Environmental Performance Evaluation of Human Development Reports of UN

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1. Environmental management - Evaluation

Environmental Performance Evaluation of Human Development Reports of UN

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DECLARATION

I Mr/Mis Ayesha Sattar S/D/O Abdul Sattar Reg.No. 56/FBAS/MSES/F08, a student of MS Environmental Sciences at the Department of Environmental Sciences, International Islamic University (IIUI), do hereby solemnly declare that the thesis entitled "Environmental Performance Evaluation of Human Development Reports of UN" submitted by me in partial fulfillment of the requirement for the degree of MS, is my original work, and has not been submitted or published earlier and shall not, in future, be submitted by me for obtaining any degree from this or other university or institute.

Name: Ayesha Sattar

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Date: 20-12-2010

IN THE NAME OF ALLAH, THE MOST MERCIFUL AND BENEFICIENT

Dedicated to My Loving Parents

&

Sweet Younger Sisters

I'm nothing without all of them

Title of Thesis: **<u>Environmental Performance Evaluation of Human Development Reports of UN.</u>**

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Abstract

Sustainable Development and its measurement is need of today's world and a challenge particularly for the developing nations. Among the sustainability indices devised so far, six indices were chosen for present study namely; 'Human Development Index (HDI)', Ecological Foot Print(EF)', 'Environmental Sustainability Index(ESI)', 'Environmental Performance Index(EPI)', 'Genuine Saving(GS)', 'Well Being Index(WBI)'. On the basis of SWOT analysis, a scoring system was devised for each index, 'HDI' and 'EF' scored highest (four out of nine for each index).

Pakistan was taken as a case study. Population, Poverty and Political Instability were found to be the major drivers for environmental, social and economic instability in Pakistan. Pearson's correlation was calculated to establish relationship between population, poverty, HDI, EF, Biocapacity and ecological deficit/reserve. A direct and non significant correlation was found between poverty, HDI (0.222) and poverty, population (0.035). Correlations among Poverty and biocapacity (-0.286), poverty and EF(-0.036), poverty and ecological reserve (-0.359) were found to be indirect and non significant. Population growth was found correlated directly and moderately-significant to EF (0.519) and ecological deficit (0.596). An indirect and moderately significant correlation (-0.765) was found between population growth and HDI. Based on this study, it is concluded that there is a need to revise definition of sustainability in order to incorporate the elements of justice and equity in a new index borrowing dimensions from existing Economic, Social and Environmental indices.

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All praises and thanks from deepest core of my heart to the glory of ***ALMIGHTY ALLAH***. The beneficent and the merciful, whose blessing enables me to complete this study. I am all the tribute to ***HOLY PROPHET MUHAMMAD (P.B.U.H.).*** The city of knowledge, torch of guidance who has guided his Ummah to the knowledge from cradle to grave.

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May ***ALLAH*** give them His blessing along happy life.

(Ayesha Sattar)

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FORWARDING SHEET

This thesis entitled, "Environmental Performance Evaluation of Human Development Reports of UN" submitted by Miss. Ayesha Sattar, Registration No. 56/FBAS/MSES/F08 in partial fulfillment of Master of Studies in Environmental Sciences has been completed under my guidance and supervision. I am satisfied with the quality of student's research work and allow him to submit this thesis for further process as per IIU rules and regulations.

Date: ____________

Signature: ____________ 20/12/2010

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Chapter 1

Introduction

1.1 What is Human Development?

Human development concept was proposed as an alternative to the conception of development that focused on economic growth- with or with out equity basis. Concept of human development is based upon three pillars i-e. development concept; development theory and development strategy. Development concept contains the answer to the question what the development is? Development theory seeks to the answer of questions like, what are the possible obstructs and delays, causal relationships and laws that a society can apply to the possible change, actors playing dominant role and their interest and the degree of effectiveness on various social groups of society and geographical regions? Development strategy is an abstract notion, refers essentially to the most effective and least costly ways and means to achieve the established objectives. Many authors have provided the definitions of human development but the most famous among them is "human development as an enlargement of all human choices whether social, cultural or political whereas the development focuses only on expansion of income" as described by Meboob ul Haq (Haq., 1995).

1.2 History

The concept of human development or human well being has its roots in the neo classical economics where individual's satisfaction level is described by the term 'utility' that is a very limited term in the sense that individual's satisfaction level can not be considered as social welfare indicator (Staton., 2007). Modern theory of well-being economics was conceptualized by Aristotle (350 B.C.E.). Who stated that well being is granted by our actions not by our belongings. Later on, different revolutions of economic well being got importance in different parts of history. Most important of them are "The Marginalist Theory (1984)," "The Ordinalist Revolution (1932)," and "The Human Revolution (1971)". While the principal architects of income counting was Nobel Laureate Simon Kuznets who worked on United State's income accounting in 1932. In 1966, United Nations Research Institute for social development (UNRISD) launched a study entitled "level of living index" in which human well being was calculated based upon the physical needs, cultural and higher needs, for 20 countries (OECD/DAC 1973; UN-ECOSOC 1975; Hicks and Sreeten 1979). In 1979, M.D. Morris of overseas Development Council released the Physical Quantity of Life Index (PQLI) with the objective of measuring whether a minimum set of human needs was being met by world's poorest people (Morris., 1979).

1.3 Sustainable Human Development and Indicators of Sustainability

All the natural things on the earth are referred as the "Natural Resources". Specifically, it excludes the things created by the human efforts. Indicated by the anthropological human history, it is evident that the human resources have been heart of human existence and core of human activities. Based upon the availability and abundance of the natural resources they are divided into two categories. Inexhaustible (not likely to be exhausted by human race e.g air, clay, sand, tidal energy and precipitation) and exhaustible that is further categorized in renewable (can maintain themselves or can be replaced if managed wisely) and non-renewable (once used are lost forever, as they are not restored). There are two types of wealth or capital. 'Capital wealth' includes all stocks of man-made things, while 'natural wealth' or 'natural capital' includes stocks of natural or environmentally given assets. But economy is not separate from the environment. For economic growth, services are provided by the environment and we are putting extra burden and degradating the environment provided that man made capital wealth is substituted for it (Pearce *et al.,* 2006). Perspective and horizon of the environmental movements was entirely changed by the book entitled "Silent Spring" by Carson (1962) and "The Limit to the Growth" by the group of the researchers of the Massachusetts Institute of Technology. Among the critical problems they cited were: the intensive use of fossil energy with the consequent end of reserves; reduction of supply of natural resources;

Increment of the industrial activity and pollution; increase and collapse of population; and, the limitation of the capacity of food production (Meadows., 1992; Siche *et al.,* 2007). In 1980, the term "sustainability" was introduced in the book "The World

Conservation Strategy" to point out the serious problems the humanity should solve probably through a new development model to overcome ecological, social, and economic disasters as the economics and environment interact in a reversible manner (Siche, et al., 2008). Brundtland Report defined that development is sustainable (Environmental and economic) when it "meets the needs of the present without compromising the ability of future generations to meet their own need" (Rennings and Wiggerings., 1997; WECD., 1987). Since Earth Summit at Rio in 1992, sustainable environmental development has become the h eart of the international environmental policies.

To make sustainability a reality, we must measure where we are now and how much further we can go. So far, a variety of models, methods and indicators have been put forward to evaluate sustainable development (Jia et.al., 2009). Often, observed data for one character or state of system is expressed as indicator. Some indicators may give information about the status of the system relative to particular sustainability boundaries or goals. These indicators are collectively presented as either in a framework of categories or into an index (Mayer., 2008). Sustainability indicators were introduced in World Conference on Environment- Rio 92 and Agenda 21, and a large number of indicators have been introduced by the researchers so far (Moffat., 1996; Hanely., 1998). Among these indicators, Human Development Index (HDI), ecological Footprint (EF), Environmental Sustainability Index (ESI), Environmental Performance Index (EPI), Human Wellbeing Index (HWI) and Genuine Saving (GS) have gained particular importance in the debate on sustainable development (Brown and Ulgiati., 1997; Odum., 1997; Jha and Bhanu-Murthy., 2003; Sutton and Costanza 2002; Morse., 2003).

1.3.1 Human Development Index

Human Development Index (HDI) is being published in the Human Development Reports by the United Nations Development Program since 1990. It was devised by Pakistani economist Mahbub ul Haq along with the well known group of economists Paul Streeten, Frances Stewart, Gustav Ranis, Keith Griffin, Sudhir Anand, and Meghnad Desai. It aimed to shift the focus of development economics from national income accounting to the people centered policies.

HDI has three basic dimensions:

- Life expectancy
- Knowledge and Education
- Standard of living

1.3.2 Ecological Footprint

Ecological Footprint measures the human demand on earth's natural resources. Its calculation methodology and concept was introduced in the PhD dissertation of the Mathis Wackernagel under Rees supervision at the University of British Columbia in Vancouver, Canada, from 1990–1994. Ecological Footprint measurements employ global hectares as measurement units, which depict world's overall productivity (Walsh *et al.,* 2006; Monfreda *et al.,* 2004).

1.3.3 Environmental Performance Index (EPI) and Environmental Sustainability Index

EPI and ESI were developed and introduced by the Yale University (Yale Center for Environmental Law and Policy) and Columbia University (Center for International Earth Science Information Network) with the help of World Economic Forum and Joint

Research Center of European Commission. ESI was published between 1999-2005 which was later on modified to the EPI. Both ESI and EPI aimed to track the environmental sustainability of the nations and provide a guideline for sustainable environmental policies. ESI consists of 76 indicators belonging to 5 different categories, calculated using different aggregation methods. (Jesinghaus, 2000; Esty et al., 2005; Clarke and Islam, 2006). EPI(2010) ranked 163 countries based upon 25 indicators linked to environmental public health and ecosystem vitality.

1.3.4 Well Being Index

Well Being Index was sponsored by the International Development Research Center (IDRC) and World Conservation Union (IUCN) and was devised in year 2000. It consists of 36 socioeconomic and 54 environmental indicators. Calculation method based on the averaging that makes it difficult to use for policy tracking purposes. That is why it was neither calculated again nor used by the researchers. But it may be very helpful in sustainability discussion and to develop a comprehensive index for sustainability (Parris and Kates, 2003).

1.3.5 Genuine Saving

The idea of Genuine Saving was put forward by the researchers of the World Bank. It took its conceptual framework from Hicksian income concept while calculation methodology has its roots in Hartwick rule.

1.4 Sustainable Development and Status of Pakistan:

Pakistan having one of the oldest civilizations of the world is located in the South Asia. It has a total area of 796,095 sq Km, of which 24.44% comprises of arable land and has a total population of 166,111,487 in 2008. Major natural resources consist of land, extensive natural gas resources, limited petroleum, poor quality coal, iron ore, copper salt, lime stone etc. Pakistan has to face severe water pollution deforestation, soil erosion, desertification etc. Pakistan has improvised and underdeveloped economy with a 2.7 % of real growth rate of GDP. A main source of livelihood is agriculture while 24% of its population is living below poverty line (CIA Fact Sheet., 2010).

1.4.1 Sustainability Efforts in Environmental Space

The Constitution of Pakistan has provisions for environmental protection and resource conservation. The Constitution mentions "Environmental Pollution and Ecology" as a subject in the Concurrent Legislative List, meaning that both the Federal and Provincial Governments may initiate and make legislation for the purpose. Several laws exist for the protection of the environment. Some of these laws are Federal and the rest Provincial in character. The important laws on the subject are the Canal and Drainage Act 1873; The Explosives Act 1884; The Ports Act 1908; The Forest Act 1927; The Fisheries Ordinance 1961; The Punjab Wildlife (Protection, Conservation and Management) Act 1964; The Fire Wood and Charcoal (Restriction) Act 1964; Motor Vehicles Ordinance 1965; The W. P. Regulation and Control of Loudspeaker and Sound Amplifier Ordinance 1965; The Agricultural Pesticide Ordinance 1971; The Antiquities Act 1975; etc. Besides, the Pakistan Penal Code 1861, which is a general criminal law, and applies all over the country, contains specific provisions on the subject. Thus, it prohibits mischief by killing or maiming animals, or damaging works of irrigation or a river or a road or a bridge or drainage or firing explosive substances with intent to cause damage. The Code also prohibits public nuisance by acting negligently to spread the infection of diseases or disobeying quarantine rule or causing adulteration of food or drink or drug, or fouling water or making the atmosphere noxious to health, etc. The promulgation of the Environmental Protection Ordinance 1983 was the first codifying legislation on the issue of environmental protection. This was indeed a consolidated enactment to plug the gaps and remove defects/deficiencies in the legislation. Later, the Government passed and promulgated the Pakistan Environmental Protection Act of 1997. The Act is fairly comprehensive, providing for the protection, conservation, rehabilitation and improvement of the environment. It contains concrete action plans and programmes for the prevention of pollution and preservation of clean and healthy environment.

1.4.2 Environmental Institutional Framework:

The Ministry of Environment is responsible for all environmental issues. A Federal Minister heads the Ministry while a federal secretary holds the administrative charge. An Additional Secretary is responsible for different sections dealing with environment, forestry, local government and urban affairs. The Pakistan Environmental Protection Council (PEPC) was first constituted in 1984 under section 3 of the Pakistan Environmental Protection Ordinance of 1983, with President of Pakistan as its Chairman. In 1994, an amendment was made in the Ordinance to provide for the Prime Minister or his nominee to be the head of the Council. The Council was reconstituted after enactment of the new law i.e. Pakistan Environmental Protection Act of 1997. Pakistan Environmental Protection Council is an apex statutory body. The Chief Executive is the

Chairperson of the Council and the Federal Minister for Environment, Local Government and Rural Development as its Vice Chairperson and Governors of all provinces are its members besides others. The Council is represented by trade and industry, leading NGOs, educational intuitions, experts, journalists and concerned ministries. Pakistan Environmental Protection Agency was created with thin staff and meager resources under 1983 Ordinance. In the beginning, agency was responsible for pollution control, however, after enactment of 1997 Act, the functions and responsibilities of the agency were enhanced and this department was strengthened technically and logistically to face the environmental challenges. Pak-EPA also provides technical support to the Ministry of Environment. Federal EPA is responsible for all projects in federal territory while provincial EPA's take care of provincial projects under the direct authority of EPA. Other related departments are:

- Environmental Tribunals (in Punjab and NWFP)
- Pakistan Forest Institute
- National Council for Conservation of Wildlife
- Zoological Survey Department
- National Center for Rural Development and Municipal Administration
- Planning and Development Departments (P&D)

The superior judiciary and in particular, the Supreme Court of Pakistan, has played a positive and constructive role in preventing the degradation of environment and preserving ecological balance of nature. The Supreme Court of Pakistan also resorted to the exercise of extraordinary jurisdiction under Article 184(3) of the Constitution by entertaining petitions pertaining to maintaining clean environment.

1.5 Objectives of the Study

The 1992 Rio Earth Summit proposed "a program to develop national systems of integrated environmental and economic accounting in all countries" (United Nations, 1994, para. 8.41). Earth summit resulted in Agenda 21 in which different concepts, theories and strategies were put forward to measure the sustainable development by different organizations, institutions, NGO's and governments. Since "Earth Summit" measuring the sustainability in every aspect (social, economic and environmental) and to devise the polices and framework for sustainable development has become highly desirable and center of sustainability efforts. Since 1992, a large number of the sustainability frameworks and indices have been put forward by different institutions and organizations. Each of them has its own definition, concept and method of calculation to measure the sustainability as there is no consensus yet over the comprehensive definition of sustainability.

The present study is divided clearly into two sections;

a) In International Perspective:

To scrutinize the most accepted and widely used sustainability framework and indices in order to:

- Analyze the conceptual framework of the sustainability indices with main emphasis on "Human Development Index" and "Ecological Foot Print"
- Evaluate whether they fulfill the requirement of sustainability (in three dimensions: Social, environmental and economical) or not.
- Analyze the data reliability, consistency, and meaningfulness and aggregation methodology for these indices.

- Analyze the linkages of these sustainability indices to policy tracking.

b) In Domestic Perspective

- To have an overview of sustainability efforts and sustainability measurements in Pakistan.
- To analyze the only regional human development report for Pakistan for its environmental performance.
- To correlate some social dimensions of Pakistani society with the sustainability dimensions for sustainability.

1.5 The Scope of the Study:

The current work is an effort to contribute to the sustainability measurement efforts of the world. As rapid industrialization, climate change, natural resource degradation and population boom have not only caused a severe threat to the world's environment but also to social norms of every country and economic growth making our planet highly unsustainable and an ugly place to live in.

In Pakistan, sustainable development is always being a second priority although we are party to almost all multilateral environmental agreements. But being a nation we are still unable to fulfill the basic requirements of our people, sustainable development is still a dream. It was an effort to provide a glimpse of the status of the human development and natural resources of Pakistan, as its economy is dependent upon natural resources and to point out some social dimensions that are affecting natural resource sustainability in general and human development in particular.

1.6 Current Status of Pakistan According to Selected Sustainability Indices

1.6.1 Human Development Index and Sub Indices (Ranking and Indicator Values)

Table 1.1

HDI value	Life expectancy at birth (years)	Adult literacy rate (% ages 15 and above)	Combined gross enrolment ratio (%)	GDP per capita (PPP US$)
141. Pakistan (0.572)	117. Pakistan (66.2)	134. Pakistan (54.2)	169. Pakistan (39.3)	132. Pakistan (2,496)

Table 1.2 Selected indicators of human poverty for Pakistan

Human Poverty Index (HPI-1)	Probability of not surviving to age 40 (%)	Adult illiteracy rate (%ages 15 and above)	People not using an improved water source (%)	Children underweight for age (% aged under 5)
101. Pakistan (33.4)	97. Pakistan (12.6)	134. Pakistan (45.8)	70. Pakistan (10)	125. Pakistan (38)

(Source: HDR 2007/08)

1.6.2 Ecological Footprint 2005 (global hectares per person)(Table 1.3)

Population (Millions)	157.9
Total Ecological Foot Print	0.8
Carbon Foot Print	0.3
Crop Land Foot Print	0.39
Grazing Land Foot Print	0.01
Forest Foot Print	0.07
Fishing Ground Foot Print	0.02
Build up land Foot Print	0.05
Total Foot Print m3/person/yr	1,218
External Foot Print m3/person/yr	1,000

(Source: LP Report, 2005)

1.6.3 Genuine Saving for Pakistan(Table 1.4)

Gross national Saving	19.9
Consumption of fixed capital	7.8
Net national Saving	12.1
Education Expenditure	2.3
Energy depletion	3.1
Mineral depletion	0
Net forest depletion.	0.8
PM10 damage	1
CO2 damage	0.9
Genuine saving	8.6

(Source: World Bank 2005)

1.6.4 Environmental Performance Index (2010)(Table 1.5)

Rank	125
Score	48.0
Income Group Average	48.7
Geographic Group Average	58.0
GDP/capita 2007 est. (PPP)	$2,357
Income Decile	8 (1=high, 10=low

Environmental objectives:

(Source: EPI Report,2010)

1.6.5 Environmental Sustainability Index (2005)

2005 ESI Ranking and Optimal Rank for Pakistan(Table 1.6)

2005 ESI Ranking	Best Ranking
131	110

According to the cluster analysis, Pakistan falls in group 7 with low system score, moderate stresses, vulnerability, capacity and stewardship.

