development

'Meeting the needs of the present without compromising the ability of future generations to meet their own needs' is the most popularized definition of sustainable development in the Brundtland report — Our Common Future in 1987. Therefore, UNDP's HDI and Wackernagle & Ree's EF parameters were used to evaluate region's development in authors' previous research from social, economic and environmental aspects[1] (see Fig.1).

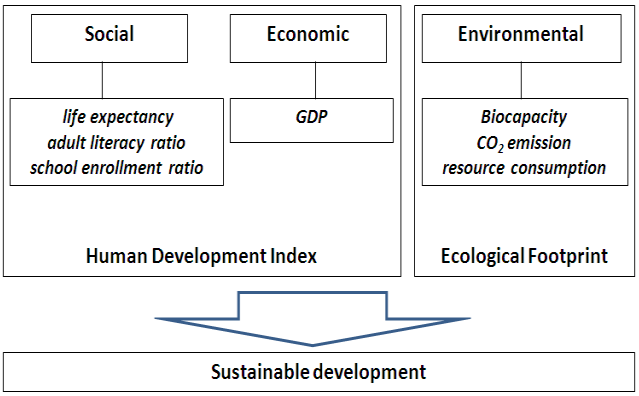

Fig.1. Elements of sustainable development

2.2 Ecological Footprint

Ecological Footprint concept offers a methodologically simple but comprehensive way for such an accounting task. It tracks national economies' energy and resource throughput and translates them into biologically productive areas necessary to produce these flows. Also, it compares this resource and energy consumption to the ecological capacity available in the country. Ecological Footprint is now widely used around the globe as an indicator of environmental sustainability since it was developed by Wackernagel and Rees in 1996.

2.3 Human Development Index

The Human Development Index is a composite index, it has become the most influential tool of measurement of poverty and wellbeing in society (longevity, income, education) (see Fig.2). It is used to rank countries by level of "human development", which usually also implies whether a country is a developed, developing, or underdeveloped country.

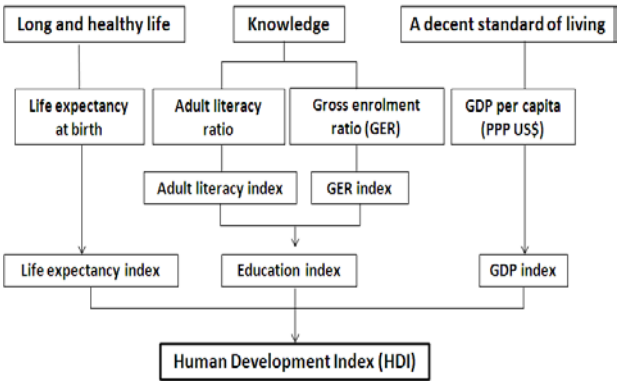

Fig.2. Structure of HDI (before 2010 edition)

2.4 EF and HDI

UNDP considers an HDI value of more than 0.8 to be "high human development". Meanwhile, a footprint lowers than 1.8gha/cap, the average bio capacity available per person on the planet, could denote sustainability at the global level[2]. For sustainable human development regions should be positioned in "sustainable development" quadrant shown in Figure 3.

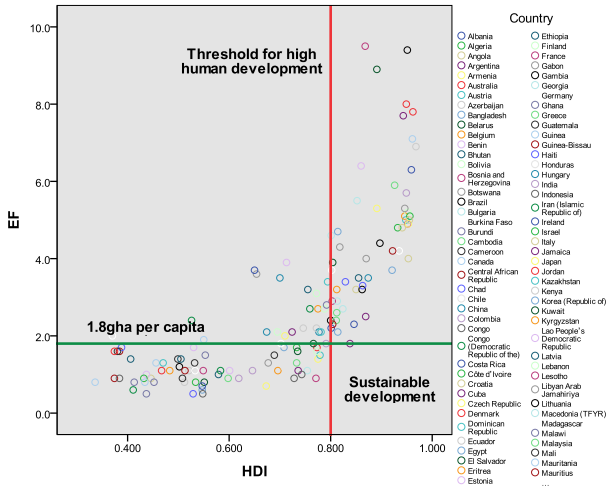

Fig.3. EF & HDI of countries[3]

Empirical analyses indicated that combine EF and HDI parameters to evaluate region's development is more satisfying, and using this quadrant method possible reasons for region's inconsistent development can be understood, and opinions for improvement could be suggested.[1]

Although EF and HDI are important parameters of social development, the authors have understood that there are still some insufficiencies of evaluation sustainable development only by these two parameters, such as lack of environmental pollution assessment and lack of income difference assessment. Therefore, the purpose of this research is to establish a third comprehensive parameter namely x index for indicating precisely the real panorama of a sustainable society. For this purpose, the authors conducted a questionnaire (Table 1) in Japan in Nov. 2010, and the same questionnaire will be conducted in China and other places.

