DEVELOPMENT AND MEASUREMENT OF ECONOMIC WELLBEING INDICES FOR PAKISTAN

PhD Econometrics

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DECLARATION

I hereby declare that this thesis, neither as a whole nor as a part thereof, has been copied out from any source. It is further declared that I have carried out this research by myself and have completed this thesis on the basis of my personal efforts under the guidance and help of my supervisor. If any part of this thesis is proven to be copied out or earlier submitted, I shall stand by the consequences. No portion of work presented in this thesis has been submitted in support of any application for any other degree or qualification in International Islamic University or any other university or institute of learning.

Yasir Riaz

DEDICATED

To my teacher, parents, and family members

APPROVAL SHEET

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ABSTRACT

The question of how to define and measure the economic wellbeing gaining prominence in academic and policy research. Role of GDP growth as a wellbeing measure has been criticized widely and several alternate approaches have been proposed in the literature. Indices based upon monetary valuation method, estimated through adjustment in national account system can be considered as a specific class of wellbeing indices. In this study, this specific group of indices has been evaluated and several improvements have been proposed.

First, "Index of Sustainable Economic Welfare" proposed by Daly, Cobb, and Cobb (1989) was computed for Pakistan. Findings of ISEW highlighted the disconnect between economic growth and wellbeing in long run. Sensitivity analysis was also conducted to assess the robustness of index. Findings revealed that index is sensitive to more than half of sub-indicators of index and exclusion of such indicators can significantly affect the shape of index. Thus, aggregation of sub-indicators into single index can be misleading. Later, improved measurement criterion referred as "Multi-dimensional Measure of Economic Wellbeing" has been proposed. Overall, three major changes have been proposed in the previous work based in review of literature and analysis of ISEW. First, it was proposed to broaden the scope of analysis through inclusion of economic and physical insecurity in wellbeing analysis. For that purpose, social and economic cost of natural disasters, mane-made crises and terrorism have been estimated and incorporated into analysis. Second, it was argued that sustainability measurement should be kept separate from current wellbeing analysis and should be measures through 'stock' type variables

instead of 'flow' variables. Adjusted net saving and ecological footprint for sustainability analysis were proposed as alternate. Third, it was argued that aggregation or taking average of such indicators that have dissimilar trends will lead in information loss. A local solution based upon the data trends was proposed as alternate. Through Multi-Dimensional Scaling and Hierarchical Clustering, similarities in data set was estimated first, and only indicators with similar trend were merged. Analysis for Pakistani dataset and related recommendations have also been presented.

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LIST OF ABBREVIATIONS

Abbreviation	Complete name
ANS	Adjusted Net Savings
CDI	Canadian Development Index
CFCs	Chlorofluorocarbons
DALY	Disability Adjusted Life Years
EF	Ecological Footprints
EMDAT	Emergency Events Database
EPI	Environmental Performance Index
GDP	Gross Domestic Product
GGEI	Global Green Economy Index
GNHb	Gross National Happiness-Bhutan
GNHi	Gross National Happiness-IIM
GNP	Gross National Product
GPeI	Global Peace Index
GPI	Genuine Progress Index
GTD	Global Terrorism Database
GWP	Global Warming Potentials
HDI	Human Development Index
HPI	Happy Planet Index
IEW	Index of Economic Wellbeing

ILS	Index of Living Standard
ISEW	Index of Sustainable Economic Welfare
ISH	Index of Social Health
LCU	Local Currency Unit
LPI	Legatum Prosperity Index
MDS	Multi-dimensional Scaling
MEW	Measure of Economic Welfare
MMEW	Multi-dimensional Measure of Economic Wellbeing
NIIP	Net International Investment Position
OECD	Organization of Economic Cooperation and Development
PCA	Principle Component Analysis
PCE	Personal Consumption Expenditures
PHI	Pemberton Happiness Index
QOL	Quality of Life Index
RPM	Rounds Per Minutes
SDG	Sustainable Development Goals
SMEW	Sustainable Measure of Economic Welfare
SNA	System of National Account
SNBI	Sustainable Net Benefits Index
SNHI	Sustainable Neighborhood of Happiness Index
SPI	Social Progress Index
UNDP	United Nations Development Program