ESI Ranking of Pakistan (Table 1.7)

No of group	7
Average ESI Score	46.2
Environmental Systems	37.4
Reducing Environmental Stresses	50.9
Reducing Human Vulnerability	49.4
Social and Institutional Capacity	44.4
Global Stewardship	52.2
GDP/ Capita	$1,730
Population (millions)	149
Area (thousand square kilometers)	1010
Population density (per square kilometer)	147
Environmental Governance Indicator (z-score)	-0.2

(Source: ESI Report., 2005)

Chapter 2

Literature Review

2.1 Sustainability, Sustainable Human Development and Sustainability Indices.

Bohringer and Jochem (2007) analyzed the different sustainability indices and showed that these indices failed to fulfill the fundamental scientific requirements in their construction and are misleading with respect to the policy advice. They discussed the sustainability in three dimensions; economy, environment and social conditions rather than one dimension metric to evaluate the sustainability.

Mayer (2007) defined sustainability in reference to the resilience, desirability and scales. He also mentioned the need of sustainability and what the sustainability frameworks are. He gave a remarkable difference between sustainability frameworks, index and indicators. Sustainability indices were categorized according to the 'Bottom Up' and 'Top Down' approaches. Factors influencing the sustainability indicators were discussed while problems across the sustainability indices like system boundaries, data inclusion, standardization & weighting methods and aggregations methods also remained point of concern.

Hazri and Dovers (2006) addressed the role of sustainability indicators as an evaluating method of sustainability within the emerging context of governance. Their work focused upon two questions; what is potential utility of indicators for policy? And in what way indicators can influence the governance. Merits and demerits of the sustainability indicator inclusion into governance were discussed in detail.

Udo and Jasson (2009) pointed out that the global human progress occurs in a complex web interaction between society, technology and the environment as driven by the governance and infrastructure management between the nations. Sustainable development was discussed in a quantitative way keeping in view the technological dimension of the sustainability. 132 nations were ranked and analyzed similar to the Maslow's hierarchy of need. And it was suggested that the global public policies are required to develop in order to bridge the gaps of sustainability.

Wilson *et al.*, (2007) emphasized upon the need of defining effectiveness of the sustainable development index (SDI) matrices as there is no consensus upon the design and use of SDI models. Six global SDI matrices were analyzed and correlated. The variability in the findings draws attention to the lack of clear direction at the global level in how best to approach sustainable development. Canada was discussed as case study to explain discrepancies between SDI measurements.

Cochrane's (2006) work explored the concept of cultural capital and suggests a framework for assessing its influence of natural capital and sustainable development. Cultural capital has its influence in three ways, i-e. management objective, efficiency of process and demand. All these three areas affect the natural capital in provision of raw material, sinks, environmental services and amenity services.

Siche *et al.,* (2008) compared the two most widely used environmental sustainability indices i.e. Environmental Sustainability Index and the Ecological Footprint with two emergy ratio. It was reported that despite the efforts of obtaining an index that comprehensively defines sustainability. All of them are required to be improved. The junction of ecological footprint with renewability emergy index may prove to be a milestone in this regard.

Jasson (2003) stated that the sustainable development is recognized world wide. Three dimensions are relevant: the interaction between culture, structure and technology. The approaches optimization-improvement-renewal and the parties are involved. This implies a strategic approach to innovation and breakthroughs in which transdisciplinarity was used as a key factor to obtain viable results. Dutch experience was used as case study.

Moffatt and Hanley (2001) presented the dynamic model and economic approaches for sustainable development using input-out approaches for the Scotland. Dynamic model provide long term horizon for the sustainability but it failed to interlink temporal considerations with spatial information.

Spangenberg (2002) highlightened the importance of environmental space as a toll for exploring sustainable development benchmark on a sound scientific basis. It is helpful to drive indicator for sustainable development for different application at both marco and micro levels. But environmental space expresses no preference for the economic system. So he suggested the need to develop new indicators for economic development.

Bartelmus (2007) presented the revised SEEA-2003, elaborating physical and hybrid environmental-economic accounts and detailing evaluation techniques for natural resources. But it rejects the monitory evaluation of environmental degradation. That is why it failed to meet the proclaimed objective of assessing sustainable development.

2.2 Human Development Index (HDI)

Neumayer (2001) used HDI to figure out the sustainable human development. An analysis for 155 countries leads to the conclusion that the indicated human development of 42 countries is potentially unsustainable. Most of these countries have a low HDI, which means that even this low achievement is not sustainable into the future. The results make a case for both a policy reform within these countries and for external assistance to help maintain at least low level of human development.

Tokuyama and Pillarisetti (2006) wrote that the broad objectives of HDI were to estimate human wellbeing, reduce poverty, economic & gender inequalities and increase human wellbeing. Although HDI undergo several transformations. It was noted that the databases in the human development reports exhibit significant measurement errors and inadequacies. The measurement errors are more conspicuous in case of data pertaining to low-income developing countries. Besides database problems, issues relating to policy revisions in the recent reports raise serious questions of credibility with the reports.

Sagar and Najam (1998) strongly criticized the HDI and wrote that although the index has become an important alternative to the traditional unidimensional measures of development but it fails to include the ecological dimensions. HDR's seems to be stagnant and repeating the same rhetoric without necessarily increasing the HDI's utility. Also index pays attention to the performance at national level, while attention should be paid to the global evaluation.

Sanusi (2008) favored the HDI by writing that not only has the index been accepted by the academics, policy makers, governments and development agencies, it has become a mean of ranking the countries annually. Yet it is being argued that it does not capture the totality of the issue the human well being. However work contributes to the efforts made to improve the index.

Morse (2003) presented the result of recalculating the HDI for a simplified method of 114 countries using various methodologies employed by the UNDP and showed that movement in results can easily be accounted by varying the methodology. He suggested that the greater focus be upon more meaningful or robust categories of human development rather than league tables where shift of a few places perhaps as result of nothing more than a methodological or data artifact, may be highlighted in the press and by policy makers.

Grimm (2007) suggested a methodology which allows computing the three components of HDI and the overall HDI for quintiles of the income distribution. This allows comparisons of the level in human development of the poor and non-poor within and across countries. It was concluded that the inequality in income is generally higher than inequality in education and life expectancy.

2.3 Ecological Footprint (EF)

Kitzes and Weckernagel (2009) comprehensively explained the concept of the ecological footprint and answered some commonly asked questions about the EF

Limnios et al., (2009) devised a self improving, market driven process of the EF of products that gives consumer a real choice in actively monitoring and reducing the ecological impact as earth is facing a major threat of resource degradation or waste emission.

Kitzes *et al.,* (2009) reported that Footprint Network's National Footprint Accounts are supported and used by the more than 70 major organizations world wide and EF accounts are being produced for more than 150 countries. Relevant literature was reviewed and summarized for the current state of debate and approaches were suggested for further development.

Jia *et al* ., (2009) computed and analysed the EF using the STRIPAT model. To avoid the collinearity produced by some drivers the method of partial least squares (PLS) was used. The result should that impact of affluence, population and technology could not be ignored. Moreover the traditional relationship between EF and economy do not exist.

Fiala (2007) criticized the EF and wrote that although it is used as a measure of sustain-ability, though evidence suggests that it falls short. It failed to satisfy simple economic principles because the basic assumptions are contradicted by both theory and historical data. the footprint arbitrarily assumes both zero greenhouse gas emissions, which may not be ex ante optimal, and national boundaries, which makes extrapolating from the average ecological footprint problematic. The footprint also cannot take into account intensive production, and so comparisons to biocapacity are erroneous. Using only the assumptions of the footprint then, one could argue that the Earth can sustain greatly increased production, though there are important limitations that the footprint cannot address, such as land degradation. Finally, the lack of correlation between land degradation and the ecological footprint obscures the effects of a larger sustainability problem. Better measures of sustainability would address these issues directly.

Beynon and Munday (2008) demonstrated the development of ecological footprint within a fuzzy environment and the impact of imprecision and uncertainty in the input-output framework. The analysis considered the level of fuzziness which surrounds the technical coefficient in the underlying input-output framework. The finding contributes to the elucidation of the potential policy impacts afforded when acknowledged imprecision and uncertainty in the data is used in estimating Ecological Footprint.

Kratena (2008) followed the Widemann et al., (2006) and used a combined approach of input-out model with EF for Germany. The EF concept was extended in the study by introducing the additional Biocapacity necessary for sustaining the given level of economy. It is assumed that the each industry has to rent the corresponding area and to apply the given technology for each industry leading to an increased cost and price. Economic indicators can be drived by measuring the income differences brought about the price increase. This difference corresponds to the Ricardian rent which is due to resource constraints on output growth.

Turnet *et al.,* (2008) used the combined input-output techniques and EF to resolve the issue of used resource measurement and pollution generation embodied in trade flow. The result was an explicit analysis of the problem that prevent the application of the fully method and the identification of the most appropriate shortcut method is the transparent way.

White (2007) examined how the human demand on bioprodcutive land, as measured by the EF, is distributed across the globe as different nations place different demand on the environment. Calculation of the Gini coefficient for total EF and its component explains the sources of inequality in overall resource use. Calculation of the Atkinson's index showed how inequality in the EF is related to the inequality of income and environment intensity.

Wiedmann *et al.,* (2006) discussed the method that allowed the disaggregation of the national EF by the economic sector, detailed final demand category, sub-national area and socio-economic group. The novelty of the approach lies in the use of input-output analysis to re-locate existing EF accounts in the context of disaggreging by the consumption category and in the expanded use of household expenditure data. The model is applicable to every country where nation foot print accounts exist.

Zhao *et al.*, (2005) aimed to present a combined approach of ecological footprint, created by the Wackernagel and Rees, and "Emergy" created by the H.T, Odum in a conventional ecological footprint form of calculation. The new method started from energy flow of a system in ecological footprint and carrying capacity. Through a study of energy flow, using the method of emergy analysis, the energy flows of a system were translated into corresponding biologically productive area.

Foken and Leclerc (2004) validated the footprint model by pointing out its shortcomings which were required to be addressed. Alternative methods of validation were proposed by giving the analytical solution of the advection-diffusion equation and lagrangian simulations. But it was concluded that despite of extensive studies validation remains an outstanding problem in the micrometeorology. In their paper three concepts were discussed: 1) use of artificial trace gases 2) the use of natural source of tracers 3) the presence of obstacles in the flowfield and their influence on the footprints.

Finnigan (2004) used footprint functions in complex flows has been questioned because of anomalous behaviour reported in recent model studies. We show that the concentration footprint can be identified with the Green's function of the scalar concentration equation or the transition probability of a Lagrangian formulation of the same equation and so is well behaved and bounded by 0 and 1 in both simple and complex flows. The flux footprint in contrast is not a Green's function but a functional of the concentration footprint and is not guaranteed to be similarly well behaved. The homogeneous shear flows, the flux footprint, defined as the vertical eddy flux induced by a unit point source, is bounded by 0 and 1 but that this is not true in more general flow fields. Analysis of recent model studies also shows that the negative flux footprints reported in homogeneous plant canopy flows are an artefact of reducing a canopy with a complex source–sink distribution in the vertical to a single layer but that in canopies on hilly topography, the problems are more fundamental. Finally, compared footprint inversion with the direct mass-balance method of measuring surface exchange. They concluded first that the flux footprint is an appropriate measure of the area influencing both eddy and adjective fluxes on a tower but that concentration footprint is the correct measure when the storage term is important. Second, we deduce that there are serious obstacles to invert flux footprints in complex terrain.

Monfreda *et al.,* (2004) discussed the protection of natural capital, including its ability to renew or regenerate itself represents a core aspect of sustainability. Hence, reliable measures of the supply of, and human demand on, natural capital are indispensable for tracking progress, setting targets and driving policies for sustainability. The newest version of the EF was utilized for this purpose. The obtained results provided a meaningful comparison among the nation's final consumption, or their economic production, and helped to analyze the Ecological Footprint embodied in trade. With the higher level of detail, the accounts can generate sectoral assessments of an economy.

2.4 Environmental Performance Index

Atici (2009) critically evaluated the environmental performance index and recommends that this index includes polluting inputs in future calculations. This study examines the structure of agricultural protection in OECD countries from a chronological and comparative perspective. In addition, the policy–environment interaction is scrutinized to better explain the environmental implications of agricultural policies in the era of globalization.

Azad and Ancev (2010) developed a study method based on the concept of an environmental performance index (EPI), to measure the economic and environmental performance of irrigated agricultural enterprises. Burden on water as an irrigation industry and demand on industry in terms of profitability and productivity were two points of concern. As an empirical application, the method was applied to a case study of seventeen natural resource management (NRM) regions within the Murray–Darling Basin (MDB), Australia. The results of the analysis showed that environmental efficiencies of irrigated enterprises vary considerably across NRM regions. The findings supported the case for policy targeting by type of irrigation enterprise and by location of enterprises.

Färe *et al.,* (2010) assessed the performance of electric power plants that produce both good and bad outputs, this study used data from the toxic release inventory to construct an Environmental Performance Index (EPI). Färe, Grosskopf, and Pasurka (2006) demonstrated that for the one good output and one air pollutant case, the EPI simplified to the ratio of good to bad output. Extended EPI was included as an index of multiple bad outputs. After deriving the index as a Malmquist Quantity Index, data was assembled from 1998 to 2005 on releases of selected toxic chemicals and electricity generation for a sample of coal-fired power plants in the United States to demonstrate how the EPI can provide initial perspectives on trends in releases of toxic chemicals by coal-fired power plants.

Srebotnjak (2007) tracked the particularly challenging situation of environmental statistics in developing countries before focusing on the role of statisticians working at the nexus of environmental statistics and policy within the context of measuring environmental performance. Three issues created particular tension at the environmental science-policy junction: data insufficiency and errors, quantitative nature of methods and language barriers. The paper examined how the EPI tackles these tensions while aiming to be a fact-based, statistically sound policy tool that helps countries achieve environmental objectives by tracking progress, identifying environmental ''best practices'', and providing strategic peer-group analyses. In conclusion, the paper suggested some remedies for the deficiencies in the co-operation between policymakers and environmental statisticians.

2.5 Environmental Sustainability Index

Sands and Podmore (2000) presented the index that aims to provide a modeling-based, quantitative measure of sustainability from an environmental perspective, comprising both on- and off-site environmental effects associated with agricultural systems with the help of Environmental Sustainability Index (ESI). A performance approach was utilized for the ESI, having inputs that were derived from long-term simulations of crop management systems with the EPIC model (Erosion Productivity Impact Calculator). 15 sub-indices for representing sustainability were chosen employing a dual framework for characterizing environmental sustainability, embodying the agricultural system's. Principal components analysis was employed to assess the information content of the 15 sustainability sub-indices. Sensitivity analysis was performed to evaluate the effects of model input uncertainty on the index. The effect of the time frame over which the index is computed was also examined for time frames ranging from 50 to 300 years. Results show that the ESI is capable of demonstrating clear differences among crop management systems with respect to sustainability.

Giannetti *et al.,* (2009) explained that the complexity of the environment demands a well-constructed composite environmental index (CEI) to provide a useful tool to draw attention to environmental conditions and trends for policy purposes. For this, a sensitivity analysis of the Environmental Sustainability Index (ESI 2005) was used as an example to assess the reliability of experts' opinions. The uncertainty due to the disagreement in experts' opinions clearly indicates that the forms we presently use to measure and monitor the actual environment are insufficient, that is, there is a lack of a "science of sustainability".

Morse and Fraser (2005) highlitghtened that the global environmental problems need to develop tools to measure progress towards "sustainability." To explore this tension, they critically assessed the Environmental Sustainability Index (ESI). By recreating this index, and then using statistical tools (principal components analysis) to test relations between various components of the index, it was challenged by the ways in which countries ranked in the ESI. Based on this analysis they suggested that ESI methodologies were biased and depict no relationship between environmental sustainability and economic growth. This criticism should not be interpreted as a call for the abandonment of efforts to create standardized comparable data. Instead, this paper proposed that indicator selection and data collection should draw on a range of voices, including local stakeholders as well as international experts. They also proposed that aggregating data into final league ranking tables is too prone to error and creates the illusion of absolute and categorical interpretations.

Sutton and Costanza (2002) estimated the global marketed and non-marketed economic values from two classified satellite images with global coverage at 1 km^2 resolution. GDP (a measure of marketed economic output) is correlated with the amount of light energy (LE) emitted by that nation as measured by nighttime satellite images. LE emitted is more spatially explicit than whole country GDP, may (for some nations or regions) be a more accurate indicator of economic activity than GDP itself, can be directly observed, and can be easily updated on an annual basis. As far as we know, this is the first global map of estimated economic activity produced at this high spatial resolution (1 km2). Ecosystem services product (ESP) is an important type of non-marketed value. The sum of these two (GDP+ESP)=SEP is a measure of the subtotal ecological–economic product (marketed plus a significant portion of the non-marketed). The ratio: (ESP/SEP)×100=%ESP is a measure of proportion of the SEP from ecosystem services. The result obtained by the new index was correlated by other two indexes i-e. Environmental Sustainability Index and Ecological Footprint. The related eco-deficit (national ecological capacity minus national footprint) correlates well with %ESP.

Niemeijer (2002) This paper investigates the issues involved with environmental indicator development for policy by looking at three recent examples from data and theory-driven approaches. The "Environmental Sustainability Index 2001" report fromWorld Economic Forum, YCELP and CIESIN is taken as an example of the data-driven approach, whereby data availability is the central criterion for indicator development and data is provided for all selected indicators. The other two examples are theory-driven, whereby, the focus is on selecting the best possible indicators from a theoretical point of view and data availability is considered only one of the aspects involved. These examples are the Heinz Center's1999 report on the "State of the Nation's Ecosystems" and the US National Research Council (NRC) report on "Ecological Indicators for the Nation". The reports and approaches are discussed and compared in order to determine their strengths and weaknesses. From this lessons are drawn for future environmental indicator work as a basis for policymaking. In the conclusions four important issues are addressed: (1) data availability; (2) ecosystem specificity of indicators; (3) spatial and conceptual aggregation of indicators and (4) baseline or reference values for indicators. For each of these issues recommendations are made.

Sutton (2003) described crude yet simple Environmental Sustainability Index (ESI) derived solely from the ratio of two classified satellite images with global coverage. An ESI is calculated for each nation of the world by dividing the amount of light energy emitted by that nation as measured by a nighttime satellite image into the total value of that nation's ecosystem services as measured by a land-cover dataset and ecosystem service values estimated by Costanza et. al. (Costanza, d'Arge et al., 1997). This index was correlated to the other two indexes i-e. Environmental Sustainability Index and Ecological Footprint index. These two indices are a composite of many sub-indices some of which correlate highly; however, the final nationally aggregated figures of the 2001 Environmental Sustainability Index and the comparable Ecological Footprint index do not correlate at all. The Eco-Value/Night Light index described here corresponds strongly with the Ecological Footprint Index and not at all with the Environmental

2.6 Genuine Saving

Pillarisetti (2005) considered the depletion of natural capital in national income accounting; the World Bank has developed a composite indicator known as genuine savings. Incorporating several environmental indicators. This paper examined the conceptual and empirical characteristics and policy implications of the measure. Analysis showed that the measure is conceptually and empirically imperfect. The policy implications based on this measure are erroneous. The paper suggests that a global approach is needed to appropriately address sustainability issues and to incorporate natural capital in national accounting.

