

A new Environmental Poverty Index (EPI) for monitoring system in the SEA (Strategic Environmental Assesment) procedure

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Abstract. In this paper, the authors apply the HPI index of UNDP 1995 to clarify the poverty levels of the poor living in six environmental poverty sectors according to ADB, 2008, in order to form a new Environmental Poverty Index (EPI) of national and provincial levels prospectively. This index is easy to communicate worldwide. To clarify the poverty levels of the environmental poverty in environmental sectors, a set of six environmental poor livelihood indicators (EPLI) is also proposed. The index and indicators are fit well the requirement of a monitoring system of the SEA procedure by Circular No 05/2008/TT-BTNMT issued by Vietnam Ministry of Natural Resources and Environment.

Two methods are proposed to calculate EPI:

$$\text{Unweight method: } EPI = \frac{1}{n} \sum_{i=1}^n HPI_i$$

$$\text{Weight method: } EPI = \frac{\sum_{i=1}^n HPI_i \times C_i}{\sum_{i=1}^n C_i}$$

where: i - the environmental poverty sector number i ;

n - the total number of environmental poverty sectors ($i_{max}=6$);

HPI_i - the UNDP's human poverty index of the environmental poverty sector i ;

C_i - the weight of HPI_i .

Keywords: Environmental poverty; Environmental poverty sectors; EPI; EPLI; SEA procedure.

1. Introduction

Issue No 5.2 of the Circular 05/2008/TT-BTNMT guiding SEA requests to use indice or indicators to monitor and to evaluate plans or strategies assessed. However, prospective indicators and indice are still lacking in

practise, although some reports or articles dealing with the topic have been compiled so far [3-7]. For all sides, alleviation of environmental poverty is sensitive enough to all socio-economic development strategies and plans assessed in SEA. Application of UNDP poverty index HPI (1995) and ADB environmental poor idears leads the authors to build up environmental poverty index EPI which may meets the target of this report.

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2. Recent identifications of the poverty index and the environmental poverty

2.1. The World Bank's study

In the World Bank's 2002 study [6], the poverty-environment indicators can be used to assess poverty environment interactions. From the Bank's perspective, it seeks to develop indicators that can be applied "from local to global levels" and that can also be used to monitor changes "globally", that is, through cross-country comparison. The proposed indicators covered two distinct fields. The first is the relationship between environmental conditions (such as quality of water supply and levels of pollution and wastes), and human health. The second monitors the impact of resource loss as a determinant of poverty, measuring how the loss of access to resources "affect the well being of the poor". While recognizing the complexity of poverty-environment dynamics, the World Bank study examines only "how resource loss can act as a determinant of poverty". In this perspective, the proposed indicators monitor how issues of deforestation, water scarcity, overfishing, and land degradation affect the well-being of the poor.

In addition, World Bank also describes some criteria of the good indicators including measurable, sensitive to change, valid, transparent and cost effective. However, the World Bank's indicator system is rather complicate to be applied by planners.

2.2. The WWF's study

The WWF's study in 2004, "Developing and applying poverty environment indicators" [7], further contributes to the development of generic poverty-environment indicators. The starting point of WWF's study is the identification of the following priority areas to be covered by the P-E indicators:

Firstly, the status indicators provide a quantitative snapshot of the status of critical issues in the poverty-environment nexus. They tell what is happening on the ground at the local level where the users of resources interact with the diverse natural resources. Basically, they includes:

- + The status of key environment and natural resource and their degradation;
- + The environment and natural resource status (forest cover, water quantity and quality, fishery, sanitation);
- + The rate of resource degradation (soil degradation).
- + Access to resource per capital availability of resource;
- + Level of vulnerability to and impact of natural disasters and declining environmental quality (drought, respiratory diseases).

Secondly, the enabling indicators are those which reflect the social response to environmental problems, to condition of poverty and to poverty environmental dynamic. The indicators of enabling conditions can be grouped into three basic categories: institutional arrangements, economic policies, and ecological management capacity.