UNICEF	United Nations International Children Education Fund
USD	United States Dollar
WB	World Bank
WDI	World Development Indicators
WHO	World Heath Organizations
WWF	World wildlife Organization

CHAPTER 1

INTRODUCTION

One of the key responsibility of states and governments is to ensure the current as well as future wellbeing of the people (Booth, 2012; Frey & Gallus, 2013). Among the wellbeing policies, economic wellbeing remained at central position during last many decades. It was largely believed that economic growth can lead to the wellbeing of the people, as with the availability of more resources, problem of scarcity will be resolved. Consequently, access to the wealth and material resources will be increased and wellbeing objective will be achieved. In this context, GDP was considered as one of the key measure of economic wellbeing and GDP growth remained central among government policies (Ravallion & Chen, 1997).

GDP growth provide a quick snapshot of the economy and summarize all economic activates in one number. Convergence of all production and services into monetary valuation make GDP growth rate comparable over space and time. It also provides comparative strengths and weaknesses of different sectors of the economy. Through well-defined procedures of calculations and estimations, it is being calculated around the globe and provide opportunity to conduct comparative studies. Key notion behind using GDP growth as a wellbeing indicator is the theory that more resources are the key to ensure

wellbeing. Saying of Jane Austen *"A large income is a best recipe for happiness I ever heard of"* clearly explain the notion of classical economics.

Although, GDP growth is extensively referred as an indicator of economic wellbeing by the practitioners, it is also widely criticized in this context by ecological as well as social economists due to its major limitations. (Brennan, 2008; C. W. Cobb & Cobb, 1994; Easterlin, 1995; Kenny, 2005; Nordhaus & Tobin, 1973; Stiglitz, Sen, & Fitoussi, 2010). Nevertheless, it can be used for the purpose of tracking economic activity but is not best suited to estimate the economic wellbeing of the population (Nordhaus & Tobin, 1973). Simon Kuznets, creator of System of National Accounts (SNA) also warned of using GNP as a wellbeing indicator in following words

> "The welfare of a nation can scarcely be inferred from a measure of national income. If the GDP is up, why is America down? Distinctions must be kept in mind between quantity and quality of growth, between cost and returns, and between the short and long run. Goals for more growth should specify more growth of what and for what[1]"

Plenty of literature is available highlighting the drawbacks of GDP or other related indicators for not adequately capturing the human wellbeing due to two broad issues. First is about the measurement issues i.e. several aspects of wellbeing have not been covered in GDP related indicators. Second question is more fundamental and is about the longer-term relationship of growth and human wellbeing (Max-Neef, 1995).

[1] Report to the US Congress of 1934

GDP measures exclude the non-market activities including unpaid house work, child care and other voluntary services(Bruyn-Hundt, 1996; Roy, 2012; Waring & Steinem, 1988). In addition to this, amount of leisure activities which may affect wellbeing positively cannot be captured through production-based indicators.

Similarly, some expenditures which affect well-being negatively but consider positive while measuring GDP. For example, traffic jams may increase the GDP due to more spending on gasoline but will affect well-being of the people negatively. Likewise, outside events like natural disasters, wars etc. have negative effects on wellbeing, but GDP cannot measure the welfare loss accrued due to such events. However, reconstruction after natural disasters contribute positively in GDP. Hence all such events like disasters, wars, accidents and crimes contribute positively in GDP as such events bring some production opportunities with them. (Stiglitz et al., 2010)

Furthermore, if quality of products or services is increased, it will affect the well-being positively. This will not be reflected in GDP or similar measure which rely more on quantity rather than quality.(Schultze & Mackie, 2002)

Impact of economic activities, specifically industrial production leave hazardous impacts on environment but GDP is unable to incorporate such effects on environment.(Nordhaus & Tobin, 1973; Smith, 2007).