Lawn (2007) stated that Green national accounting has existed in a variety of forms for just over thirty years. Having essentially begun as environmental cost adjustments to Gross Domestic Product, green national accounting now includes such indicators as the Genuine Progress Indicator, Genuine Savings, and the Ecological Footprint. It is concluded that a suite of indicators is required to convey a complete picture of a nation's sustainable development performance. In addition, economic indicators need to be supplemented by biophysical indicators, although the latter should never be incorporated directly into national income accounts since they serve as indicators of ecological sustainability, not of economic performance. Finally, the fact that a number of recently established indicators are still in the embryonic stage of development means that considerable refinement is necessary before they are likely to be broadly accepted by the policy-making community.

Lin and Hope (2004) took the genuine savings index (GSI) as a simple indicator that can be used to assess an economy's sustainability. It defines wealth more broadly than orthodox national accounts, and recalculates national savings figures based on this new definition. Genuine savings aim to represent the value of the net change in the whole range of assets that are important for development: produced assets, natural resources, environmental quality, and human resources. This paper took the broad framework developed in previous studies and tests its application with respect to the United Kingdom and Taiwan between 1970 and 1998, with the goal of assessing the feasibility of using such measures quite broadly as indices of sustainable development. The paper showed that both the United Kingdom and Taiwan have positive genuine savings rates over the period in question, with the United Kingdom registering lower ones than Taiwan.

Atkinson and Hamilton (2002) pointed out that the role that international trade plays in measuring sustainable development has come under recent scrutiny. They examined international resource flows using an input–output framework that is akin to 'ecological balance of payments' analysis. The empirical section of this paper applied this model to data on global trade and natural resource depletion in 1980, 1985 and 1990. The results provided a quantitative assessment of the significance of direct and indirect imports of resources required by Japan, the United States and the European Union. It is interesting to note that a number of resource exporters appear to be unsustainable at least on the basis of the criterion that the savings rate net of asset consumption (i.e. genuine savings) should not be negative. These findings, in turn, could form the basis of policies to assist exporters in adopting prudent resource and public investment policies.

Dietz and Neumayer (2007) considered the Genuine Saving as a measure of net investment in produced, natural and human capital. It is a necessary condition for weak sustainable development that genuine saving not be persistently negative. However, according to data provided by the World Bank, resource-rich countries are systematically failing to meet this condition. Alongside the well-known resource curse on economic growth, resource abundance might have a negative effect on genuine saving. In fact, the two are closely related, as future consumption growth is limited by insufficient genuine saving now. In this paper, they applied the most convincing conclusion from the literature on economic growth that it is institutional failure that depresses growth to data on genuine saving. They regressed the gross and genuine saving on three indicators of institutional quality in interaction with an indicator of resource abundance. The indicators of institutional quality are corruption, bureaucratic quality and the rule of law. They found that reducing corruption has a positive impact on genuine saving in interaction with resource abundance..

2.7 Interlinkages of Sustainable Development, Population, Poverty and Political Instability:

O'Regan *et al.,* (2009) reported a study of the relative sustainability of 79 Irish villages, towns and a small city classified by population size. Quantitative data on more than 300 economic, social and environmental attributes of each settlement were assembled into a database. Two aggregated metrics were selected to model the relative sustainability of settlements. Ecological Footprint (EF) and Sustainable Development Index (SDI) were aggregated to create a single Combined Sustainable Development Index. Creation of this database meant that metric calculations did not rely on proxies, and were therefore considered to be robust. Methods employed provided values for indicators at various stages of the aggregation process. This allowed both the first reported empirical analysis of the relationship between settlement sustainability and population size, and the elucidation of information provided at different stages of aggregation. At the highest level of aggregation, settlement sustainability increased with population size, but important differences amongst individual settlements were marked by aggregation. EF and SDI metrics ranked settlements in differing orders of relative sustainability. Aggregation of indicators to provide Ecological Footprint values was found to be especially problematic, and this metric was inadequately sensitive to distinguish amongst the relative sustainability achieved by all settlements. Many authors have argued that, for policy makers to be able to inform planning decisions using sustainability indicators, it is necessary that they adopt a toolkit of aggregated indicators. Here it is argued that to interpret correctly each aggregated metric value, policy makers also require a hierarchy of disaggregated component indicator values, each explained fully. Possible implications for urban planning are briefly reviewed.

Ghirlanda *et al.,* (2010) considered models of the interactions between human population dynamics and cultural evolution, asking whether they predict sustainable or unsustainable patterns of growth. Phenomenological models predict either unsustainable population growth or stabilization in the near future. The latter prediction, however, is based on extrapolation of current demographic trends and does not take into account causal processes of demographic and cultural dynamics. Most existing causal models assume (or derive from simplified models of the economy) a positive feedback between cultural evolution and demographic growth, and predict unlimited growth in both culture and population. They augmented these models taking into account that: (1) cultural transmission is not perfect, i.e., culture can be lost; (2) culture does not always promote population growth. And showed that taking these factors can cause radically different model behavior, such as population extinction rather than stability, and extinction rather than growth. We conclude that all models agree that a population capable of maintaining a large amount of culture, including a powerful technology, runs a high risk of being unsustainable. It was suggested that future work must address more explicitly both the dynamics of resource consumption and the cultural evolution of beliefs implicated in reproductive behavior (e.g., ideas about the preferred family size) and in resource use (e.g., environmentalist stances).

Moles *et al*., (2008) investigated the relationships between settlement size, functionality, geographic location and sustainable development. Analysis was carried out on a sample of 79 Irish settlements, located in three regional clusters. Two methods were selected to model the level of sustainability achieved in settlements, namely, Metabolism Accounting and Modelling of Material and Energy Flows (MA) and Sustainable Development Index Modelling. MA is a systematic assessment of the flows and stocks of material within a system defined in space and time. The metabolism of most settlements is essentially linear, with resources flowing through the urban system. The objective of this research on material and energy flows was to provide information that might aid in the development of a more circular pattern of urban metabolism, vital to sustainable development. In addition to MA, a set of forty indicators were identified and developed. These targets are important aspects of sustainable development: transport, environmental quality, equity and quality of life issues. Sustainability indices were derived through aggregation of indicators to measure dimensions of sustainable development. Similar relationships between settlement attributes and sustainability were found following both methods, and these were subsequently integrated to provide a single measure. Analysis identified those attributes of settlements preventing, impeding or promoting progress towards sustainability.

Jong-A-Pin (2009) examined the multidimensionality of political instability using 25 political instability indicators in an Exploratory Factor Analysis. They found that political instability has four dimensions: politically motivated violence, mass civil protest, instability within the political regime, and instability of the political regime. The causal impact of political instability on economic growth using a dynamic panel system Generalized Method of Moments model and found that the four dimensions of political instability have different effects on economic growth. Only the instability of the political regime has a robust and significant negative effect on economic growth.

Khan and Saqib (2009) investigated the effects of political instability on inflation in Pakistan. Applying the Generalized Method of Moments and using data from 1951-2007, examined the link in two different models. The results of the 'monetary' model suggested that the effects of monetary determinants are rather marginal and that they depend upon the political environment of Pakistan. The 'nonmonetary' model's findings explicitly establish a positive association between measures of political instability and inflation. This was further confirmed on analyses based on interactive dummies that reveal political instability significantly leading to high (above average) inflation.

Khan and Heuvel (2007) analyzed the political context as it is important for the understanding of a health policy and its success, because contextual factors may significantly influence the health policy process and health. This article described how the political context in Pakistan influences the health policy process. They used qualitative research methods based on document analysis and interviews of relevant actors in analyzing the impact of the political context on the health policy process. Document analysis included policy documents and official reports of the health ministries, health-related departments and international agencies. Interviewees included relevant actors involved in the health policy process at local, provincial, national and international levels. Pakistan had experienced unbalanced power structures and frequent changes in government, which had disturbed health resources and has resulted in a centralized health system that hinders wider participation and disrupts health policy-making, planning and implementation. So it was concluded that the political context has had a negative influence on the health policy process in Pakistan.

Darbya *et al.,* (2004) set out an infinite-horizon political economy model with partisan and office motivation effects in an endogenous growth context to demonstrate that the existence of political uncertainty regarding re-election tends to reduce the amount of public investment by incumbent governments and underlies a switch from government investment to government consumption, thereby reducing growth. The political equilibrium was inefficient and so did not maximize social welfare. Using panel data regressions they showed, for OECD countries, that there is empirical support for the hypothesis that political uncertainty tends to reduce public investment, and that there are partisan effects in public investment decisions.

Butkiewicz and Yanikkaya (2005) explained that sociopolitical instability was considered as detrimental to long-run growth. This paper presents the results of a thorough investigation of the effects of sociopolitical instability on growth, for a panel of countries over a 30-year period. Consistent with the existing literature, weak relationships between sociopolitical instability and growth are found. Political violence had the greatest adverse effects on growth. Also, the impact of sociopolitical instability was greater in countries with high levels of development and democracy. Robustness tests indicated little evidence of simultaneity problems, but estimation results are very sensitive to extreme observations, and to a lesser extent, parameter heterogeneity. The results suggested that one of the best ways to improve the lot of the poorest countries is the prevention and/or termination of violence and war.

Campos and Nugent (2002) related the cause of unstable macroeconomic environment is often regarded as detrimental to economic growth. Among the sources contributing to such instability, much of the blame has been assigned to political issues. This paper empirically tests for a causal and negative long-run relation between political instability and economic growth but finds no evidence of such a relationship. Sensitivity analysis indicates that there is a contemporaneous negative relationship but also that, in the long run and ignoring institutional factors, the group of African countries plays the determining role.

Vries and Petersen (2009) considered that the sustainability science poses severe challenges to classical disciplinary science. To bring the perspectives of diverse disciplines together in a meaningful way, they described a novel methodology for sustainability assessment of a particular social-ecological system, or country. Starting point was that a sustainability assessment should investigate the ability to continue and develop a desirable way of living vis-à-vis later generations and life elsewhere on the planet. Evidently, people hold different values and beliefs about the way societies sustain quality of life for their members. The first step, therefore, was to analyze people's value orientations and the way in which they interpret sustainability problems i.e. their beliefs. The next step was to translate the resulting worldviews into model-based narratives, i.e.

scenarios. The qualitative and quantitative outcomes are then investigated in terms of associated risks, opportunities and robustness of policy options. The Netherlands Environmental Assessment Agency (PBL) had followed this methodology, using extensive surveys among the Dutch population. In its first Sustainability Outlook (2004), the resulting archetypical worldviews became the basis for four different scenarios for policy analysis, with emphases on the domains of transport, energy and food. The goals of the agency's Sustainability Outlooks were to show that choices are inevitable in policy making for sustainable development, to indicate which positive and negative impacts one can expect of these choices(trade-offs), and to identify options that may be robust under several worldviews. The conceptualization proposed was both clear and applicable in practical sustainability assessments for policy making.

Arrow (2003) presented a dynamic model of the economy with changing population; the latter should properly be one of the state variables of the system. It entered both in the maxim and, at least under total utilitarianism, and into the production function in one way or another. If population growth is exponential and constant returns prevails, then a simple transformation to per capita variables can be used to eliminate one state variable, but this ceases to be true if growth is not exponential, as it obviously is not and cannot be. If the growth of population is exogenous, then introducing it into the system does not affect the optimal policy. However, if one asks whether the system is sustainable, in the sense of at least maintaining total welfare (integral of discounted utilities), then the criterion is that that the value of the rates of change of the state variables is non-negative, so that the shadow price of population becomes relevant. In this paper, they derived explicit formulas in a simple model, show that rate of growth of per capita capital is not the correct formula but must have another terms added to it. This question has also been studied under an alternative criterion of long-run average utilitarianism.

Chapter 3

Methodology Employed by the Sustainability Frameworks

Calculation methodology employed by the each index is given as under:

3.1 Human Development Index (HDI):

The HDI is the summary measure of the human development. It measures the average achievement of a country in three basic dimensions of human development:

- A long and healthy life, as measured by life expectancy at birth.
- Knowledge, as measured by the adult literacy rate (with two-third weight) and the combined primary, secondary and tertiary gross enrollment ratio (which two-third weight).
- A decent standard of living, as measured by GDP per capita in purchasing power parity (PPP) term in US dollars.

Before the HDI itself is calculated, an index needs to be created for each of these indices. The life expectancy, education and GDP indices- minimum and maximum values (goalposts) are chosen for each underlying indicator.

Performance of each dimension is expressed as a value between 0 and 1 by applying the following general formula:

Dimension Index = actual value – minimum value / maximum value – minimum value

The HDI is then calculated as a simple average of the dimension indices.

Table 3.1 WORLD INDICATORS FOR CALCULATING THE HDI

Indicator	Maximum Value	Minimum Value
Life expectancy at birth* (years)	**85**	**25**
Life expectancy at birth (years)	**100**	**0**
Combined gross enrolment ratio (%)	**100**	**0**
GDP per capita (PPP US$)	**40,000**	**100**

* The goalpost for calculating adult literacy implies the maximum literacy rate of 100%. In practice, the HDI is calculating using upper bound of 99%

3.1.1 Calculating the HDI.

This illustration of the calculated of the HDI uses data for Pakistan.

a) Calculating the Life Expectancy Index

The life expectancy index measures the relative achievement of a country in life expectancy at birth. For Pakistan, with a life expectancy of 65.6 years in 2005, the life expectancy index was 0.676

Life Expectancy Index = 65.6 - 25 / 85-25 = 0.676

b) Calculating the Education Index.

The education index measures a country's relative achievement in both adult literacy and combined primary, secondary and tertiary gross enrollment. First, an indices for adult literacy rate and combined gross enrollment are calculated. Then these two indices are combined to create the education index, with two-third weight given to the adult literacy and one-third weight to combined gross enrollment. For Pakistan, with an adult literacy rate of 55% in 2005 and a combined gross enrolment ratio of 68.7% in 2005, the education index is 0.812.

Adult Literacy Rate = 55 -0 / 100-0 = 0.55

Gross Enrolment Index = 71 – 0 / 100 - 0 = 0.71

Education index = 2/3(adult literacy rate) + 1/3(gross enrolment index)

= 2/3(0.55) + 1/3(0.71) = 0.602

c) Calculating the GDP Index

The GDP index is calculated using adjusted GDP per capita (PPP US $). In the HDI, income serves as a surrogate for all the dimensions of human development not reflected by a long and healthy life and knowledge. Income is adjusted because achieving a respectable level of human development does not require unlimited income. Accordingly, the logarithm of income is used. For Pakistan, with a GDP per capita of 2,500(PPPUS $) in 2005, the GDP index is 0.740.

GDP Index = log (2,500) – log (100) / log (40,000) - log (100) = 0.53

3.1.2 Calculating the HDI

Once the dimension indices have been calculated, determining the HDI is straight forward. It is a simple average of the three dimension indices.

HDI = 1/3(life expectancy index) + 1/3 (education index) + 1/3 (GDP index)

1/3 (0.773) +1/3(education index) + 1/3(0.740) = 0.775

(HDR., 2007/08)

3.2 Concept of Ecological Foot Print:

Importance of ecological foot print as an environmental sustainability index has been highlighted by several authors such as Turner, et. al.,(2001)., Wilson, et. al., (2007), Siche et. al., (2008), Mayer,(2008), Beynon and Munday,(2008), Kratena(2008), Jia, et, al., (2009), Kitzes and Wackernagel (2009), Kitzes, et.al., (2009), Limnios et. al., (2009). However, a few authors like Fiala (2008) have also criticized the ecological footprint index.

The idea of ecological footprint was initially introduced by Wackernagel, 1991a,b; Rees, 1992 and Wackernagel and Rees, 1996. The Ecological Footprint measures human demand on nature by assessing how much biologically productive land and sea area is necessary to maintain a given consumption pattern(Wiedmann et. al., 2006; Monfreda, et. al., 2004). Ecological footprint analyzes the relationship between development and environment. As a striking relationship was found between development and increase in nation's footprint (Fiala 2008). Ecological footprint measurements starts from the consumption of resources in terms of mass unit and transform this mass into land appropriation in second step(Monfrede., 2004., Turner et.al., 2007). These natural resources are provided by the bioprodcutive areas. A bioprodcutive area is an area that provides goods and services consumed by the individuals, communities or organizations. It can also be derived for products or for particular activities and absorb all of the waste it generates, using prevailing technology and resource management. It is assumed that the world's distinct bioprodcutive areas that provides economically useful concentration of renewable resources consist of cropland (1.5 billion ha), grazing lands (3.5 billion ha), forest (3.5 billion ha) and built up land (0.3 billion ha). Remaining of the planet is also biologically active, but their renewable resources are not concentrated enough to contribute in overall biological productivity (Euro stat., 2000; FAO., 1999; SEI., 1998; WRI., 2000). So bulk of biosphere's regenerative capacity if termed as 'Biocapacity' (renewable resources) is an aggregate of the production of various ecosystems in a certain area (e.g. of arable land, pasture, forest, productive sea). Some of it may also consist of built up or degraded land. The earth's Biocapacity increases with a larger biologically productive area and with a higher productivity per unit area (WWF, 2005). Biocapacity is dependent not only on natural conditions but also on prevailing land use practices (e.g. farming, forestry)(Schaefer., 2006). If the Footprint (demand) exceeds the biocapacity (supply), there is "overshoot" or, at a local level, "ecological deficit," an unsustainable situation that occurs when an ecosystem is exploited more rapidly than it can renew itself, and/or when an area is relying on places beyond its borders to handle its consumption and waste disposal needs(ASAP., 2010).

3.2.1 Measurement Units:

The Ecological Footprint is most commonly expressed in units of global hectares. Global hectares represent world's average productivity for all the productive land and water areas in given years. Use of a common unit makes easy the comparison of the natural resources (Global Foot Print Network., 2006). Biological materials consumed and the waste generated is utilized to calculate the individual's footprint. For this purpose, amount of materials consumed (tons per year) by that person is divided by the yield of the specific land or sea area (annual tones per hectares) from which it was harvested or where its waste material was absorbed. Yield and equivalence factors are then utilized to convert these hectares into global hectares (Kitzes and Wackernagal., 2009; Galli et al., 2007). An equivalence factor presents the world average potential productivity of a given bioproductive area relative to the world average potential productivity of all the bioproductive areas. Agro-Ecological Zones (GAEZ) assessment provides a current estimation of achievable crop yield as compared to maximum potential crop yields for National Foot Print Accounts (Kitzes et. al., 2009).

The same amount of goods and services may not be produced each year by the same hectares and changes over time therefore, for each locale yield factor, are calculated as new, every year (Limnios., 2009).

Table 3.2 Equivalence Factor:

Area Type	**Equivalence Factor (gha/ha)**
Primary Crop Land	2.64
Forest	1.33
Grazing Land	0.50
Marine	0.40
In-land Water	0.40
Built up Land	0.64

3.2.2 Calculation of Ecological Foot Print, Biocapacity and Ecological Deficit:

For the sake of simplicity equation for calculating Ecological Foot Print, Biocapacity and Ecological Foot Print were taken from PhD dissertation of Saeed (2005)

Ecological Foot Print calculations are conceptually simple. Annual per capita consumption of major entities is estimated by aggregating regional or national data and by dividing total consumption by the total population size. For many categories consumption can be assessed as:

Consumption = production + imports – exports

In the next step, land area appropriated per capita for the production of each consumption item is calculated by dividing average annual consumption of that item by its average annual productivity or yield.

Foot Print Component = production +import – export / yield

(S.Zhao et. al., 2005)

Crop production, grazing, forestry, fisheries, and built-up areas provide for mutually exclusive demands on the biosphere, the sum of which equals the total Ecological Footprint. Each of these categories represents an area in hectares, which is then multiplied by its equivalence factor to obtain the Footprint in global hectares.