- + Institution arrangement (legal framework support environment and poor, institutional reform, participatory process);
- + Economic policy and incentive (property right, budget allocation for P-E);
- + Ecological management capacity (monitoring capacity, EIA, SEA, EA).

Thirdly, the social capital indicators are qualitative ones which reflect the capacity of local populations to influence on basis decisions and institutional arrangement that shape their livelihood and resource use.

The indicator system of WWF is useful for the regions with large areas of natural preservations, such as forest covers, national parks, natural protections like Yunnan Province

of China. In these regions, the ecological benefits are considered in balance with the socio-economic ones. This can be well understood because WWF is the Wild World Fund organization. Sustainable development planning is likely looking for a more simple tool and balance of the three components of social - economical - ecological benefits.

During recent years, many methods have been approved to speculate the poverty and environment separately. UNDP has created HPI, CPM to measure the general poverty on difference levels. The UNDP poverty indice have been adapted worldwide to measure the proverty on natinal level for years. Many indicators or set of indicators have also been highlighted elsewhere to environmental purpose. However, the combination of poverty and environment is still lacking.

2.3. The ADB's study

Fortunately, during the 2008 year, ADB [1] has elucidated clearly what is the environmental poverty (EP). ADB shows that there are 6 EP sectors, and that EP must bears geographical aspects, ADB call the poverty in the areas where the primary cause is the tangible surroundings environmental poverty and the poor who live in those areas the environmental poor.

3. The environmental poverty

3.1. The categories of the environmental poverty from ADB's point of view

The concept of poverty of ADB, 2008 [1]

The poverty can be spoken of in broader and narrower ways.

- A narrower conception of poverty, one is the deprivation of the material components of well-being (or wealth), such as food, clothes, shelter, and health (or access to medical care).

The possession of these goods is sometimes called a welfare.

- A broader conception is possible because the humanwell-being involves more than material things. The freedom from poverty may also require such things as freedom, citizenship, good character, friends, obedient children, faithful spouse, liberal education, and a purpose in life. The narrower conception is contained within the broader conception, as welfare is contained in well-being. Although the ADB's commitment to poverty reduction is not necessarily limited to the narrower conception of poverty, it can limit to the less controversial and more easily quantified deprivations of poor people. So the poverty acording to ADB means a material poverty, and an inability to acquire the material things necessary to live well.

Environmental poverty in Asia and the Pacific

Poverty in Asia and the Pacific is increasingly concentrated in the places with harsh living conditions, including marginal land, depleted resources, pollution, congestion, and proneness to natural and human-generated disasters. The ADB's report is about those poor people whose poverty is primarily caused by such environments. They are not all the poor, but they constitute a major segment and one whose importance will increase with time. Although it can be included nature in the notion of the environment, it can be also included human artifacts. So, the ADB's notion of environment is that of the tangible surroundings that affect a person's well-being. The environment consists of public goods and public evils and, therefore, need for public actions to make changes in the shared space of the poor. Private actions, such as building nicer dwellings, are not sufficient when the area is congested or its air is polluted. ADB calls the poverty in the areas where the primary cause is the tangible surroundings environmental poverty and the poor who live in those areas the environmental poor [1, 2].

Environmental poverty sectors

Because the poverty is a part of a complex system and has a number of dimensions, it is difficult to distinguish the environmental causes of poverty from the non-environmental ones. Although the environment can have any degree of influence in a person's poverty, in quantifying, it should try to separate those people for whom it is the primary factor from the rest. As the former, it can count all those poor people who live in places where the environment is the main factor in the poverty of their area generally. The latter are those poor people who do not live in such marginal areas. ADB assumes that in certain rural locations, the primary reason for an inability to escape poverty has to do with the natural environment. For example, assessments of the poor living in dryland areas may conclude that the main reasons for their persistent poverty are marginal land and a lack of access to water. This does not mean unawareness that the poverty has multiple causes, often including political and institutional. But the natural resource endowment may keep the people poor even when the institutions and policies are favorable to the poor. Because of this, it can engage in some simplifying when calculating the number of environmentally poor people.