Another major drawback of GDP/GNP based indicators is that such indicators do not consider inequalities among the society. If at any time, inequality among people increase, it will affect well-being of people negatively but GDP cannot reflect this. (Fesseau, Bellamy, & Raynaud, 2009)

Another limitation of GDP measures is that such indicators measures only flow of production/services not stock. So, consumption of non-renewable natural resources such as use of oil reserves contribute positively to the GDP. However, there is trade-off between current and future wellbeing, as extensive consumption of such resources increases current wellbeing in the cost of future wellbeing. Such effects cannot be captured through GDP based measures. (Stiglitz et al., 2010)

In addition to the above-mentioned measurement related issues with GDP, social economist also raised a question about longer term relationship between growth and wellbeing. Max-Neef (1995) showed that economic growth can increase the human wellbeing to a certain level, called threshold point, after that growth may lead to the reduction in wellbeing and quality of life. Threshold hypothesis theory was largely supported by the empirical evidences from developed as well as developing countries (Castaneda, 1999; Diefenbacher, 1994; Guenno & Tiezzi, 1998; Tim Jackson & Marks, 1994; T Jackson, Marks, Ralls, & Stymne, 1997; Tim Jackson & Stymne, 1996; Osberg & Sharpe, 1998; Rosenberg & Oegema, 1995; Stockhammer, Hochreiter, Obermayr, & Steiner, 1997). Following to this, P. Lawn and Clarke (2010) presented contracting threshold hypothesis and showed that, as global economy is expending, there is a contraction over the time in the threshold level of wellbeing. It was reflected from their analysis that countries which started their journey on growth path earlier, took more time to reach to the threshold level with higher per capita GDP and higher wellbeing level. The late comer countries on growth path are reaching to the threshold point at quite low level of wellbeing. So poorer and late comer countries can never enjoy the wellbeing level, as enjoyed by wealthier nations.

Easterlin (1995) paradox also showed that growth has not solved the problem of scarcity. He presented a large amount of evidence from diverse sources to support the basic finding that rising incomes did not lead to increases in happiness or satisfaction with life. Followed to this, several interpretations were presented to explain the causes of happiness/satisfaction other than increase in income.

In a nutshell, GDP can be used as a good indicator for productivity rather than wellbeing. As highlighted, it was never invented to measure the wellbeing, rather was referred in the welfare context with the passage of time.

1.1 APPROACHES TO MEASURE THE ECONOMIC WELLBEING

Approaches as well as measurement criteria for economic wellbeing indices is different from GDP measurement, as more people centric approach is required for wellbeing indices (Posner & Costanza, 2011). In literature, plenty of alternate approaches have been proposed to measure the wellbeing as well as sustainability of economic welfare. These proposed indices can be categorized in several ways. First, a broad categorization for subjective and objective wellbeing can be considered. Within objective wellbeing category, further classification can be made on conceptual basis, as wellbeing can be defined either in term of fair allocation or in term of functioning and capabilities (Stiglitz et al., 2010). Furthermore, a broad classification for measurement criteria can also be considered, e.g. monetary vs. non-monetary indices of wellbeing. Another important way of categorization is to consider current and future wellbeing separately. A detailed summary of such measurement criteria and indices is given in chapter 2.

Despite the fact that all such approaches provide valuable information about the complex nature of human life and human welfare. This study will focus more on objective measurement criteria through monetary valuation approach. Rational behind focusing on this domain will be presented in subsequent sections.

1.2 OBJECTIVES OF THE RESEARCH

Main aim of this research is to investigate the relative strengths and weakness of monitory valuation-based wellbeing indices and suggest improvements considering the relative weaknesses and identified gaps. Specific objectives of the study are:

- To review the key economic wellbeing indices and theoretically compare different classes of wellbeing indices with monitory valuation-based indices.
- To compute the selected index "Index of Sustainable Economic Welfare index" for Pakistan.
- To highlight the relative weaknesses of computed index and to propose a new wellbeing index based on highlighted research gap.