Footprint (gha) = Area (ha) x Equivalence Factor (gha/ha) (Monfreda et al., 2004)

3.2.3 Footprint of Renewable Resources

a) Primary Products

Majority of biologically renewable resources, to the human economy, are provided by the forests, pastures, croplands and fisheries. While minimally altered and unprocessed output of the given area is know as primary products e.g. raw fruits, vegetables, forage for livestock, fisheries, etc. the Footprint of these products represents the biological and technical capacity required for their production, standardized using the average global yield:

$$A = \frac{P + I - E}{GY}$$

Where, 'A' represents Area (ha), 'P' production (tons),'I' Imports (tons), 'E' Exports (tons) and 'GY' Global yield (tons/ha).

b) Secondary Products:

Derivatives of the primary products are known are secondary products. Imports of secondary products use the global conversion factor, and domestically produced secondary products use the national conversion factor. The area of exports is weighted in proportion to the amount of products imported and produced domestically and their respective conversion factors.

$$SIA = \frac{SI \times GCE}{PGY}$$

Where 'SIA' is the Area of secondary imports (ha),'SI' is Secondary Imports (tons),'GCE' is the Global conversion efficiency (primary tons/secondary tons) and 'PGY' is the primary global yield (tons/ha)

$$SPA = \frac{SP \times NCE}{PGY}$$

Where 'SPA' stands for area of secondary production (ha), 'SP' for secondary production (tons), 'NCE' is National conversion efficiency (primary tons/secondary tons) and 'PGY' for primary global yield (tons/ha)

$$SEA = \frac{SE \times SIA + SPA + SP}{SI}$$

Where, 'SEA' represents secondary area of exports (ha), 'SE' Secondary exports (tons), 'SIA' Secondary area of imports (ha), 'SPA' secondary area of production (ha) 'SI' secondary imports (tons) and 'SP' secondary production (tons).

c) Footprint of Built-up Area and Hydropower:

The National Footprint Accounts now include both an ecological Footprint and Biocapacity estimate for built-up land, or land under human infrastructure, calculated by assuming that built infrastructure occupies formerly productive cropland (Kitzes ., 2009).

$$BFP = BA \times BEF \times CYF$$

Where 'BFP' is Footprint of built up area (gha) 'BA' is built up area (ha), 'BEF' is built up area equivalence factor (gha/ha), 'CYF' is cropland yield factor.

Areas occupied by hydroelectric dams and reservoirs, used for the production of hydropower, are also counted within built-up land. The hydropower Footprint is calculated for each country using the average ratio of power output to inundated reservoir area for a selection of large dams for which both surface area and power output data are available.

$$HFP = \frac{E \times HEF}{C}$$

Where 'HFP' represents Footprint of hydro area (gha), 'E' energy (GJ), 'C' Constant (GJ/ha), 'HEF' is Hydro area equivalence factor (gha/person) (Kitzes et al., 2007).

d) Footprint of Fossil Fuels and Nuclear Energy:

i) Waste Assimilation:

Amount of carbon dioxide produced by the anthropogenic activities is the most important indicator of human activities upon biosphere's regenerative capacity. This Footprint is calculated by the amount of forest land this is necessary to absorb carbon dioxide emissions, after adjusting for uptake by the oceans.

$$A = \frac{EC \times (1 - FAO)}{SR}$$

Where 'A' is area (ha), 'EC' is CO2 emission (tons), 'FAO' is fraction absorbed by oceans, 'SR' is sequestration rate (tons/ha).

ii) Biomass Substitution:

The biomass substitution concept implies the calculation of the area needed to replace the fossil fuel with their equivalent in fuel wood, as it is the most dominant fuel used throughout the human history without any modifications.

$$A = \frac{E}{RWY \times EF}$$

Where 'A' represents area (ha), 'E' Energy (GJ), 'RWY' is Round wood Yield (GJ/ha) and 'EF' is expansion factor.

3.2.3 Calculation of Biocapacity

Biocapacity, or the supply side of the equation, is the counterpart of the Footprint, or the demand side. A nation's total Biocapacity is the sum of its bioproductive areas, also expressed in global hectares (gha).

$$BC = A \times EF \times YF$$

Here BC stands for Biocapacity (gha), 'A' area (ha), 'EF' is Equivalence factor (gha/ha) And YF is yield factor

3.2.4 Ecological Deficit and Ecological Overshoot

A country whose Footprint exceeds its Biocapacity runs what we term an ecological deficit.

$$ED = FP - BC$$

Where ED, FP, BC, stands for Ecological deficit (gha), Footprint (gha) andBiocapacity (gha) repectively.

For countries with low Biocapacity:

$$ED = CFP - PFP$$

Where,

ED = Ecological deficit (gha), CFP = Consumption Footprint (gha),PFP = Production Footprint (gha).

For Ecological over shoot

EOS = PFP - BC

Where, EOS = Ecological overshoot (gha), PFP = Production Footprint (gha), BC = Biocapacity (gha)

Thus, Ecological footprint and Biocapacity are given fundamental importance as indicators in this piece of work exhibiting global impact, applied to people, planet earth, to an individual, to a town or to the whole earth surface are correlated with the human development index and we performed same task for said indices for Pakistan.

(Source: calculation methodology for the national Footprint accounts, 2008 Edition).

3.3 Environmental Performance Index.

The 2010 EPI measures the effectiveness of national environmental protection efforts in 163 countries. The EPI measures two core objectives of environmental policy:

1. Environmental Health, which measures environmental stresses to

human health; and

2. Ecosystem Vitality, which measures ecosystem health and natural resource management.

The 2010 EPI relies on 25 indicators and targets are drawn from four sources: (1) treaties or other internationally agreed upon goals; (2) standards set by international organizations; (3) leading national regulatory requirements; or (4) expert judgment based on prevailing scientific consensus. Using the 25 indicators, scores are calculated at three levels of aggregation, allowing analysts to drill down to better understand the underlying causes of high or low performance. The aggregation process proceeds in the following steps: 1. Scores are calculated for each of the ten core policy categories based on two to eight underlying indicators. Each underlying indicator represents a discrete data set. The ten areas are as follows:

(1) Environmental Burden of Disease; (2) Water Resources for Human Health; (3) Air Quality for Human Health; (4) Air Quality for Ecosystems; (5) Water Resources for Ecosystems; (6) Biodiversity and Habitat; (7) Forestry; (8) Fisheries; (9) Agriculture; and (10) Climate Change.

This level of aggregation permits analysts to track countries' relative performance within these well-established policy areas or at the disaggregated indicator level.

2. Scores are next calculated for the objectives of Environmental Health and Ecosystem Vitality.

3. The overall Environmental Performance Index is then calculated, based on the mean of the two broad objective scores. The rankings are based on these Index scores.

3.3.1 Indicator Selection

For each of the major policy categories Identified the selected indicators should comprise four major properties i-e. relevance, performance orientation, transparency and data quality.

3.3.2 Calculating the EPI

To standardize all 25 indicators, each country score builds on an analysis of the raw data on national performance to a proximity-to-target-measure, which we spread across a scale of zero to 100. We examine the distribution of each indicator to identify whether extreme values might skew the aggregation of the indicator. Extreme outliers (greater than or equal to three standard deviations from the mean) are more likely to be the result of data processing (especially for modeled data) than actual performance. Accordingly, we adjust outliers using a recognized statistical technique called "winsorization" – in this case trimming at the 95th or 97th percentile of the distribution. In a small number of cases even this level of winsorization left significant outliers, and in such cases, we winsorized at a greater level based on a comparison of the two alternative values. After these adjustments, an arithmetic transformation is undertaken so that the observed values are scaled from zero to100, where 100 corresponds to the target and zero to the worst observed value. The resulting proximity-to-target scores are calculated using this formula:

[100 - (target value - winsorized value)] x 100/(100 - minimum winsorized value)

Logarithmic transformation also improves the interpretation of differences between Countries at opposite ends of the scale.

3.3.3 Data Aggregation and Weighting

In the environmental indicator arena, aggregation is an area of methodological controversy. While the field of composite index construction has become a well recognized subset of statistical analysis, there is no clear consensus on how best to construct composite indices that combine disparate issues. Various aggregation methods exist, and the choice of an appropriate method depends on the purpose of the composite indicator as well as the nature of the subject being measured. While we have assigned explicit weights in the construction of the EPI, the actual implicit weights differ slightly owing to the country score distributions and variances in each policy category.e.g. The Environmental Health and Ecosystem Vitality subcategories each represent 50% of the total EPI score. This equal division of the EPI into sub-scores related to humans and nature is not a matter of science but rather a policy judgment. Yet this even weighting of the two overarching objectives reflects a widely-held intuition that both humans and nature matter. This choice (used in the 2008 and 2006 Pilot EPIs) has been widely accepted. Indeed, for every deep ecologist who favors more weight being placed on Ecosystem Vitality, there is a "humans first" environmental policymaker who prefers that the tilt go the other way. Within the Ecosystem Vitality objective, the Climate Change indicator carries 50% of the weight (i.e., 25% within the total EPI). This focus on greenhouse gas emissions reflects the increasing importance attached to climate change in policy discussions and its potential to have far reaching impacts across all aspects of ecosystem health and natural resource management. The remaining policy categories – Air, Water, Biodiversity, Forestry, Fisheries, and Agriculture – are each evenly weighted to cover the remaining 50% of the Ecosystem Vitality objective.

Table 3.3 Weights (as % of total EPI score), Sources, and Targets of EPI Objectives, Categories, Subcategories, and Indicators.

Environmental Health (50%)	Environmental burden of disease (25%)	Environmental burden of disease (25%)	World Health Organization	10 DALYs (Disability Life Adjusted Years) per 1,000 population
	Air pollution (effects on humans) (12.5%)	Indoor air pollution* (6.3%)	World Development Indicators	0%population using solid fuels
		Outdoor air pollution* (6.3%)	World Development Indicators	20 ug/m3 of PM_{10}
	Water (effects on humans) (12.5)	Access to water* (6.3%)	World Development Indicators	100% population with access
		Access to sanitation* (6.3%)	World Development Indicators	100% population with access
Ecosystem Vitality (50%)	Air Pollution (effects on ecosystem) (4.2%)	Sulfur dioxide emissions per populated land area (2.1%)	Emissions Database for Global Atmospheric Research (EDGAR) v3.2, United National Framework Convention on Climate Change (UNFCCC), Regional Emissions Inventory in Asia (REAS)	0.01 Gg SO2/sq km
		Sulfur dioxide emissions per populated land area	Emissions Database for Global Atmospheric Research	0.01 Gg SO2/sq km

		(2.1%)	(EDGAR) v3.2, United National Framework Convention on Climate Change (UNFCCC), Regional Emissions Inventory in Asia (REAS)	
		Nitrogen oxides emissions per populated land area* (0.7%)	EDGARv3.2, UNFCCC, REAS	0.01 Gg NOx /sq km
		Non-methane volatile organic compound emissions per populated land area* (0.7%)	EDGARv3.2, UNFCCC, REAS	0.01 Gg NMVOC /sq km
		Ecosystem ozone* (0.7%)	Model for OZone and Related chemical Tracers (MOZART) II model	0 ppb exceedance above 3000 AOT40. AOT40 is cumulative exceedance above 40 ppb during daylight summer hours
	Water (effects on ecosystem) (4.2%)	Water quality index (2.1%)	United Nations Environment Programme (UNEP) Global Environmental Monitoring	Dissolved oxygen: 9.5mg/l (Temp<20°C), 6mg /l (Temp>=20°C); pH: 6.5 - 9mg/l;

			System (GEMS)/Water	Conductivity: 500μS; Total Nitrogen: 1mg/l; Total phosphorus: 0.05mg/l; Ammonia: 0.05mg/l
		Water stress index* (1%)	University of New Hampshire Water Systems Analysis	0% territory under water stress
		Water scarcity index* (1%)	Fand and Agricilture Organization (FAO)of the UN	0 fraction of water overuse
	Biodiversity & Habitat (4.2%)	Biome protection (2.1%)	International Union for Conservation of Nature (IUCN), CIESIN	10% weighted average of biome areas
		Marine protection* (1%)	Sea Around Us Project, Fisheries Centre, University of British Columbia	10% of Exclusive Economic Zone (EEZ)
		Critical habitat protection* (1%)	Alliance for Zero Extinction, The Nature Conservancy	100% AZE sites protected
	Forestry (4.2%)	100% AZE sites protected	FAO	ratio >=1 n cubic meters / hectare
		Forest cover change* (2.1%)	FAO	% no decline
	Fisheries* (4.2%)	Marine trophic index (2.1%)	UBC, Sea Around Us Project	no decline of slope in trend line
		Trawling intensity (2.1%)	UBC, Sea Around Us Proje	0% area with combined bottom

				trawl or dredge catch within declared EEZ areas
	Agriculture (4.2%)	Agricultural water intensity* (0.8%)	FAO	10% water resources
		Agricultural subsidies (1.3%)	Yale Center for Environmental Law & Policy, World Development Report, Organization of Economic Cooperation and Development (OECD)	0 Nominal Rate of Assistance (NRA)
		Pesticide regulation (2.1%)	UNEP-Chemicals	22 points
	Climate Change (25%)	Greenhouse gas emissions per capita (including land use emissions) (12.5%)	World Resources Institute (WRI) Climate Analysis Indicator Tool (CAIT), Houghton 2009, World Development Indicators (WDI) 2009	2.5 Mt CO2 eq. (Estimated value associated with 50% reduction in global GHG emissions by 2050, against 1990 levels)
		CO2 emissions per electricity generation (6.3%)	International Energy Agency	0 g CO2 per kWh
		Industrial greenhouse gas emissions intensity (6.3%)	WRI-CAIT, WDI, Central Intelligence Agency	36.3 tons of CO2 per $mill (USD, 2005, PPP) of industrial GDP (Estimated value

				associated with 50% reduction in global GHG emissions by 2050, against 1990 levels)

(Environmental Protection Index Report., 2010)

3.4 Genuine Saving:

The calculation of GS involves the itemization of a nation's stock of wealth, and an accounting of changes to that stock. The World Bank researchers have defined GS as follows:

Genuine Savings = Production – Consumption – Depreciation of Produced Assets

– Depletion of Natural Assets,

= Gross Domestic Savings – Consumption of Fixed Capital (Depreciation) + Education Expenditure – Air Pollution Costs – Water Pollution Costs – Depletion of Nonrenewable Natural Resources – CO2 Damage Costs

The following adjustments to the standard savings measure were made to arrive at adjusted net savings:

- **Gross national saving**. Calculated as the difference between GNI and public and private consumption.
- **Consumption of fixed capital** was subtracted. This represents the replacement value of capital used up in the process of production.
- **Current spending on education** was added. Standard savings measures only count as an investment that portion of total expenditure on education (usually less than ten percent) which goes toward fixed capital such as school buildings; the rest is considered consumption. Although it is not obvious exactly how to measure changes in the value of a nation's human capital stock (Jorgensen and Fraumeni, 1992), it is clear that within an adjusted net savings framework that considers human capital to be a valuable asset, expenditures on its formation cannot be labeled as simple consumption.

As a lower-bound first approximation, the calculation thus included current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment.

• **Rent from the depletion of natural resources** was substracted. Rent was measured as the market value of extracted material minus the average extraction cost. As discussed above, this is an approximation of the Net Price valuation method (which uses marginal extraction cost) which in turn is an approximation of the more exact user Cost method. Energy, mineral and forest depletion were included. All resources considered were non-renewable, with the exception of forest resources; in the case of forestry, rent on depletion was calculated as the rent on that amount of extraction which exceeded the natural increment in wood volume.

• **Damages from Carbon Dioxide** emissions were subtracted. This calculation effectively expands the notion of a national "asset" yet further to include its unpolluted air. Ideally, the number subtracted would reflect marginal damages from the entire range of air pollutants emitted; as a first approximation, a conservative estimate for damages from a single major pollutant was used.

Table 3.4 Summary of the GS Calculation Methodology

Item	Adjustment	Rationale
Gross Domestic Saving		Basis for the index
Consumption of fixed capital	-	Accounting for replacement value of produced capital in the production process
Education Expenditures	+	Adding in value of investments in human capital
Air pollution Cost	-	Subtracting the environmental degradation costs
Water Pollution Cost	-	Subtracting the environmental degradation costs
CO_2 Damage Cost	-	Subtracting the environmental long-term damage costs
Nonrenewable natural resource depletion costs	-	Subtracting the declining costs of natural capital due to extraction or harvest
Genuine Saving	-	Standing for how much a country truly saves for future

(Lin., 2004; Manual for Calculating Adjusted Net Savings., 2002)

3.5 Environmental Sustainability Index

Methodology for ESI calculation consists of following six steps:

3.5.1 Country Selection Criteria

A total of 146 countries met inclusion criteria for the 2005 ESI. Selection of the country depends upon variable size, country coverage and indicator coverage.

3.5.2 Variable Standardization for Cross-Country Comparisons

To calculate the ESI scores for each country and to facilitate the aggregation of variables into indicators, the raw data needs to be transformed to comparable scales. Some of the ESI variables already are denominated to make such cross-country comparison possible. Where this is not the case, we identify an appropriate denominator such as GDP, agricultural GDP, the total value of imports of goods and services, total population, the world average price of gasoline, city population, population aged 0-14 years, total land area, populated land area, as well as known amphibians, breeding birds, and mammal species.

3.5.3 Variable Transformation

To fit the variable to the imputation and aggregation process the imputation model's assumption of multivariate normality.

$$S_{xj} = 1 \quad p$$

$$\Sigma\, (x_j - \mu_j)^3$$

$$J=1$$

$$\overline{\qquad\qquad}$$

$$\Sigma^3{}_{xj} \; p$$

3.5.4 Multiple Imputation of Missing Data

The question of how to treat missing or incomplete observations, which arise in virtually all types of environmental data collection, is among the most persistent and complicated problems facing policy analysts. Two major assumptions are commonly made in the imputation literature:

1. The pattern of missing values in a multi-variate vector of observations does not depend on the unobserved responses. In other words, the probability that a value is missing may be completely random (the statistical term is Missing Completely At Random or MCAR). Alternatively, it may depend on the observed values, which is called Missing At Random or MAR. The MAR assumption is more realistic for most real-life situations. If the parameters governing the missingness process are also independent of the parameters of the observed data model, the missing data mechanism is called "ignorable" and can be estimated.

2. A parameterized, functional form for the distribution of the vector observations can be formulated, and in most cases the estimates for the parameters of that form can be approximated using an iterative procedure (Johnson and Wichern, 1998).

The method of imputation being utilized by the ESI are:

a) Ad-hoc Methods, b) Comparison of Regression Imputation with MCMC Imputation, c) Markov Chain Monte Carlo Simulation.

3.5.5 Data Winsorization

Winso-rization corresponds to shifting observations in the tails of the distribution to specified percentiles. For each variable, the values exceeding the 97.5 percentile are lowered to the 97.5 percentile. Similarly, values smaller than the 2.5 percentile are raised to the 2.5 percentile.

3.5.6 Data Aggregation and Weighting Aggregation

Composite indices are aggregations of sets of variables for the purpose of meaningfully condensing large amounts of information. The most common types of indices used are weighted sums and weighted geometric means of sub-components. The ESI belongs to the first group because it is the equally weighted sum of the 21 indicators.

$I_i = \Sigma^{p}_{j=1} W_j X_j \quad i=1,\dots,n,$

where is the j^{th} weight given to X_j, which which corresponds to the z-score of the j^{th} indicator.

Weighted summations, in the form of aver-ages, are not necessarily scale invariant. That means that the resulting index value, I^i, for the i^{th} object depends on the scales of the variables aggregated in the index.