To discuss better synergies between the poverty and environmental linkages, the Poverty Reduction Unit and the Environment and Social Safeguard Division in the Regional and Sustainable Development Department of ADB in 2008 year prepared a study on the "environments of poverty" seen from the (poor) people's perspective [1]. The book reviews the latest consensus on poverty-environment connections and summarizes emerging problems in the environments of the poor in Asia and the Pacific. Through initiating a discussion about the environmental poverty, the study adds a new dimension to the international debate and practice by emphasizing the needs for poverty reduction in a geographical context,

rather than in an eco-system context alone. The environmental poverty perspective divides the poor according to the environmental conditions that affect their well-being (it is called hereafter sectors of environmental poverty)

1. *The dry-land poor* are those living on arid and desert land areas;

2. *The flood-affected wetland poor* are those in wetland areas who are frequently affected by flooding;

3. *The upland poor* are those living in upland or mountainous areas that are remote;

4. *The coastal poor* are those living adjacent to coasts and dependent upon coastal and/or marine resources;

5. *The slum poor* are those living in substandard settlements with high exposure to urban pollutants.

6. *Many of the disaster poor*, i.e. poor people affected by natural disasters are incorporated in the above mentioned categories.

The ideas on environmental poverty is comprehensive and noteworthy works of ADB. However, ADB has not yet created suitable indice for the issues.

3.2. General Principles of Environmental Poverty Indicators

The UNDP-UNEP paper [5] compares indicators to be like flags, used to simplify, measure and communicate information, and to rally support for action. An indicator is nothing mysterious; it is simply a way of measuring and making understandable something that is considered important. Being able to appreciate the work on Poverty and Environmental indicators that international agencies or academics do, and to use them is indeed valuable. But it is not the same thing as being able to build indicators (individually or collectively) perfectly suited to the context. It is for this reason that this part addresses some foundational and practical issues in elaborating and using indicators.

Criteria for Choosing Indicators

UNDP-UNEP [5] confirms that it is possible to choose which (and how many) indicators to select according to a list of “desirable properties”, based on what indicators should be:

1. *Measurable*: the indicators should be expressible in numbers or labels in units, assigning categories to empirical counterparts. If this basic condition is not fulfilled, it is not even worth trying to formulate an indicator.

2. *Reliable*: the indicators should be stable and consistent. They should not change every time that a repeat measurement is carried out. In other words, indicators should give at least approximate answers every time, so when they are used, the information provided is trusted. Thus, when the presence of *E.coli*/100 ml is used to assess the quality of the water and the likelihood of diarrhoea, the answer it provides should not change (randomly or not) every time that the test is run on the same sample;

3. *Valid or relevant*: the indicators should provide measures that reflect the concept or purpose that it is intended to be reflected. This criterion refers to the extent of matching between the situation an indicator intends to reflect and an operational definition of that indicator. For instance, we should not use a measure of safe water to assess the prevalence of respiratory infections. For that, the measures of ventilation in cooking area and the use of traditional fuels are more valid or relevant;

4. *Policy-relevant*: the indicators can be used to expose problems and are useful for policy-formulation and decision-making, allowing agents to make informed decisions, what facilitates the implementation of policy-goals. For instance, indicators on percentage of the population residing in disaster prone areas are relevant for government planning and housing policies. Similarly, indicators of deaths by water-borne diseases are useful in planning water and sanitation policies;

5. *User-friendly*: the indicators should not be obscure. They should be easy to understand and to communicate. Usually, indicators about chemical components found in the air or in the water are difficult to understand. Whereas much of people are known about the impact of carbon dioxide on the climate change, not much are said about the effect of PM_{10} on the human health;

6. *Sensitive to changes*: the indicators should respond to changes in circumstances, so that they are useful to detect changes. Poverty line measures, based on headcounts, are insensitive to changes below the poverty line. Since the headcount index only counts the number of people below a certain poverty line, the poor can become even poorer and the indicator does not change;

7. *Analytically sound*: the indicators must be clearly elaborated and structured along logical principles, collected by using standard and accepted technical methods. Lack of safe water, for instance, is measured according to the criteria put forward by the World Health Organisation, that takes into account the water quality, quantity and frequency in consumption, providing a logical framework for using the safe water as an indicator;