1.3 SIGNIFICANCE OF THE STUDY

This study will be helpful to understand the complex nature of human wellbeing. It will provide brief summary of different approaches opted to measure the economic wellbeing, and relative strengths/weaknesses of opted approaches. In this way, study will shed some light on the complex nature of human wellbeing. Key significant contributions will be:

- Study is aimed to contribute to in on-going debate on wellbeing and will be helpful on devising comprehensive measure of wellbeing
- Analysis at macro-economic level will be helpful for policy makers and practitioners to relate the findings with policies.

1.4 RESEARCH GAP

Detailed discussion on research gap will be provided in chapter 2. However, it is pertinent to mention that study will take "Stiglitz Commission Report" as an initial research call. Commission's reported thoroughly compared the different approaches opted to measure the wellbeing and highlighted several areas of future research. One of the key highlighted area is monitory valuation-based wellbeing index.

Current study will consider this suggestion as an initial research call and conducted thorough review of this specific class of index. Further justification for the selection of this class of indices and their relative strengths and weaknesses will be provided in chapter 2.

1.5 STRUCTURE OF THE THESIS

Structure of thesis is as follows. Chapter-1 provides brief description of the topic, shortcoming of production-based measures, summary of alternate approaches and scope of this research. Chapter-2 presents the summery of some selected literature on this topic. In first section of chapter-2, discussion on definition and scope of economic wellbeing is summarized. A specific definition opted for this study also presented. Afterward, different approached opted for the measurement of economic wellbeing including subjective

measurement criteria, objective measurement criteria and measurement of sustainability in wellbeing studies are presented. Key strengths as well as shortcoming of several approaches are also discussed.

In Chapter-3, a brief discussion on monetary valuation approach is presented. Following to this, details of research methodology and data description is provided.

Chapter-4 is divided into three sub-section. In first sub-section, finding of computation of "Index of Sustainable Economic Welfare for Pakistan" is presented. This is followed by sensitivity analysis. Sensitivity analysis revealed that ISEW is sensitive to more than half of sub-indices/indicators and hence aggregation may mislead the analysis. Third section covers the proposed index for wellbeing. Discussion revolves around the theoretical framework of proposed index, definition of additional data and findings of proposed "Multidimensional Measure of Economic Wellbeing" Separate analysis of current and future wellbeing is presented.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the concepts as well as measurement criteria of economic wellbeing is summarized. A comparative analysis and strengths/weaknesses of several approach are also discussed.

2.1 DEFINING ECONOMIC WELLBEING

The terminology "wellbeing" is a metaphor and can be defined in different ways in different circumstances. In literature, several terminologies including economic wellbeing, material wellbeing, economic welfare and quality of life appeared interchangeably. Sometime, terminologies like happiness and life satisfaction are also used for similar concepts. Before proceeding to the discussion of measurement of wellbeing, it is imperative to first define the terminology.

Although, several definitions of term "wellbeing" were presented in literature, there is no consensus on a single definition. Table 3 in annexure presents few of the definitions from literature.

Few of the definitions presented in table-3 are broader in nature and define the state of wellbeing only. Others also explain the different dimensions of wellbeing. Few of the definitions differentiate between economic and non-economic dimensions of wellbeing. To be explicit in this research work, it is preferred to adopt a definition which is objective in nature and not only describe the outcome state but also cover the relevant dimensions of the wellbeing as well. In addition, focus of current research retained on economic wellbeing only. Though, it is admitted that role of governments and states is to ensure the augmentation in overall wellbeing of people, beyond to the sphere of economy. Economic wellbeing is one component of the general wellbeing. This research will contribute to only one sphere and should not be considered as a comprehensive study of ecological, social and other relevant spheres of life. The definition adopted for this research is given below:

> "Economic wellbeing can be defined as a state, in which people have ability to meet their basic needs, can access to quality education, health and other necessary services, can access to decent livelihood opportunities and can excel their capacities and skill to fulfill their goals. The state of wellbeing should be resilient to shocks, should not exploit the wellbeing opportunities of future generations and should be achieved collectively with the sense of social responsibility."

To proceed further, first the conceptual approaches related to wellbeing analysis will be discussed. Then, a brief survey of already proposed indices will be presented. The discussion will revert to the above-mentioned definition and rational behind this definition will be discussed in the end of this chapter.