(Environmental Sustainability Index Report., 2005)

3.6 The Wellbeing Index:

Wellbeing Assessment is a method of assessing sustainability that gives people and the ecosystem equal weight and provides a systematic and transparent way of:

• deciding the main features of human and ecosystem wellbeing to be measured;

• choosing the most representative indicators of those features; and

• combining the indicators into a Human Wellbeing Index (HWI), Ecosystem Wellbeing Index (EWI), Wellbeing Index (WI), and Wellbeing/Stress Index (WSI, the ratio of human wellbeing to ecosystem stress). Together, these four indices provide a measurement of sustainable development.

3.6.1 Human Wellbeing Index (HWI)

The HWI is a more realistic measure of socioeconomic conditions than narrow monetary indicators such as the Gross Domestic Product and covers more aspects of human wellbeing than the United Nations' Human Development Index. It is the average of:

a) **Health and population**. How long people may expect to live in good health (1 indicator). The stability of family size (1 indicator).

b) **Wealth.** How well needs are met for income, food, safe water, and sanitation (6 indicators). The size and condition of the national economy, including inflation, unemployment, and the debt burden (8 indicators).

c) **Knowledge and culture.** Education (primary, secondary, and tertiary school enrollment rates) and communication (accessibility and reliability of the telephone system and use of the Internet) (6 indicators). Lack of a suitable indicator prevented coverage of culture.

d) **Community.** Freedom and governance (political rights, civil liberties, press freedom, and corruption) (4 indicators). Peacefulness (military expenditure and deaths from armed conflicts and terrorism) (2 indicators). Violent crime rates (4 indicators).

e) **Equity.** Household equity: the difference in income share between the richest and poorest fifths of the population (1 indicator). Gender equity: disparities between males and females in income, education, and parliamentary decision-making [3 indicators].

3.6.2 Ecosystem Wellbeing Index (EWI)

The EWI is an equally broad measure of the state of the environment, with a fuller and more systematic treatment of national environmental conditions than other global indices such as the Ecological Footprint and the Environmental Sustainability Index. It is the average of:

a) Land. How well a country conserves the diversity of its natural land ecosystems (4 indicators) and maintains the quality of the ecosystems that it develops (1 indicator).

b) Water. River conversion by dams (2 indicators). The water quality of drainage basins (17

Indicators). Water withdrawal as a percentage of the national supply from precipitation (1 Indicator). Inadequate data prevented coverage of the sea.

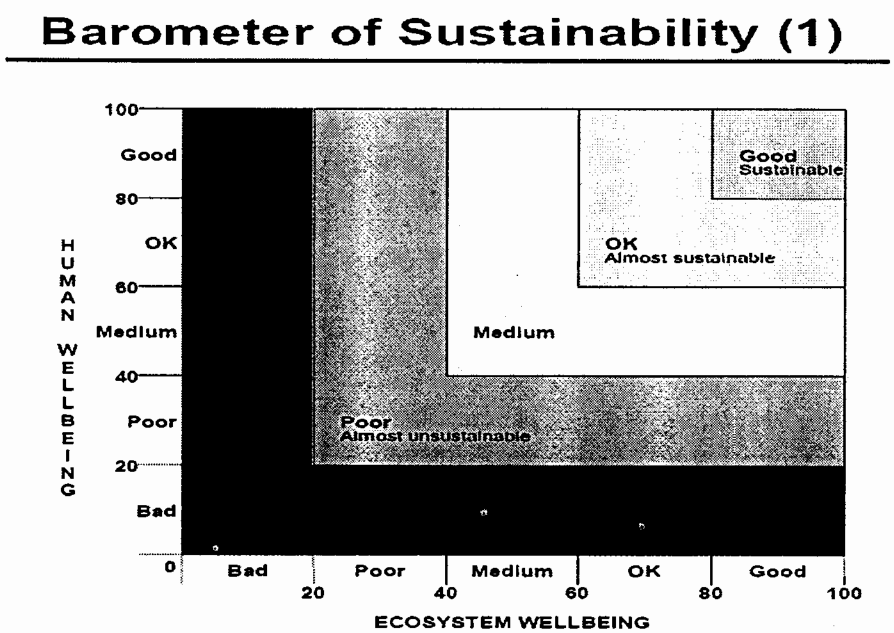
c) Air. Emissions of greenhouse gases and ozone depleting substances to the global atmosphere (2 indicators). The quality of city air (9 indicators).

d) Species and genes. How well a country conserves its wild species of mammals, birds, amphibians, reptiles, and higher plants (2 indicators), and the variety of its domesticated livestock breeds (2 indicators).

e) Resource use. How much energy a country consumes (2 indicators). The demands its agriculture, fishing, and timber sectors place on resources (9 indicators).

3.6.3 Wellbeing Index (WI) and Wellbeing/Stress Index (WSI)

The WI and WSI break new ground in measuring people and the ecosystem together to compare their status, show the impa ct of one on the other, and focus national and community energies on the improvement of both. The WI is the point on the Barometer of Sustainability where the HWI and EWI intersect. It shows how well societies combine human and ecosystem wellbeing and hence how close they are to sustainability. The WSI is the ratio of human wellbeing to ecosystem stress (the opposite of ecosystem wellbeing). It shows how much harm a society does to the environment for its level of development.



(Source: The WellBeing of Nations., 2001)

Chapter 4

Materials and Methods

Mankind is dependent upon natural resources for it economies and to fulfill all the necessities of the life. So human beings have significant impact on earth in term of utilization of the natural resources (Zhao et al., 2005). In the whole process human being are converting all the natural resources from a higher entropy level to the lower level. But during this process an extra entropy is created that is shifted to the out world in term of burden on earth (Spangenberg., 2002). Of course, our surrounding environment and even our environment have a threshold capacity to bear this burden. In addition to the environment and economy the third most important dimension of the utility and the production is the society. Norms, ethics, behavior and attitude of a group of peoples is most important towards natural resources and defining the economical patterns. By recognizing the three dimension of the human existence on the earth it was necessary to measure that where we are and how much further we can go in order to 'meet the needs of present without harming the needs of future generation" as definied by the Burthland's report.

4.1 Study Approach:

Study approach of this research endeavor under view was designed to have a glimpse of the sustainability evaluation efforts undergoing at international level in general, to analyze the effectiveness of two most promising sustainability indices i-e Human Development Index and Ecological Footprint and to compare these two indices with other famous indices and to discuss the sustainability evaluation for Pakistan in particular.

4.2 Study Design:

Six sustainability indices were selected as under:

- Human Development Index
- Ecological Foot Print
- Environmental Sustainability Index
- Environmental Performance Index
- Wellbeing Index
- Genuine Saving Index

All the reports regarding these indices were collected and analyzed.

For Pakistan, development and environmental indices were evaluated and correlated along with the impact of poverty, population size and growth on each index. The outcomes of correlation studies for development and environmental indices were used to interpret the effectiveness of these indices.

4.3 Data Collection:

Data for analysis of Ecological Footprint and Human Development Index was sought from PhD dissertation of R.Saeed (2007) supervised by the Professor Dr. Derca Mihai and dependent partially on the data from foot print net work organization and living planet reports. Data for population and poverty was collected from census of Pakistan.

4.4 SWOT Analysis

All the reports gathered were analyzed using SWOT analysis. The key tool used presently in planning the national sustainable development includes Strengths, Weaknesses, Opportunities and Threat (SWOT) analysis, which originates from the business management literature and was adopted in the 1980s(Karppi, 2001). The two main components of SWOT are the indicators of the internal situation described by existing Strengths and Weaknesses and the indicators of the external environment described by existing Opportunities and Threats (Tarrados, 2007)

4.5 Statistical Analysis:

Evolution of the Human development Index, Ecological Footprint, Biocapacity, Ecological Deficit/Ecological Reserve, trends in population and poverty were drawn using Microsoft excel spreadsheets.

Correlation studies were performed using SPSS software package. Correlation studies were performed to find out the relationship among 'Human Development Index', 'Ecological Footprint', 'Biocapacity', 'Ecological Deficit/Ecological Reserve', population, poverty and political instability of Pakistan.

Chapter 5

Results and Discussion

5.1 SWOT Analysis

5.1.1 SWOT Analysis of Human Development Index (HDI)

Strengths:

1) HDI is most widely recognized measurement of Human development published by the UNDP in 1990 for the 1st time. It is known as the flapship publication of not only UNDP but also of entire UN system.

2) Its mile stone is sustainability indicators beyond the domain of the economic indicators like gross national product (GNP) and gross national product (GDP).

3) There are three basic dimensions of human Development. (a) A long healthy life (measured by life expectancy, (b) Knowledge (measured b y adult literacy rate), (c) A decent standard of living (Measured by GDP growth). Human right to spend a good life has been given special emphasis in this index.

4) A quite simple method of calculation has been adopted as the three sub-indices are weighted equally and aggregated by arithmetic mean.

5) There is a Focus on socioeconomic dimension of human development.

6) Moderate number of indicators.

7) It has largely attracted the attentions of the politicians, policy makers and the public.

8) It is used as a path way to achieve millennium development goals.

9) By measuring the HDI, UNDP locates the resource-poor-segments of a country and guide the governments in creating necessary institutional framework and procedures.

Weaknesses:

1) Flawed definition/philosophy of human development or more specifically of sustainable human development.
2) Mathematical equations that are utilized to generate the HDI are no doubt simple but arbitrary and unjustified.
3) Calculation methodology has been changed over time and again, that indicates the uncertainty and doubts of the creating body about the metholdogy.
4) Unreliability of the data quality and incomplete coverage.
5) Missing ecological components without which it would be impossible to define sustainability.
6) GDP, a measure of economic growth does not portray actual disparity and inequality among nations.
7) It is created by a team of economists and cultural, technological and environmental perspectives are not integrated well.
8) It specifically pays attention to the national performance but not to the sustainable development from global perspective. For example concept of "common goods" has been ignored while devising HDI.

9) Inequality considerations have not been taken into account while evaluating performance of component indices.

Opportunities:

1) Need for more refined HDI by resolving technical issues to contribute towards best possible measurement of sustainable human development.
2) UN is the only platform accepted world wide by all the nations. So HDI is the most accepted index. If worked out properly it would become an important tool for measuring sustainable development/human development.
3) It mould contribute to diminish inequality in by adding new components to the HDI or at least HDR.
4) Balanced weightage should be given to the different type of capitals namely natural, social and human capital.
5) It should fulfill the heeds of sustainable human natural resource management and development.
6) Need of consensus development over components of a comprehensive index.
7) Two dimensions of prism of sustainability i-e economy and society have been paid maximum emphasis in HDI, environment must also be given due importance.
8) By finding out gaps in the countries sustainability/human development, the role of UN and developed nations could be worked out.
9) It can help policy makers to device plans and policies that may lead to sustainable development.

Threats:

1) The aim of measuring human development is accomplished well using current methodology for HDI.
2) Flawed definition, which lacks many important components which must be considered. Ambiguous calculation method and data errors may harm its effectiveness and performance.
3) Without including ecological component, UN's claim to measure human development seems to be false.
4) Inequality considerations are not taken into account, and inequality gaps between developed and developing world, is not checked by UN.
5) Erroneous data and unjustified method of calculation produces unreliable results.
6) UNDP's goal of achieving sustainable human development would not be achieved, if effective measurement procedures are not adopted
7) Measurement of human development using current methodology categorizes different nations and apparently wealth of nations is exhibited instead of human sufferings and deprivation based on social stratification on the basis of present scenario would enlarge social and economical inequality.

5.1.2 SWOT Analysis of Ecological Footprint (EF) Index.

Strengths:

1) It measures human demand on bioproductivity by a given population using prevailing technology and resource management scheme.
2) It measures how much of the generative biological capacity of the planet is demanded by the human activities.
3) It calculates the direct and indirect impacts of production and consumption on the environment
4) It utilizes global hectares as measurement units that denote world's average productivity for a given year.
5) EF can be calculated for an individual people, group of people (such as nations) and activities (such as manufacturing of products).
6) Carbon footprint refers to the quantity of carbon dioxide emission in terms of carbon dioxide equivalents.
7) EF treats the 'waste' differently with every category that is associated with every human activity.
8) EF is based upon the 'equivalence factor' that is calculated by assigning empirical based weighting coefficients to the commodities of available data.

Weaknesses:

1) Concept of EF strictly follows the Principle of consumer's responsibility for emission of green house gases that is in contrast to the producer's responsibility that is basis of Kyoto protocol.
2) EF is not an indicator of the state of biodiversity.
3) The EF has totally ignored the other dimensions of the society such as human health and the well-being of society.
4) It gives a quantitative measure of burden over natural resources but it can not draw conclusion that who should be using what.
5) It fails to address the sustainability of consumption that it was originally conceived to do.
6) It limits the end user's understanding due to its inherent complexity of methodology.
7) Rather than measuring the sustainability, it measures the resource inequality between two areas.
8) Arbitrary boundaries are made for the cross country comparison.
9) It measures the production at the source only, but due to globalization interrelatedness has increased, due to globalization.
10) Land degradation that is the most important issue regarding sustainability is not addressed in the EF.

Opportunities:

1) A combination of all aspects of sustainability would be appealing.
2) It may act as a bridge between ecological and economic systems with modification in its methodology and individual components.
3) It may act as policy and planning tool for environmental sustainability.
4) As it is an indicator of carrying capacity available for human use, it may be used to setup resource consumption boundaries.
5) Green house gases (GHG) emission is increasing continuously day by day, by giving GHG extra importance it may put a limit on GHG emission.
6) If worked out properly and other dimensions of sustainability are also included it can act as leading sustainability index.

Threats:

1) EF would become an environmental indicator but not a tool for policy making for sustainable development.
2) If not modified further it would fail to link economic development to the environment.

5.1.3 SWOT Analysis of Environmental Performance Index (EPI).

Strengths:

1) It comprises of 25 indicators that address 6 policy pillars namely, environmental health, air pollution, water, biodiversity & habitat, natural resources and climate change.
2) These indicators are goals of treaties/international agreements, standards of international organizations, national/international regulations or scientific census.
3) These 25 indicators are divided into two major policy categories i-e. 'Environmental health' and 'ecosystem vitality'.
4) Individual indicator is calculated for each category, summed up and Environmental Performance Index is calculated by taking mean of two categories.
5) Countries with data gap (sufficient data is not available for calculation index) are skipped.
6) Target is set for each country based upon international treaties/agreements, a proximity-to-target value is calculated which gives a realistic guideline to policy makers.
7) There is strong correlation between indicator and index that is the most prominent property of an indicator as depicted by environmental health, water pollution, climate change and natural resources.
8) There is no deliberate bias of the index results against a few countries.
9) The results could be reproduced very easily.
10) Relationship of the indicators to the millennium development goals is obvious.

11) Agriculture is given proper importance which is center of food production and important constituent of environmental sustainability.

Weaknesses

1) Still there is no consensus upon method of calculation for a sustainability index; weighing and aggregation methodology used for the calculation is still controversial.
2) Countries may obtain value more than the maximum assigned value that is adjusted by a method known as winsorization.
3) Environmental Health Category has been assigned a due weightage of 25% and there is no section given for the status and consumption of natural resources.
4) In Ecosystem Vitality category, climate change indicator is given maximum weightage (50% of Ecosystem Vitality category and 25% of overall EPI).
5) Its seems that indicators are selected randomly.
6) As indicated by its name, main focus is environment; where as other components of sustainability like economy, culture etc have been ignored altogether.
7) Errors have been noticed not only in raw data but also in measurements.
8) Emphasis is given on accountability of effects of environment on human health effect of anthropogenic activities on environment has not been given due importance.
9) Most of wealthy OECD countries have scored higher, as they have batter score in Environmental Health category but failed to score batter in climate change and natural resource categories.

Opportunities:

1) It can act as guideline for policy makers in the fields of biodiversity, climate change, natural resource management, pollution control and environmental health.
2) It can help to select some useful environmental indicators for devising a comprehensive index for sustainable human development.
3) If EPI is adopted with slight modifications according to the desires of the different nations, the need for devising new indices will be over
4) Targets set by international treaties and agreements can be conformed by adopting the EPI.
5) It can be helpful for sustainable agriculture and to increase food production-one of the biggest problems of today's world.
6) Results can be rechecked due to their easy reproducibility.

Threats:

1) As method of calculation has been changed continuously, so it may harm its effectiveness and validity, of EPI
2) Based upon the calculation methodology, controversies have arisen while categorizing the countries.
3) In environmental spectrum, some indices are over emphasized while others have neglected.
4) Randomly selected indicators have harmed its effectiveness.
5) It would become only an indicator of environment as other component have been neglected.

6) Erroneous data leads to the ambiguous conclusions.

7) Spectrum of inequity has been broadening as richer countries have been ranked higher usual.

5.1.4 SWOT Analysis of Environmental Sustainability Index (ESI).

Strengths:

1) ESI consists of 76 data sets and 21 indicators which cover five major categories namely; environmental system, reducing environmental stress, societal and institutional capacity to respond environmental challenges and global environmental stewardship.

2) It is based upon pressure-state-response environmental policy.

3) The main objective of the ESI is to compare the sustainability of the countries. Values of ESI varies from 0 (most unsustainable) to 100 (most sustainable).

4) The ESI methodology consist of six steps; selection of countries, standardization of the variable coverage and indicator coverage, transformation of the variable (for imputation and aggregation procedure), substitution of the missing data using the multidimensional imputation algorithm, winsorization of data, aggregation of the data to the indicators and final score of ESI.

5) It covers some dimension of sustainability comprehensively like natural resource depletion, pollution and ecosystem destruction, forest and ecosystem protection, population density and ecosystem vitality.

6) ESI is being considered as a powerful tool for tracking environmental performance, designing policy responses, environmental analysis and decision making.
7) Due to analytical nature of ESI, environmental management has become more quantitative, empirically grounded and systematic.
8) Sustainability may have different meanings for developing and developed nations. So both of them require entirely different scenarios for policy. In ESI attention has been paid to problems within different societies.
9) ESI may help to identify the particular issues within a country, its comparison with the other countries facing similar problems is also done.
10) ESI provides a link to the Millennium Development Goals.

Weaknesses:

1) Increased popularity of the ESI is due to the reason that it is promoted by the powerful world economic forum and strong media.
2) Like all other sustainability indicators ESI has to suffer from serious and persistent data gaps.
3) A number of environmental issues and policy pillars like quality of waste management, land destruction. Soil erosion and certain type of pollution exposure have been ignored.
4) Maximum capacity of the natural resources that they can offer for economic development without degradation has not been taken into account.

5) Modeling techniques have been utilized to overcome data gaps, measurement errors, systematic errors, human errors and missing data sets.

6) ESI seems to have created some bias for rich countries as they have performed better in ESI than the other countries which do not seem to be realistic.

7) ESI should pay attention to the environmental problems caused by the developed nations and those problems that have no geographic boundaries.

8) Analysis of relationship between GDP and ESI showed that they have a stronger relation for wealthy nations as compared to the poor ones.

9) Vision and philosophy behind the ESI is confused i-e three components namely environmental system, social and institutional capacity and global stewardship has positive relationship with GDP per capita, where developed nations are scoring excellent, while environmental vulnerability suggests a U shaped relationship. While in case of stress placed on environment, developed nations have scored worst.

10) Environmental sustainability should be discussed into four steps; maximum threshold values offered by the natural resources for economic development without degradation, environmental degradation by anthropogenic activities, effects of degradation and environmental management. ESI has created a confusion regarding these four steps and failed to address them comprehensively.