8. *Comparable*: the indicators should facilitate the assessment between different circumstances and time-scales. One indicator that has, on the onehand, a very specific meaning and, on the other, a low applicability. Comparability can, however, be achieved at different levels. For instance, one can have a general comparable category as “drinking water” that could be operationalized using different particular indicators, such as percentage of population with safe water, or percentage of incidence of diarrhoea, or under-five mortality rates. The important thing is to ensure that the comparability is achieved at some level;

9. *Cost-effective*: the indicators should be measured in an affordable way according to the perceived value of the information produced;

10. *Context-dependent*: the indicators should be valid to the reality in which they are supposed to be applied. Often this involves a geographic limitation of the scope of the indicator. For instance, Target 9 of MDG 7, the general indicator of "proportion of land area covered by forests" can become context-dependent targets according to different percentage of forest cover that one wishes to keep (e.g. 60% for Cambodia, 9% for Bhutan), or can even be translated into afforestation rates (35% for Romania); often this involves a geographic limitation of the scope of the indicator. The indicators about erosion and hunger convey a very simple message when jointly articulated: agricultural systems need to be improved to prevent under-nutrition and its manifestations.

The above-said indicator criteria can be overall accepted to PEP aims. However, for the national and provincial levels, it is noteworthy to add two more criteria:

11. *The number of indicators should be limited*, for example, HDI consists of 3 indicators only. A set of a lot indicators makes the planners to land on an embarrassing situation and need more time and money to find out the data.

12. *The calculation methods must be simple*, the more simple, the more convenient to integrate in plans, HDI is an excellent example for this issue.

The human poverty index (HPI) of UNDP and method of its calculation

The HPI created by UNDP in 1995 varies from 1.0 (totally poor) to 0.0 (no poor). It is based on five criteria in the following equation:

$$HPI = \left(\left[I_1^3 + I_2^3 + I_3^3 \right] / 3 \right)^{1/3}$$

$$I_3 = \frac{1}{3} (I_{31} + I_{32} + I_{33})$$

in which: I_1 - the rate of untimely deaths (deaths under 40 years old) / total deaths / year, source of data: DOH (Department of Health);

I_2 - the rate of literate adults (≥ 15 years old) / year, source of data: DOET (Department of Education and Training);

I_{31} - the rate of population who are unable to access to safe water / year, source of data: DARD (Department of Agriculture and Rural Development);

I_{32} - the rate of population who are not offered medical care (in Vietnamese context, who have not medical insurance card) / year, source of data: DOH;

I_{33} - the rate of children (≤ 5 years old) malnourished / the same age group of children / year, source of data: DOH.

To calculate value of I_i , it should be used an interrelate equation as follows:

$$I_{it} = \frac{V_o - V_t}{V_o - V_p}$$

in which I_{it} is the sectoral indicator number i in the year t ; V_o is the value of the indicator i in the beginning (starting) year of the plan, selecting from the poorest target community (maximum value); V_t is the value of the indicator i in the year t ; V_p is the prospective value of the indicator i of the last year of the plan (minimum value).

The UNDP's HPI is an indicator of poverty in general, but not environment-related poverty as above-mentioned by ADB and later by UNDP-UNEP. However, the worldwide utility and high qualification of HPI strongly show its ability of application in PE purpose.

4. The environmental poor livelihood indicator EPLIi

Environmental poor livelihood indicator EPLIi is essential to determine among the poor who are really the environmental poor. Because not all the poor who are living in the poverty environmental sectors are the real environmental poor. In each of 6 environmental poverty sectors one can select a number of poor communes based on national poor standard (income/capita) - these communes are the poors in general; for

such poor communes, select the most characteristic *environment-based livelihood*. The community which yields more than 50% of annual income from that environmental livelihood is the

environmental poor one. EPLI_i is calculated in Table 1. The HPI_i should be calculated from these environmental poors. See the attached here-under flowchart.