Table1. Public awareness of sustainable development

1. 個人 Personal	2. 社会 Social	3. 環境 Environmental	4. 経済 Economic
□ スローライフ /Slow life（自給自足、地産地消、精神面・体力面でゆとりのある暮らし）	□ 治安の良さ/Good public order	□ 大気汚染の減少 /Reduce air pollution	□ 相互扶助の強化 /Strengthen mutual assistance（親戚、地域、組織の構成員どうしの助け合いの強化）
□ 自由 /Freedom	□ 平等性/Equality	□ 水汚染の減少 /Reduce water pollution	□ 経済成長/Economic growth
□ 人権が守られること /Protection of human rights	□ 対外的な安全保障 /External security	□ 生物多様性の保全/Biodiversity protection	□ 所得格差の解消 /Eliminate income difference
□ プライバシーを侵害されないこと /Inviolable privacy	□ 自分の国への誇り /Proud of your country	□ 砂漠化の抑制 /Desertification control	□ 国内総生産(GDP)のうち研究・開発分野の占める割合の増加/Increase percentage of R&D in GDP
□ 自分の能力を向上させること/Improve personal ability	□ 医療保険制度の整備/Improve medical insurance system	□ 温暖化の抑制 /Prevention of global warming	□ 雇用の確保 /Employment security
□ その他（具体的に＿）	□ その他（具体的に＿）	□ その他（具体的に＿）	□ その他（具体的に＿）

3. RESULT

In general, a region with high HDI also coincided with high EF. Regression analysis indicates that EF and HDI have considerable correlation, their equation is:

$y = 30.591x^3 - 35.401x^2 + 12.32x - 0.0372$

($R^2 = 0.7093$)

Here, y is EF, and x is HDI.

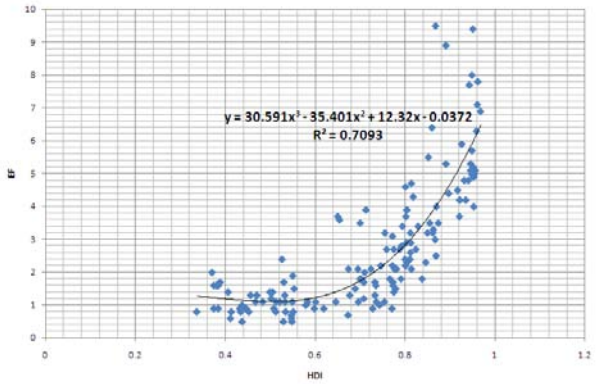

Fig.4. Correlation of EF and HDI

In the questionnaire survey there were 40 repliers, male: female is 54:46, majority of the repliers were over 40 years old, and they have a higher education and rich life experiences. Table 2 shows the result.

Table2. Results of questionnaire

1. Personal		2. Social		3. Environmental		4. Economic	
Slow life	21	Good public order	11	Reduce air pollution	3	Strengthen mutual assistance	14
Freedom	3	Equality	10	Reduce water pollution	7	Economic growth	2
Protection of human rights	10	External security	6	Biodiversity protection	17	Eliminate income difference	9
Inviolable privacy	2	Proud of your country	6	Desertification control	2	Increase percentage of R&D in GDP	5
Improve personal ability	4	Improve medical insurance system	7	Protection of global warming	9	Employment security	9
Others	0	Others	0	Others	2	Others	1

4. CONCLUSION

Combining EF and HDI parameters to evaluate regions' development is more comprehensive than single indicator. And there is a considerable correlation between EF and HDI. Questionnaire survey shows that there are some components to be included in sustainable human development assessment. After conducting more surveys, the components of a 3rd index can be determined, and authors are going to establish a 3D evaluation system for assessing regional development.

5. REFERENCE

[1] Wu Qing, Dinil Pushpalal. Evaluation of Sustainable Human Development Using Ecological Footprint and Human Development Index: A Case Study of Chinese Provinces, Footprint Forum 2010, Italy (2010)

[2] WWF, Living Planet Report 2006, p19 (2006)

[3] Data source: Human Development Report 2007/2008, Living Planet Report 2008.