11) ESI has rejected any correlation between environmental problems. While for most of the time they are interlinked.

12) An ambiguous procedure has been adopted for obtaining z-scores.

Opportunities:

1) ESI covers a wide number of issues.
2) Pressure-state-response environmental policy gives an opportunity to judge the effects of human activities on environment and response of society back to those problems.
3) Clear and distinct steps of methodology would help to make further improvements in it.
4) Due to comparative analysis between countries for ESI, tracking policy rules have become easy to define for different countries to solve their problems.
5) By further improvements it may provide a comprehensive guideline for sustainability for both developed and developing nations.
6) It has become very easy to track development in attainment of MDGs and other international goals.

Threats:

1) Without bridging the data gaps, the aim of the ESI would not be achieved.
2) Approaches like working behind ESI would lead to the conclusion that wealth is batter than environment which is not acceptable.
3) Spectrum of inequity would be broadening as powerful and wealthy nations maintain their privileged place as result of such indicators.
4) Support of the powerful forum may not necessarily guarantee the validity and effectiveness of the index.

5) If methodologies may not be changed significantly, it will purely be an index of developed nations carving a false picture of their sustainability.
6) Without making clear philosophy behind the ESI, it is not possible to gauge practical results.

5.1.5 SWOT Analysis of Genuine Saving (GS).

Strengths:

1) World Bank devised an indicator to assess a sustainability of a country's economy beyond the traditional methods of calculation economy.
2) Loss in standard national accounts due to depletion of natural resources, pollution damages, welfare loss in the form of human sickness and health, expenditures on education and human capital are taken into account in this index.
3) GS saving gives an overall over view of wealth created and consumed.
4) Negative values of the GS predicts that a country is following an unsustainable path that would be harmful for welfare and development in long term
5) All the indices included in the GS belong to weak sustainability criteria.
6) The most promising feature of GS is taking into account of human capital as it tries to comprehend the sustainability in three dimensions i-e. physical, natural and human capital.

Weaknesses:

World Bank itself has recognized a number of short comings in the GS.

1) Data is collected from unreliable tax records without its reference to the real time results.
2) Only those natural resources have been taken into account that has proven to be of industrial and economical importance.
3) All other types of the natural resources like water, soil, forest cover, water shed and all types of energy have been ignored.
4) Carbon dioxide is considered only as a potential pollutant. All other types of pollutions and pollutants have been ignored.
5) Expenditures on human health, welfare and education are considered as a loss of income.
6) Relationship between environment and the economy is not as simple as it appears to be in the GS.
7) GS calculations entirely depends upon GDP calculations whatever the domain may be.
8) Richest OECD countries have scored maximum, as they have largest GDP reserves in the world. Despite the fact that natural resource consumption and depletion is maximum in these countries.
9) Economy is treated as self sufficient system rather than as finite subset of ecosystems.
10) Natural resource consumption scenario is ignored by the GS.

Opportunities:

1) It can act as 'national balance sheet' for economy and money capital accounting.
2) It gives a good estimation of the investment in the field of education and human capital management.
3) As for sustainable development we are dependent upon assets namely human and natural capital. Human capital strategy of the GS can be utilized for a sustainable development index.

Threats:

1) Unreliable data affects the effectiveness of the index.
2) Useful results couldn't be drawn for policy making, planning and implementation as data has no reference to real time results.
3) Its an effort to divide the world into two groups namely rich and poor on the basis of materialistic and inequality approaches.
4) The neoclassical economist way adopted for the calculation of GS is causing a crisis both in environmental and economic space.
5) Economy is expected to suffer severe shocks due to over exploitation of natural resources. After attaining a certain maximum value it would suffer a short fall.
6) Both economy and environment can not be sustainable by applying the non-conservatory approach of GS.

5.1.6 SWOT Analysis of Well-Being Index (WI).

Strengths:

1) In 1990 the 'World Conservation Union' (IUCN) and the 'International Research Center' developed an index based upon the Robert Prescott-Allen's Barometer of sustainability.
2) The philosophy of the well-being index depends upon its comparison to an egg which is good only when both egg white and yolk are well. Similarly, a society can be well if both the ecosystem and the human beings are well.
3) Calculation method is based upon international target, national standards and expert opinion.
4) It includes the dimensions like conservation of biodiversity, quality of natural land, water, ecosystems, restoration of the chemical balance of global atmosphere, the quality of local air, monitoring of all wild species and the genes in domestic species and keeping resource, within the carrying capacity of ecosystems.
5) Well-Being index is further divided into two indices namely Human Well-Being Index (HWI) and Ecosystem Well-Being index. While Well-Being Index/Well-Being stress Index gives a comparison of two.
6) Human Well-Being Index included indicators like health, population, life longevity, wealth, knowledge, culture education, communication, community freedom, governance, peacefulness violent crime rate, equity, house hold equity and gender equity.
7) EWI includes land, water, air, species, genes and resource use.

8) People and ecosystems are given equal weightage.

9) It uses seven staged cycle consisting of flexible user based methodology.

Weaknesses:

1) Almost half of the world has been reported with bad EWI.

2) Calculation methods and method sources are not specified.

3) The elements of the EWI are not closely correlated.

4) Two third of the world's population lives in countries with bad HWI; less than one sixth country are with a good or fair HWI. The disparity between the best and the worst is huge. The average HWI of the top 10% countries is almost eight times that of bottom 60%.

5) No country has been ranked as sustainable or near sustainable, 116 countries are running at double deficit, while 114 countries have higher ecosystem stress than the human well being.

Opportunities:

1) Robert Prescott-Allen's Barometer of sustainability can be helpful to trigger out an index for sustainability.

2) It provides a path to reach international standards and targets set in international agreements.

3) It provides and opportunity to address the two pillars of sustainability i-e. human being and ecosystem and stress posed by the human activities on ecosystem.

4) It provides a link to the carrying capacity of the ecosystems which may define the maximum capacity of the ecosystems to provide resources for sustainable development.
5) Burden of the human activities on ecosystem can be traced out in terms of well being stress index

Threats:

1) It missed the third component of sustainability i-e. economy. Although it included an index in "the Human Well Being Index". But it needs to be addressed comprehensively.
2) Without specifying data source and calculation method, validity and importance of the index is not very effective.
3) It has ranked the entire world to be running at ecological deficit, which could be a discouraging impact for ecological sustainability efforts.
4) Well-Being Index has ranked the world into good, fair or worst. But the disparity seems to be huge. It appears to divide world into categories.

5.2 Comparative Analysis of Indices:

Attempts to develop indicators to improve decision making are long standing in the areas of sustainability (Hodge., 1997; Seasons., 2003). An impressive number 0f the sustainability indices has been developed so far (OECD, 2002; Ness et al., 2007; Table 5.1). Some of the commonly used and newly developed sustainability indices are discussed here. Most of these indices use the data controlled b y the United Nations or by other international agencies. Many of these indices use similar type of data but the results may vary due to difference in their methodologies, calculation methods and philosophies. It definitely creates confusion for the sustainability efforts. Data reliability is a major concern for almost all the frameworks. Another inherent problem with the sustainability assessment efforts is that more than 50 definitions of the sustainable development were listed by the several organizations and individual researchers between 1979 and 1997 (Udo and Jansson., 2009). So each index deals with the sustainability according to its own definition. For the sake of simplicity, these indices have been analysed on the basis of triple bottom line approach for the sustainability as reported by the authors such as Valentin and Spangenberg, 2000; Rogers and Ryan, 2001; Wheeler and Elkington, 2001 and Capello and Nijkamp, 2002. And further for the result reliability, individual characteristics of the indices were analyzed, as listed below.

For data collection all the sustainability indices consider the political boundaries while many sustainability issues like flow of people, commodities and most of the environmental issues do not observe these boundaries that create an element of uncertainty in the sustainability evaluation/assessment. (Mayer., 2008). EF, EPI and

ESI all deal with the environmental sustainability in broader terms but all consider the political boundaries for the data collection and sustainability assessment. Moreover, environmental issues for most of the time are dynamic in nature. EPI and ESI calculate the environmental sustainability in static way. Only EF has been quite successful to address the problem in a dynamic way.

Large number of indicator for each index also creates an issue. Greater numbers of indicator make the calculation long, laborious and difficult to deal with. More over an indicator is included in an index when it is considered to be most important for the sustainability issues. But if reliable data is not available for that indicator it affects the effectiveness and efficiency of the overall index as sufficient data is not available for most of the times for all the indicators included in an index. EPI, ESI and WEI have to face this problem. While EF and GS include the indicators based upon available data which may affect their comprehensive nature ((Parris and Kates, 2003; Esty et al.,2005; Morse and Fraser, 2005; Lindholm et al., 2007; Ness et al., 2007; OECD, 2002; Anonymous, 2007).

Again, weighting and normalization put a question mark on validation of the sustainability indicators. As each indicator has to deal with the large number of data which is required to be normalized but there is no hard and fact rule defined so far. Weighting methods derived by the statistical analysis may not b acceptable for the policy makers while the varied normalization make the comparison between different indices almost impossible (Booysen., 2002; Nardo et al., 2005; Sands and Podmore, 2000; Niemeijer, 2002; Parris and Kates, 2003; Jesinghaus, 2000; Olalla-Tárraga, 2006; Diaz-Balteiro and Romero,2004; Clarke and Islam, 2006).

For most of the time indicators utilization similar kind of data produces different results. This is due to the variation is aggregation method. An aggregation method produces the overall sense of the system. By changing the aggregation method we may have entirely different results from the same set of data. In such cases sensitivity analysis becomes important to the guide the policy makers to the right way (van Kooten and Bulte, 2000; Tran et al., 2007; Zhou et al., 2006).

Table 5.1 Overview of Characteristics of Sustainability Indices

Properties	**HDI**	**EF**	**EPI**	**ESI**	**GS**	**WBI**
Proponent	UNDP	WWF	World Economic Forum	World Economic Forum	World Bank	UNCF
No of Countries	180	148	177	146	104	180
No. of Indicators	4	Depends upon available data	25	76	Depends upon available data	36
Data Source	Multiple	National Records	National Records	National Records	National Tax accounting	Collected by regional offices of IUCN
Data Reliability	Medium	Medium	Medium	Medium	Not Reliable	Lower
Aggression Method	Average	Accounting	Average/Regression Analysis	Average/Regression Analysis	Average	Average

Links of Policy Target	Strong	Strong	Medium	Strong	Weak	Weak
Units of Measurement	Several	Global Hector/Land Area	Several	Several	GDP/capita	Several
Complexity/Type	Dynamic/Simple	Dynamic/Complex	Static/Complex	Static/Complex	Simple/Dynamic	Simple/Static
Normalization		Transformation in square km	Best=100 Worst=0	Standard Deviation	Monetarized	Best=100 Worst=0
Weighting	Equal	Equal	PCA and experts	Equal/experts	Equal	Subjective(not derived)

5.3 Assigning the Weightage to each index

Keeping in view triple bottom line for sustainability, indices discussed above are assigned weightage. Each of three aspects of sustainability (Environment, Social and Economic) were given a total score of 3. Each index was assigned a score out of 3 for each dimension of prism of sustainability depending upon its ability to deal with it. Finally these values were summed up to obtain aggregate value for each index. According to these calculations no index was able to deal with all the three aspects effectively.

Table 5.2 Assigning Weightage to Indices on The Basic of Prism of Sustainability

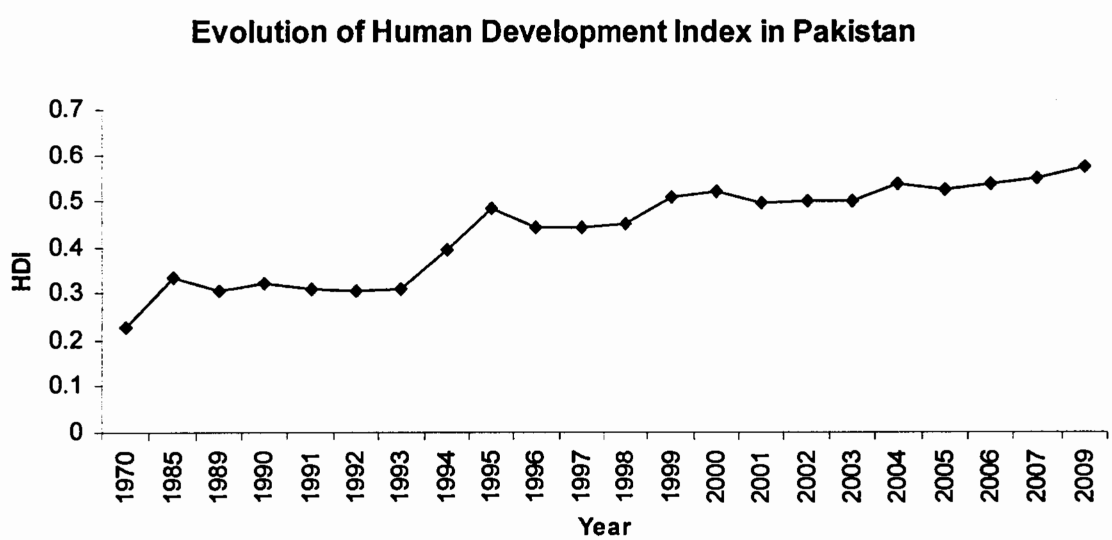
Index	Environmental Aspects	Social Aspects	Economic Aspect	Aggregate
HDI	0	2	2	4
EF	3	0	0	3
EPI	2	1	0	3
ESI	1	1	0	2
GS	0	1	2	3
WBI	2	2	0	4

5.4 Trends in Human Development Index (HDI), Ecological FootPrint, Biocapacity, Ecological Deficit and Ecological Reserve/Ecological Deficit for Pakistan.

5.4.1 Trends in HDI.

Fig 5.1 shows the evolution of the HDI in Pakistan. Since 1970 to 2009 it shows an increase from 0.226 to 0.572. This is not an appreciable increase in such a long period of 29 years. Whereas still there is long way to go in order to attain the value of 0.8 which is considered to be value for sustainable development. Increase in HDI value is contributed by the increase of each of three elements of the HDI i-e. life expectancy, education and GDP/

Fig 5.1

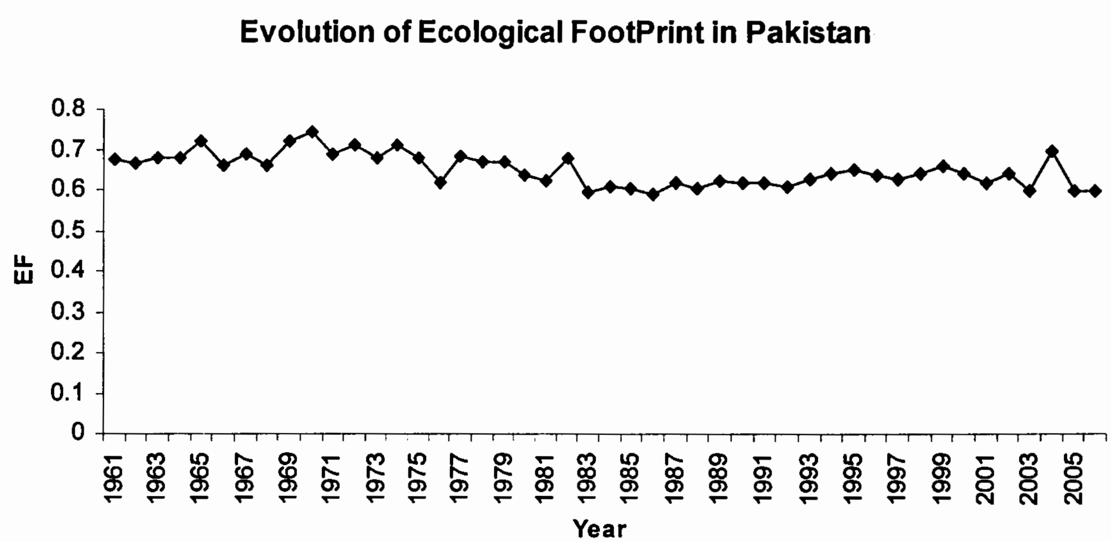


(Data Source: HDR 1990-2009)

5.4.2 Trends in Ecological Footprint (EF)

Fig 5.2 shows the evolution of the Ecological Footprint (gha/ person) for Pakistan. The EF of Pakistan was 0.673 in 1961. This followed a varying trend in different years. It was maximum in 1970 i-e, 0.75 and minimum in 1986 i-e 0.59. The difference between maximum and minimum values of the ecological was 0.16 during four and a half decades which is not a big value. The overall EF makes Pakistan fall in a category of very low consumption pressure. For value of EF 1.8 gha/person is considered to be threshold above which is considered negative. Pakistan has a very low value as compared with the threshold value which denotes very low quality of life as a whole and which has not improved appreciably during last four and a half decades.

Fig 5.2

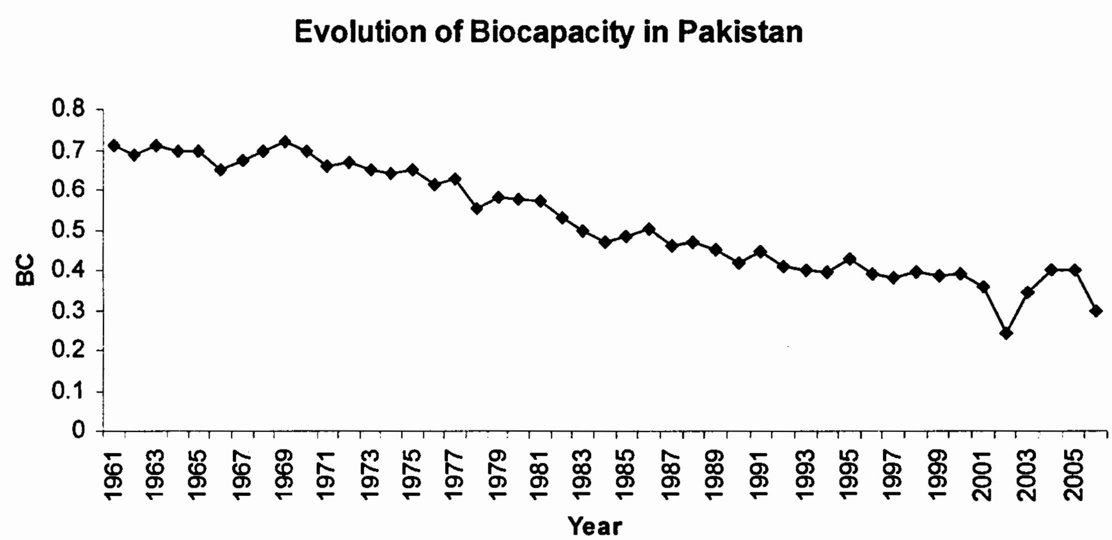


(Data Source: Living Planet Reports)

5.4.3 Trends in Biocapacity of Pakistan

Biocapacity measures how biologically productive land is. Fig 5.3 shows the evolution of Biocapacity in Pakistan and depicts a remarkable decline in BC from 0.712 (g ha/ person) in 1961 to 0.3 (g h/ person) in 2005. The BC of Pakistan is further expected to decrease if the same pattern is followed in coming years. The observed decrease is mainly due to rapid increase in population and successive distribution of global hectares per person (cropland, grazing land, forests and fishing grounds).