Table 1. PELI_i in the 6 environmental sectors

i	Environmental poverty sectors	EPLI _i	Note /source of data
1	The dry-land poor	Ratio of the poor households lacking water for cultivation for more than 1 crop/year/total of the poor households	In average, there are two crops per year in dryland / DARD
2	The flood-affected wetland poor	Ratio of the poor households with the annual income from paddy farming is counted for more than 50% of total of households income/year/total of the poor households	DARD
3	The upland poor	Ratio of the poor households with the annual income from slash and burn farming is counted for more than 50% of total of households income/year/total of the poor households	DARD
4	The coastal poor	Ratio of the poor households with the annual income from nearshore marine product catching is counted for more than 50% of total of households income/year/total of the poor households	Nearshore fishery is in shallow water within 5 km apart from shore line according to ADB/DARD
5	The slum poor	Ratio of the slum poors without permanent jobs / total of the slum poor labor force	DOLISA
6	Many of the disaster poor	Ratio of the poor households which losed welfare of more than 20 %/5 year /total of the poor households by natural hazards (calculation for the period of 5 years before, up to the beginning year of planning) ⁽¹⁾	DARD

5. Environmental poverty index - EPI

EPI is a complex index synthetized from UNDP's HPI counted for the environmental poor in the six environmental poverty sectors of ADB as showed in Table 2 hereunder.

Table 2. Environmental poverty index EPI

Index (of national or provincial level)	Sector 1: the slum poverty	Sector 2: the flood-affected wetland poverty	Sector 3: the upland poverty	Sector 4: the coastal poverty	Sector 5: the dry-land poverty	Sector 6: many of the disaster poverty
EPI	HPI ₁	HPI ₂	HPI ₃	HPI ₄	HPI ₅	HPI ₆

Note: - (I₁) calculation for cities of ≥ 100.000 inhabitants only;

- (I₂, I₃, I₄, I₅, I₆) - Sectoral poverty - calculation for countrysides.

⁽¹⁾ Because the natural hazards may not happen every year, so that the PELI₆ should be calculated for the tenure of five years (five years equal to tenure of a national or provincial plan).

The calculation of EPI is carried out on the communal level by five steps:

1. Select six typical (the poorest) environmental poverty sectors all over the country or target province;

2. In each of these sectors select a number of poor communes based on the national poor standard (income/capita and infrastructure). These communes are *poor in general*;

3. For such general poor, select the most characteristic environment-based livelihood as be showed in Table 1; calculate PELI_i; the poor communes which yield more than 50% of annual income from that livelihood are *the environmental poor*;

4. The HPI_i is calculated for these environmental poor communes. This is the environmental poverty level of each environmental poverty sector;

5. The EPI is calculated from the HPI_i, this is the environmental poverty level of the whole country or province.

To calculate EPI one can use:

$$\text{Unweight method: } EPI = \frac{1}{n} \sum_{i=1}^n HPI_i;$$

$$\text{Weight method: } EPI = \frac{\sum_{i=1}^n HPI_i \times C_i}{\sum_{i=1}^n C_i};$$

in which: i is the environmental poverty sector number i ; n is the total number of poverty sectors ($n_{max}=6$); HPI_i is the human poverty index of the environmental poverty sector i ; C_i is the weight of HPI_i and can be calculated as:

$C_i = \frac{N_i}{N_o}$, where N_o is the least number of the environmental poor households of one among the six environmental poverty sectors; N_i is the number of environmental poor households of the sector i ($N_i > N_o$). N_o and N_i can be calculated in some test communes if required (depends on the shortage of time and budget of planning and survey).

The value of EPI varies from 0.0 (no environmental poor) to 1.0 (totally environmental poor).

6. Conclusions

The EPI - an index, not indicators - is leveling the environmental poverty of a whole country or a whole target province. EPI is a complex index synthesized from the UNDP's HPI counted for the environmental poor living in the six environmental poverty sectors as the ADB has pointed out.

1. The EPLI is an indicator, showing the environmental poverty in each environmental poverty livelihood group.

2. The EPI is simple enough to recognize and categorize PE in the national or provincial levels of planning. It requires a little of time and finance, but is qualified enough to present the PE system in the plans and strategies assessed, so that it fits well the requirement to monitor the system of SEA.

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