Fig 5.3

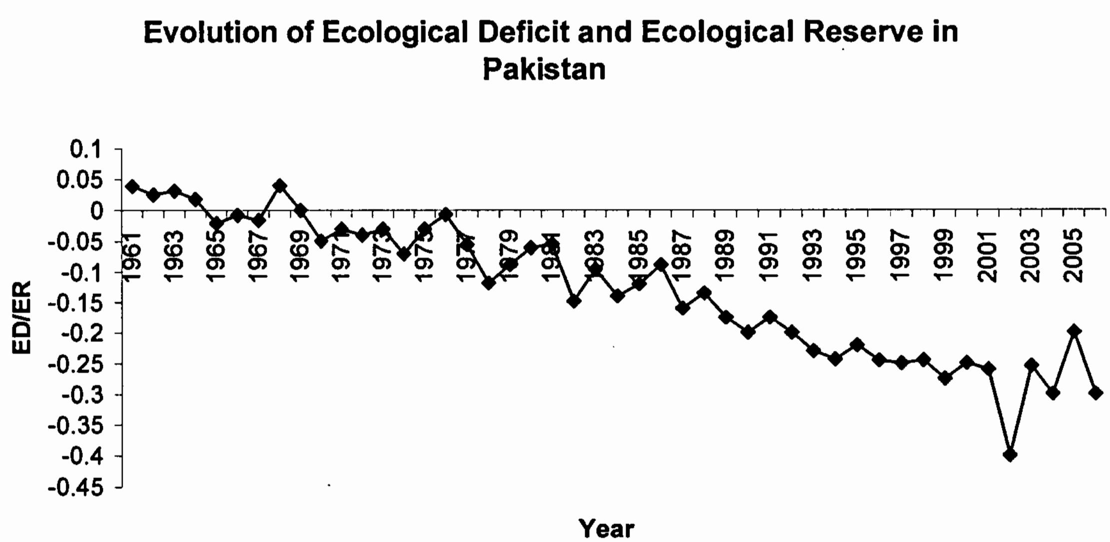


(Data Source: Living Planet Reports)

5.4.4 Trends in Ecological Deficit/ Ecological Reserve (ED/ER)

Fig 5.4 shows that Pakistan was enjoying an Ecological Reserve till 1961. But after 1964 the situation started to get worse. There was a steady decrease in ER(termed as ecological deficit below value of zero) and it reached -0.3 in 2006 which seems to be reducing further following the same pattern. So country was running at an Ecological deficit of 0.3 in 2006. Decrease in value of ER or increase in value of ED is mainly due to population boom, excessive pressure on resources and consequent degradation of natural resources.

Fig 5.4

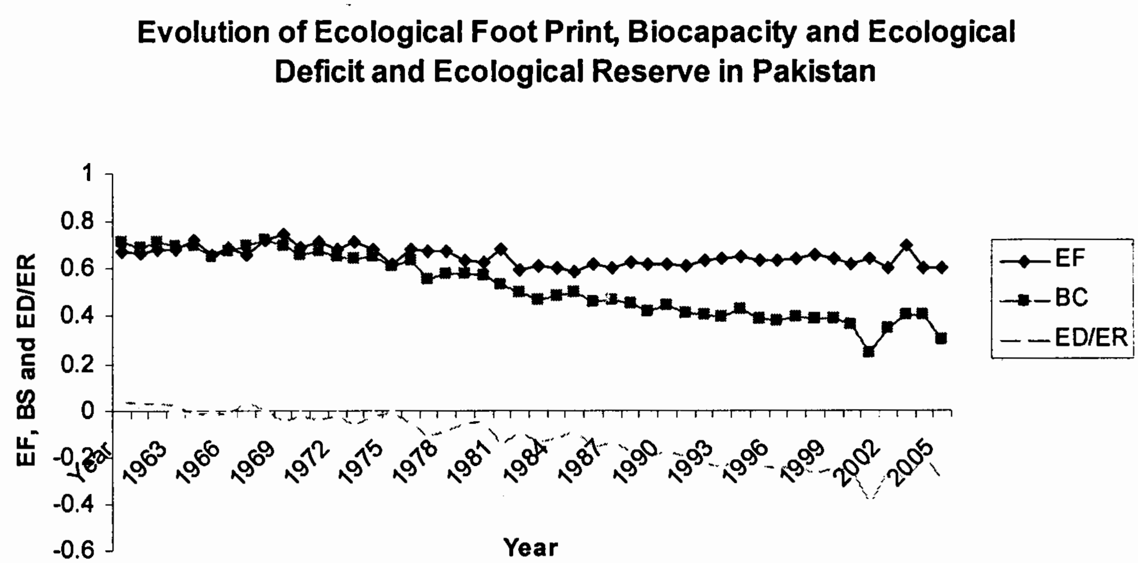


(Data Source: Living Planet Reports)

5.4.5 Comparison in Trends of Ecological Footprint, Biocapacity and Ecological Deficit/Ecological Reserve

Fig. 5.5 exhibits the evolution of Ecological footprint, Biocapacity and Ecological deficit/ecological reserve and sketches a holistic picture of trends for Pakistan. Although Ecological Footprint of Pakistan is much less than the other nations of the world; but when it is compared with Biocapacity, picture is quite disappointing.

Fig 5.5



(Data Source: Living Planet Reports)

5.4.6 Trends in Population and Poverty of Pakistan

Fig 5.6 and 5.7 shows trends in population and poverty of Pakistan, respectively. Population of Pakistan has increased from 39,448,232 in 1950 to 174,579,000 in 2009 at an average growth rate of 1.60 (Census of Pakistan). According to World Bank, report poverty rate has declined to 17.2% in 2007-08 as compared to 22–26% in the fiscal year 1991(World Bank 2009) .

Fig 5.6

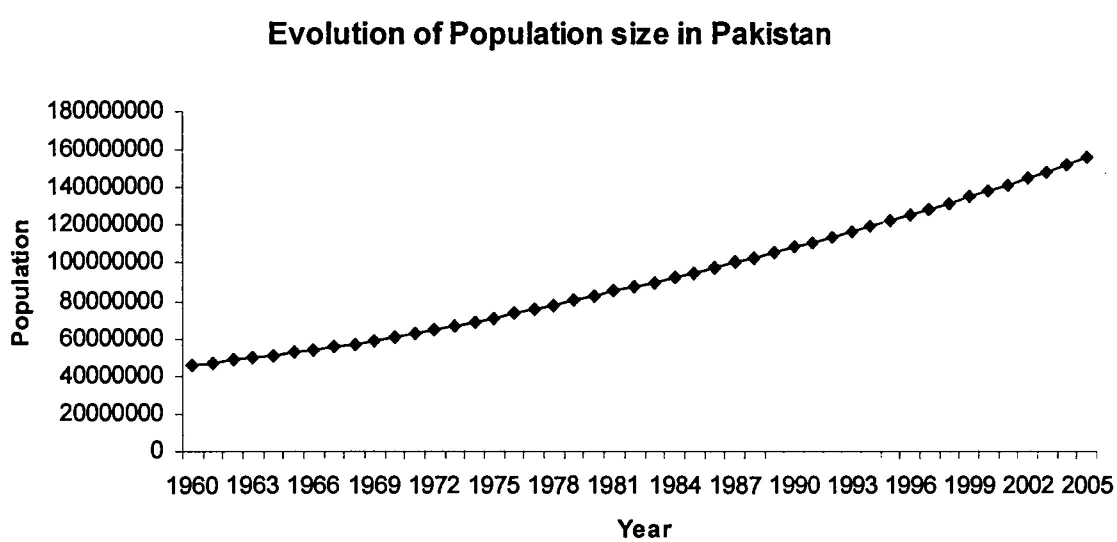
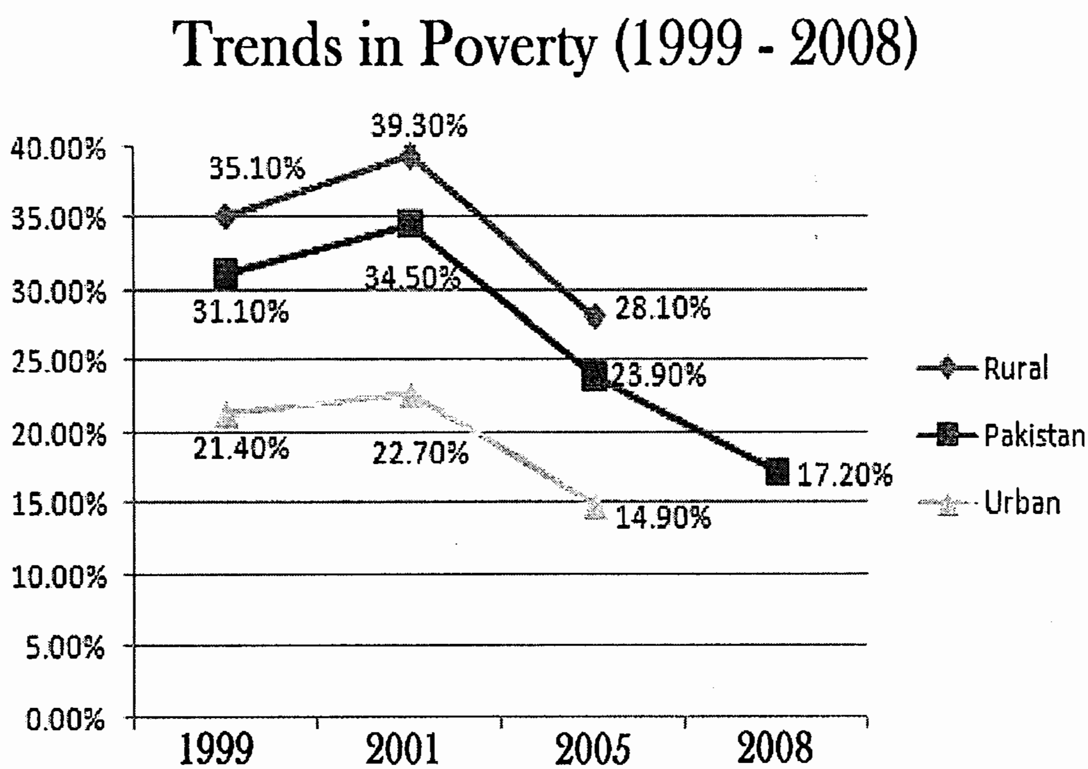


Fig 5.7 Trends in Poverty for Pakistan



(Source: World Bank., 2010)

5.5 Political Instability in Pakistan

Pakistan bears world's one of the largest Muslim populations of the world and is strategically one of the most important countries of the world. But unfortunately the country has to suffer a lot due to ongoing power struggle between presidents, prime ministers and army chiefs since the time of independence. Pakistan has had five constitutions, out of which most widely accepted and functional is that of 1973(Kronstadt., 2005). Federal parliamentary system is followed in the country according to constitution of 1973, where president is head of state, prime minister is head of government and commander in chief is head of armed forces. In sixty three years after its independence, Pakistan had to cope with the four military interventions, first was staged by General Ayub Khan (1958), followed by General Yahya Khan (1969), General Zia ul-Haq (1977) and, finally, General Pervez Musharraf (1999) (Shah., 2005). Governments were dissolved again and again either by the presidents due to conflicts with the prime ministers or over ruled by the military chiefs. The decision making regarding development, environmental conservation and management of resources (both human and natural) has suffered a lot due to political instability in the country.

5.6 Analysis of National Human Development Report of Pakistan (2003)

So far only one Regional Human Development Report has been published so far for Pakistan entitled "POVERTY, GROWTH AND GOVERNANCE". This report aims to interlink economic recession and institution governance to the poverty.

In its first chapter, analyses the economic crisis in Pakistan and links it to the poverty. Whereas there should have been also be an attempt to analyze the extreme poverty as a cause of economic crisis.

In second chapter, GDP growth, economic development, agricultural gro wth and poverty eradication have been discussed in different political eras along with the respective plans.

Chapter three aim to answer some of the questions like (i) who are the poor (ii) What pushes them into poverty and (iii) what are the mechanisms which keep them poor? And draws some conclusions.

Chapter four elaborates the role of the private sector and NGO's at different levels of society for poverty reduction.

Chapter five presents the strategic plan for 1) economic growth, 2) poverty elevation. Economic Growth plan aims to achieve rapid GDP growth based upon pure economic policies where as environmental perspective of the economic growth has been ignored altogether.

In case of poverty elevation strategies, main focus is to empower women for poverty reduction while the second important point is to provide access over input and output markets and increase their productivity and income on sustainable basis (nhdr-Pak., 2003).

Having an overview of the contents of national human development report of Pakistan, environmental content was found missing in it, altogether. It is entitled "POVERTY, GROWTH AND GOVERNANCE". Environmental conditions of the country and its relevance to the society and economy has entirely been ignored.

First chapter of the report addresses the economic crisis and poverty. Pakistan is an agricultural country and economy of Pakistan largely depends upon the agricultural production. Which has direct link to the environment. Water crisis is discussed only in terms of fulfilling agricultural requirements. Discussion on general water issues including sanitation, provision of clean drinking water to the public, decreasing water table etc. is missing. Agricultural production is affected by the soil erosion, water salinity, changing weather conditions, and cropping patterns. Rapid increase in population is also a reason of the failure of our current agricultural system as we need to reestablish our agricultural system on modern technological basis. Most of our poor folk living is villages depends upon agricultural production either directly or indirectly. They are the worst affected ones by environmental degradation. The report has failed to address all these issues. Environmental conditions such as climate change, loss of biodiversity, deforestation, desertification, water logging, soil erosion are major reasons of our declining agricultural production. There is no explanation given to these issues in the report.

Economic development and GDP growth depend upon agricultural production and industrialization. Agriculture is all about environment and condition of natural resources while industry indirectly depends upon the natural resources for raw materials. Whereas according to the data analyzed ecological deficit of the Pakistan would become -0.4 in 2010 and seems to increase further during coming years. In addition, rapid industrialization is also exerting a burden on natural resources. For gaining low cost production, technological aspects are ignored and industry is depredating environment in terms of water pollution, air pollution and soil deterioration.

In the last section of the report, strategic plan is put forward for the economic growth and poverty alleviation. Again environmental policy, planning and implementation section is not there.

5.7 Correlating the Population Size / Population Growth and Poverty with Human Development Index, Ecological Footprint, Biocapacity, Ecological Deficit/Ecological Reserve for Pakistan:

5.7.1) Correlation between Population Growth and Human Development Index:

Hypothesis:

There is a negative correlation between population growth and human Development Index.

Table 5.3

Correlations

		population growth (annual%)	human development index
population growth (annual%)	Pearson Correlation	1.000	-.765**
	Sig. (2-tailed)	.	.000
	N	46	19
human development index	Pearson Correlation	-.765**	1.000
	Sig. (2-tailed)	.000	.
	N	19	20

**. Correlation is significant at the 0.01 level (2-tailed).

Number of observations for the analysis was nineteen for human development index(1970-2009) and 46 for annual population growth(1960-2007). In order to find the correlation between two variables, significant two tailed alpha value was 0.01. While Pearson Correlation was found to be -.765, hence it was proved that the hypothesis was correct. With an increase the population size, human development index decreased significantly.

5.7.2) Correlation between Population Size/Population Growth and Ecological Footprint

Hypothesis:

a) There is a positive correlation between population growth and ecological footprint.

b) There is a positive correlation between total population size and ecological footprint.

a

Table 5.4 a

Correlations

		population growth (annual%)	evolution of ecological footprint
population growth (annual%)	Pearson Correlation	1.000	.519**
	Sig. (2-tailed)	.	.000
	N	46	45
evolution of ecological footprint	Pearson Correlation	.519**	1.000
	Sig. (2-tailed)	.000	.
	N	45	46

**. Correlation is significant at the 0.01 level (2-tailed).

Number of observations for the analysis was forty five (46) for Ecological Footprint(1961-2005) and forty five (45) for annual population growth(1960-2007). In order to find the correlation value between two variables, significant two tailed alpha value was 0.01. While Pearson Correlation was found to be 0.519. Hence it proved that our hypothesis is correct with an increase in population, ecological foot print also increases.

b

Table 5.4 b

Correlations

		POP	EF
POP	Pearson Correlation	1	.181
	Sig. (2-tailed)		.223
	N	47	47
EF	Pearson Correlation	.181	1
	Sig. (2-tailed)	.223	
	N	47	47

POP=Population, EF=Ecological FootPrint

The number of observations for total population and ecological footprint was 47 for each variable. Pearson correlation found was 0.181 showing that there is no significant relationship between total population and ecological footprint. Hence it is proved that hypothesis is false.

5.7.3) Correlation between Population Size and Biocapacity:

Hypothesis:

There is a negative correlation between population size / population growth and Biocapacity:

Table 5.5

Correlations

		POP	BC
POP	Pearson Correlation	1	-.431**
	Sig. (2-tailed)		.003
	N	47	47
BC	Pearson Correlation	-.431**	1
	Sig. (2-tailed)	.003	
	N	47	47

**. Correlation is significant at the 0.01 level

POP= Total Population, BC= Biocapacity

The number of observations for population (1961-2005) and Biocapacity (1961-2005) was 47 for each variable. In order to find out the correlation between two variables, significant two tailed alpha value was 0.01. While the Pearson correlation was -.431, showing a significant inverse relationship between total population and Biocapacity i-e. with an increase in population, Biocapacity decreases. Hence it is proved that the hypothesis is correct.

5.7.4 Correlation Between Population Size / Population Growth and Ecological Deficit/Ecological Reserve.

Hypothesis

a) There is a positive correlation between population growth and ecological deficit.

b) There is a negative correlation between total population and ecological reserve.

a)

Table 5.6 a

Correlations

		population growth (annual%)	ecological deficit/ecological reserve
population growth (annual%)	Pearson Correlation	1.000	.596**
	Sig. (2-tailed)	.	.000
	N	46	45
ecological deficit/ecological reserve	Pearson Correlation	.596**	1.000
	Sig. (2-tailed)	.000	.
	N	45	46

**. Correlation is significant at the 0.01 level (2-tailed).

The number of observations for annual population growth ((1960-2007) was forty six (46) and for ecological deficit (1961-2005) was fort five (45). In order to find out the correlation between two variables significant two tailed alpha value was 0.01. Pearson correlation value for two variables was 0.596 showing a significant relationship between annual population growth and ecological deficit i-e by an increase in population size, ecological deficit also increases.

Table 5.6 b

Correlations

		POP	EDER
POP	Pearson Correlation	1	-.755**
	Sig. (2-tailed)		.000
	N	47	47
EDER	Pearson Correlation	-.755**	1
	Sig. (2-tailed)	.000	
	N	47	47

**. Correlation is significant at the 0.01 level

POP=Population, EDER= Ecological Reserve

The number of observations for population size (1961-2005) and ecological reserve (1961-2005) was 47 for each. For the correlation between two variables, significant two tailed alpha value was 0.01, Pearson correlation value for two variables was -.755, hence a strong negative correlation between selected variables was proved i-e. with increase in population, ecological reserve decreases.

5.7.8 Correlation between Poverty and Human Development Index

Hypothesis:

There is significant negative correlation between poverty and Human Development Index.

Table 5.7

Correlations

		POV	HDI
POV	Pearson Correlation	1	.222
	Sig. (2-tailed)		.133
	N	47	47
HDI	Pearson Correlation	.222	.1
	Sig. (2-tailed)	.133	
	N	47	47

POV= Total Poverty, HDI=Human Development Index

The number of observations both for poverty and human development index was 47 for each variable (from 1961 to 2005). Pearson correlation value was 0.222. It shows a positive but non-significant correlation between two variables. Logically with an increase in Human Development Index, poverty should decrease. The obtained results may be due to data artifact or due to the fact that human development index is not an ideal representative of human well being or deprivations.

5.7.9 Correlation between Poverty and Biocapacity

Hypothesis:

There is a significant negative correlation between total poverty and biocapcity.

Table 5.8

Correlations

		POV	BC
POV	Pearson Correlation	1	-.286
	Sig. (2-tailed)		.051
	N	47	47
BC	Pearson Correlation	-.286	1
	Sig. (2-tailed)	.051	
	N	47	47

The number of observations available both for total poverty and Biocapacity was 47 (from 1961 to 2005). The Pearson's correlation value was -0.286. Hence a negative but non significant correlation was found, showing with an increase in poverty, Biocapacity is not being affected significantly. So the hypothesis was partially true.

5.7.10 Correlation between Poverty and Ecological Foot Print.

Hypothesis:

There is significant positive correlation between two selected variables.

Table 5.9

Correlations

		POV	EF
POV	Pearson Correlation	1	-.036
	Sig. (2-tailed)		.813
	N	47	47
EF	Pearson Correlation	-.036	1
	Sig. (2-tailed)	.813	
	N	47	47

The total number of observations was 47 for each variable. Pearson's correlation value was -.0.36. Which shows a negative correlation between two variables; hence, with an increase in poverty, ecological footprint decreases with deteriorated quality of life. Hence, the hypothesis was proved correct.

5.7.11 Correlation between Poverty and Population:

Hypothesis:

There is significant positive correlation between Poverty and Population.

Table 5.10

Correlations

		POV	POP
POV	Pearson Correlation	1	.335*
	Sig. (2-tailed)		.021
	N	47	47
POP	Pearson Correlation	.335*	1
	Sig. (2-tailed)	.021	
	N	47	47

*. Correlation is significant at the 0.05 level (2-tailed).

The available data was for years ranging from 1961 to 2005. Pearson's correlation value was 0.335, with a positive correlation between two variables. But the correlation is not as significant as it was logically supposed to be. It might be due to data artifact

5.7.12 Correlation between Poverty and Ecological Reserve:

Hypothesis:

There should be a negative correlation between Poverty and Ecological Reserve.

Table 5.11

Correlations

		POV	EDER
POV	Pearson Correlation	1	-.359*
	Sig. (2-tailed)		.013
	N	47	47
EDER	Pearson Correlation	-.359*	1
	Sig. (2-tailed)	.013	
	N	47	47

*. Correlation is significant at the 0.05 level (2-tailed).

The number of observations for the two variables was 47 each (the data ranged from 1961 to 2005). Pearson's correlation value was -0.359. This showed a negative but non significant correlation between poverty and ecological deficit. Though the correlation is not highly significant but it is clarified that the ecological reserves are not depleted as rapidly by the poor as is the case for the rich or developed countries.

5.8 Discussion:

Among sub-indices of Human Development Index, the education index for Pakistan was 0.23 in 1975 and 0.47 in 2007 and still there is a big gap to reach an ideal value of at least 0.8. Pakistan had a life expectancy index of 0.57 in 1975 and hardly attained a value of 0.64 in year 2005. The same is the story regarding GDP index which was 0.37 in 1975 and 0.6 in 2005. Human development index of Pakistan was 0.305 in 1989 and 0.539 in year 2006. Future predictions for the Education Index, Life Expectancy Index and GDP Index revealed that they would increase in case of Pakistan but utmost efforts are required in this regard.

Human Development Index has improved with the passage of time but still there is a long way to go in order attain an index value of 0.8 which is minimum value of HDI to achieve sustainable development.

According to Footprint network organization's data, the Biocapacity and Ecological footprint of Pakistan were 0.3 and 0.6, respectively. While in Living Planet report of 2008 it has been mentioned that the total Biocapacity of Pakistan has become 0.4 with an ecological deficit of –0.4. Ecological foot print of Pakistan is not a threat if seen in global perspective but as compared with the national Biocapacity, it presents a disappointing picture being the almost double of that.

If the value for Ecological Footprint is above 1.8 gha/person, which is a value up to which a country or nation is not harming the earth by over consumption or mismanagement of resources. But above this value, a person or a nation is considered to be consuming resources voraciously and above defined rights to consume.

Pakistan is a developing country facing many serious problems, most important of which are political instability, poverty and rapidly growing population.

Population of Pakistan has increased from 39,448,232 in 1950 to 174,579,000 in 2009 at an average growth rate of 1.60.

According to World Bank, poverty rate has declined to 17.2% in 2007-08 as compared to 22–26% in the fiscal year 1991. Literacy rate is 56.2%, according to the definition that the population above the age of 5 that can read and write is said to be literate.

Pakistan has a total area of 79.61 million hectares, 27% of which is cultivated and 8% of which is in forest area. There are 8.9 million hectares of uncultivated land and 24.4 million hectares which are not available for cultivation (Minfal., 1995). The ratio of cultivated land to population is 0.16 ha per person. Most of 17.2 million hectares of cultivated land are irrigated, with 70% of the water coming from canals and the rest from other sources. Total renewable water resources are 233.8 cu km (2003) while Freshwater withdrawal (domestic/industrial/agricultural) is 169.39 cu km/yr (2%/2%/96%) per capita: 1,072 cu m/yr (2000).

Throughout the human history, human population is subject to continuous increase. Many scientists consider this increase as carcinogenic i-e. "cancer like" occupying the land and water. As a result either destroying the natural resources or utilizing beyond their threshold limits. Some authors like Moles et al., (2008) and Eris (2010) wrote about the population linkages to sustainable development. But specified debate about sustainable human development/ human development index and its correlation to environment is missing in the literature except an effort by Saeed (2007) in his PhD dissertation who correlated environmental resource counting/management with economy/human development (a comparative study of Romania and Pakistan) . A relevant study was that of O'Regan (2009) who described the impacts of population size on Ecological Footprint in Irish villages in small perspective.

Pakistan with limited natural resources, poor economy and a population growth rate of 1.6, is under serious crisis. Major aim of the economic policies being provision of food, shelter and living necessities of life to the rapidly growing population. As a result sustainable development or environmental sustainability has become a secondary option. Pakistan is experiencing rapid industrialization, but environmental concerns have been ignored altogether in order to provide cheaper stuff to the poor folk. Major points of concerns of the economic policies are to increase per capita income, to increase the literacy rate of masses and to provide basic health facilities to the people. As a result, there is slow pace of improvement in human development index. Besides this, as far as condition of natural resources is concerned, situation is alarming. More people mean more food, more stuff and shelters and other necessities of life that put an extra burden on natural resources or their utilization beyond exhaustible limits.

Poverty may not be necessarily the major cause of environmental damages. But poor folk lacks basic necessities of life, lack food stuff, shelter, education, health care facilities etc. Tagging t he country back in the efforts to achieve sustainable human development. Moreover, poor masses are more vulnerable to the environmental disasters and are more likely to damage the environment as they are unaware of its importance.

Political instability may be the root cause of all the problems that Pakistan has failed to tackle unlike is many other countries, despite its age of sixty years. Pakistan had to face uneven power structures, frequent and sudden changes in government. This political instability has interrupted and disrupted the policy making, planning and implementation (Khan and Heuvel., 2007). Policy making planning and implementation are three primary pillars in a state's development.

Chapter 6

Conclusion and Recommendations:

6.1 Measuring Sustainable Human Development

The term sustainability had been coined in 1980 in the book "The world's Conservation Strategy". But till 1992 more than 70 definitions of the sustainability were coined by different researchers. In 1987, Burtland report defined the sustainable development as 'development that meets the needs of present without compromising the ability of future generations to meet their own needs (IUCN., 1980; Carson 1962;). All the sustainability indicators developed so far are confined to the academic literature and conceptual frameworks, very little of them could reach to the practice yet. Errors analyzed in the sustainability evolution procedures / induce:

- There is no consensus developed over the definition of sustainability yet. Each sustainability indicator has its own conceptual and philosophical framework to interpret the sustainability. Different conceptual backgrounds lead to different results.

- All the sustainability indicators are aimed to exhibit the status of sustainability in a country and to guide the policy makers to develop sub indices; calculation methodologies provided that most of these sustainability indices are so complex that they are unable to guide the policy makers.

- Almost All sustainability indices have some sort of bias in their methodologies which influences their effectiveness.

- Almost all sustainability indices follow the politically defined boundaries for data collection. But many of the environmental problem such as climate change, hydrological changes, flow of people, pollution across boundaries etc do not follow political boundaries.

- An index includes indicators for its measurements. But if the required data is missing for an indicator, it is eliminated from the index, which harms the validity of the index.

- Sustainability index calculation methods and components keep changing over the time with a feeling that sustainability concept of the previous framework was defective.

- Sustainability indicators have to deal with large amount of data sets. Which differ most of the time in values, measurement units and boundaries. Such data sets are required to be standardized so that an equally effective aggregation method may be applied. A number of standardization methods are available in literature. Use of different standardization methods may alter the results.

- Different sustainability indexes give different values to the indices included in the framework. A large number of indicators can be included for each dimension of the sustainability (environmental, social and economic). All the indices may not have equal influence on sustainability and can not be weighted equally. There is no well defined way to assign weightage to the sustainability indices.

- Aggregation method is another issue over which there is no consensus found yet.
- Data variability and availability limits the selection of the indicators for the countries. So same index can not be applied with same effectiveness in every country.
- Most of the indices discussed have large number of indicators. Involvement of large number of indicators makes the situation complicated and which give rise to the ambiguities for decision making.
- Sustainability indicators aimed to guide the governments in decision making process but inclusion of these indexes into governance may lead to negative implications due to theos gaps and nonflexible mechanisms.

6.2 Recommendations:

In order to improve the efficiency of sustainability indices following suggestions are put forward

- Definition of the sustainability should be critically reviewed in order to develop a consensus upon the elements of sustainability.
- As different sustainability matrices have different theoretical background, so sustainability indices with same philosophical basis should be grouped together, it will make comparison easy among them.
- Discrimination should be made among strong and weak sustainability capitals. Critical capital should be identified for measuring strong sustainability.
- Indices addressing strong and weak sustainability should be grouped separately for the comparison purpose.
- Environmental sustainability should be given core importance as it is linked to economic, social welfare, progress and sustainability.
- As environmental sustainability has no boundaries, so inventories should be developed in a way to measure environmental sustainability at national as well as at international level.
- Identifying the complex nature of the sustainability and complex interlinked ecosystems, human and economy web, priorities and sustainability needs may vary

from country to country. This variability should be kept in view while developing the sustainability matrices.

- The main objective of the sustainability indices is to measure the current situation of sustainability, to draw a future sketch and guide towards the way in which efforts are required. So sustainability indices should provide a clear and comprehensive guide line for policy making.

- Efficiency of a sustainability index depends upon the data reliability. There is a one common gap in all the sustainability matrices that they are lacking sufficient and reliable data. As sustainability is the need of today's world, so in every region of the world, inventories should be developed to gather reliable data that may be used by all the sustainability frameworks according to their requirement.

- Data weighting and aggregation is another point of conflict among the indices. There is a need to develop either a scientific consensus among these methodologies or indices with same methodologies should be grouped together.

6.3 A Case Study of Pakistan:

According to the Brundtland Commission, that the poverty is the main cause and effect of the global environmental problems (WCED, 1987; p.3). This statement is much when we compare the ecological footprints of the nations. It is rich global class or nations that consume the resources apathetically, causing more threat to the natural resources. As majority of the poor folk is forced to live in the ecologically vulnerable areas and lack the resources to relocate themselves or to protect them against the negative exposure. Lower education rate and exposure to the polluted air, contaminated water, and hazardous and solid waste increases their vulnerability to the health risks. Poor people are more directly dependent on biological resources for their livelihoods than rich people and they degrade it only at family labor cost. Environmental degradation is thus relatively more costly to poorer people. Natural and man made disasters often force the poor to temporarily or permanently leave their homestead to seek survival elsewhere. The associated environmental stress and resource scarcity result in widespread displacement of the poor. Hence, the statement that the poor people are the most serious threat to environmental degradation doesn't seem to be true as they themselves suffer due to calamities created by the rich.

Economy can not be isolated from the environment. There is independence both because the way we manage the economic impacts on the environment, and because environmental quality has impacts on the performance of the economy. Human being, in this whole scenario, plays the most important role. Many renowned authors like Gray S. Beaker(1992); Schultz (1992); Husz (1998) and Lucas(1998) elaborated the concept of Human Capital/ Resource. According to Husz, "By "Human Capital" we mean the time, experience, knowledge and abilities of an individual and abilities of an individual household or a generation, which can be used in the production process. By having an optimistic approach, global population can be considered as a "Human Capital/ Resource" that can save or utilize the environmental resources of the planet earth in a sustainable manner, if managed properly. Human resource for Environmental conversation includes aspects like population optimization, legislation, leadership development.

Table 6.1 Summary of Correlation Studies

Sr. No.	Variables	Results (Correlation)
1.	Population Growth/Size & Human Development Index	Indirect, Moderately Significant
2.	Population Growth & Ecological Foot Print	Direct, Non-Significant
3.	Population Size & Ecological Footprint	Direct, Non-Significant
4.	Population Size & Biocapacity	Indirect, Non-Significant
5.	Population Growth & Ecological Deficit/reserve	Direct, Non-Significant
6.	Population Size & ecological reserve/reserve	Indirect, Moderately Significant
7.	Poverty & Human Development Index	Direct, Non-Significant
8.	Poverty & Biocapacity	Indirect, Non Significant
9.	Poverty & Ecological Footprint	Indirect, Non-Significant
10.	Poverty & Population	Direct, Non-Significant
11.	Poverty & Ecological Reserve	Indirect, Non-Significant

Human Development index is the measure of human development in terms of life longevity, literacy rate and GDP index. With an increase in population, it would become difficult to provide basic necessities of life in terms of health facilities and education. So it would not be easy to achieve HDI goals with a steady increase in population. So HDI should decrease logically with an increase in population, the obtained results are logically unjustified and may be a data artifact.

Moreover, a positive, non-significant correlation was observed between HDI and poverty, which is again logically wrong. A's HDI includes, GDP, measurements as compulsory part. And poverty in Pakistan decreased from 31.10% to the 17.20% (from 1990 to 2008). According to the obtained results, with a decrease in poverty, HDI should also decrease, which is illogical. These conclusions lead to the facts that GDP growth gives picture of overall economic growth of the country. As GDP is the measure of over all wealth that a country has and does not portray the picture regarding actual status of the deprived masses or the poor.

Ecological Foot Print measures the individual's burden on natural resources in terms of resource consumption and waste production. With an increase in population, Ecological Foot Print should also increase. But a non-significant correlation was observed between population size/growth. It also depicts a low consumption pressure and low living standard of people of Pakistan. Reverse is the case for poverty and ecological foot print, that correlation was negative and non significant, i-e. with a decrease in poverty, consumption pressure of the people increases, that is why the rich nations have highest ecological foot print in the world. Ecological Foot Print measures the overall foot print of the nations. Individual's foot prints have been ignored in living planet reports. The observed non-significant correlation between population and ecological foot print may be due to non significant methodology used for foot print calculations. Ecological Foot Print is an environmental index that mainly focuses on the natural resource accounting and threshold capacity of our environmental resources. When this index was studied in an integrated manner (correlation studies with population size), the results obtained were non significant which produces a doubt regarding its validity.

Biocapacity refers to the capacity of a given biologically productive area to generate an on-going supply of renewable resources and to absorb its spillover wastes. The results showed that biocapacity and population size are correlated to each other negatively but with non siginificant results. An increase in population should result in logical decrease in biocapacity of the country which does not seem to be so valid in the case of Pakistan. Pakistan is facing severe deterioration of the natural resources like water, land, forests and biodiversity. Same is the case for the correlation between biocapacity and poverty. Poor are more likely to be dependent directly on natural resources or degradation of natural resources casts direct impacts on the poor.

Ecological Deficit/reserve is the level of resource consumption and waste discharge by a population in excess to locally sustainable natural resource production/availability and assimilative capacity. With an increase in population, ecological deficit should also increase whereas ecological reserve should decrease. As increase in population adds the burden on natural resources. In case of Pakistan, a positive correlation was observed between population growth and ecological deficit. Same was the case for correlation between poverty and ecological deficit/reserve. Major proportion of Pakistan's population inhabits rural space and is dependent upon agriculture for its livelihood. Due to the lack of insight and awareness to the importance of the natural resources, the rural poor causes significant harm to the natural resources. Other reasons for declining biocapacity is the negligence on part of government i-e lack of effective institutional, policy and implementation frame work.

As discussed above ecological foot print measures the overall situation of a country's 'natural capital'. It links neither to the economic of the country nor to the social condition (population, poverty, political instability as discussed here) of the nation. An ideal correlation was not found which could confirm the validity of ecological indices taken into consideration while portraying an integrated picture.

A positive, non-significant correlation was observed in case of population and poverty. With an increase in population, poverty either increases or in other words the pace of poverty alleviation efforts is not fast enough to counter the issue of increasing population size.

Keeping in view, the triple bottom line for sustainability, we have to integrate and interlink all the three dimensions of sustainability/sustainable human development. Human Development Index addresses the social and economic aspects of the sustainability. But there is a problem with GDP measurements as it does not depict the economic condition of all segments of the society. Secondly, Ecological Foot Print that is purely an environmental index which deals with the environment issues but economic and social issues are not addressed.

There is no doubt that the sustainable human development can neither be measured nor achieved if any of the aspects of sustainability is missing. That is why it is necessary to integrate the results of different indices to obtain a comprehensive picture. HDI is calculated by the UNDP and EF is measured by the foot print network organization and WWF. A comprehensive index for the sustainability can be obtained if the efforts of the two organizations are integrated, or at least they publish such results that can be compared and integrated in order to portray a quite comprehensive picture of the sustainability status for the world or countries.

6.4 Recommendations:

Managing population and alleviating poverty efficiently or overcoming both for sustainable development, economic progress and environmental sustainability requires long term policy making, planning and implementation. That in turn ,requires stable political governing bodies that is missing unfortunately in Pakistan.

- People of Pakistan should realize that they can only have political and economic freedom by eradicating exploitative elitist and feudal political structures.

- Most of the members of the current national and provincial assemblies are young and seems to be well aware of the importance of stable democracy. They should make such amendments in the constitution that may strengthen the democratic powers in the country.

- Our politicians should learn lessons from the past experiences and must not create such circumstances that would again empower the anti-democratic powers.

- Media should play its role. Both print media and electronic media have much freedom now a days in the country. They should rise awareness among the masses for the importance of democracy and should raise voice against democracy violating efforts.

- Elections should be held regularly in the country. Constitution of Pakistan (1973) has sufficient provisions for establishment of political governments, freedom of democracy, religions and fair election; no one must be allowed to abolish it.

- Long term policies should be made to put a limit to the unchecked population.

- We should adopt an optimistic approach towards population. Population should be considering as 'Human Capital or Human Resource' and should be managed and developed accordingly.
- Human capital should be managed in such a that it may become self sufficient.
- The best way to deal with both population and poverty problems is to educate the people.
- Provide the masses with technical education according to the requirement in every field e.g teach the scientific methods of cropping to the farmers. By using the scientific ways of cropping, yield will not only be increase but it will also help to sustain the long term fertility of the land.
- Incorporate the environmental education or environment based education used in the syllabi of educational institutes.
- By creating the awareness among the people about the environment we can create big changes in slum environment.
- Electronic media and print media can play their active role in creating the awareness among common masses.

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