2.2 SUBJECTIVE MEASURES OF WELLBEING

The first approach to define and measure the wellbeing was developed in connection to the psychological research and was about the subjective wellbeing. The terminologies like subjective wellbeing, happiness, life satisfaction or quality of life sometime used interchangeably in this category. This approach is relatively newer in the field of Economics, as for the decades, economists believed that it is enough to study the fulfilment of objective conditions along with people's choices. However, in recent years, there is more consideration on what people value and how they act in their lives. Subjective wellbeing or happiness studies provided the better insight of people's behavior, beyond to the understanding provided by the income/consumption only (Stiglitz et al., 2010). Such studies highlighted the discrepancies among the assumption of economics. One of the good example in this regard is Easterlin paradox. Easterlin (1995) showed that happiness or satisfaction with life is not associated with higher income in longer term. Using a large amount of evidences from diverse sources to support the basic finding, he argued that happiness depicts direct relationship with income within nation as well as among nations, but with the passage of time, this relationship does not continue even with the increase in income.

Although, happiness is not a new concept, as many of the intellectuals throughout the history considered people's happiness or satisfaction with life as one of the key dimension to of human life. The ancient philosopher like Aristotle, Confucius and Plato incorporated happiness into their work. As per the Aristotle's philosophy, happiness is an ultimate objective of human existence. Aristotle was convinced that a genuinely happy

life required the fulfillment of a broad range of conditions, including physical as well as mental well-being (Rowe & Broadie, 2002). Plato, in his masterful book the Republic, has a lot to say about happiness. He linked happiness with morality, virtue and human fulfilment (Adam, 1902). In Islamic teachings, happiness is linked with the concept of morality and faith. Focus of Islamic teachings is to think beyond to material aspect and do focus on attaining happiness on non-martial concerns. Allah SWT said, "Whoever does good whether male or female and he is a believer, We will most certainly make him live a happy life, and We will most certainly give them their reward for the best of what they did." (Qur'an, 16:97)

In recent era, happiness remained under consideration in the fields of psychology, sociology and philosophy. However, there was a little focus on this subject by the economists and policy makers. In 1972, Sicco Mansholt, fourth president of European Commission introduced the concepts of Gross National Happiness (McKay, 2013). Later, this concept was incorporated in national policy frame-work of Bhutan by the former king of Bhutan Mr. Jigme Singye Wangchuckn (Ura & Galay, 2004). The computation methodology of GNH was first developed in 2005 by Med Jones of International Institute of Management, a US based think tank. Gross National Happiness is composed of four pillar namely good governance, sustainable socio-economic development, preservation and promotion of culture and environmental conservation (McKay 2013). In Bhutan, GNH was developed by Center for Bhutan Studies and GNH using Alkire Foster method. This index is composed of nine domains.

In 2005, Gallup initiated a world poll expanding to 160 countries to assess the subjective wellbeing and happiness of adult population. Through well-defined methodology, Gallup

collects data using more than 100 global and few region-specific questions. This data provides researchers an opportunity to develop subjective wellbeing or happiness

In this regard, most notable initiative was taken by United Nation when, in July 2011, General Assembly adopted a resolution to consider the happiness as a key indicator for national progress. United Nation's Sustainable Development Solutions Network is releasing world happiness report from 2012. These reports primarily rely on Gallup world poll and estimate the value of happiness on the basis of six variable including come (GDP per capita), healthy life expectancy, social support, freedom, trust (absence of corruption) and generosity. Mostly high-income countries appeared more happier countries as well. Among the contributing factors that shape the happiness index, income and social support appeared more influencing variables.

Another initiative in this regard is Happy planet index, which is calculated by UK based think tank New Economic Foundation. Happy planet index is composed of four indicators i.e. people's wellbeing using the data of Gallup's world pool, life expectancy, inequality between people within country and ecological footprints. The findings of happy planet index analysis are interesting as several wealthy Western countries do not rank superior on the proposed Index. On the other hand, several middle and low income countries depict high score on the index as such countries achieved high life expectancy and wellbeing with much smaller Ecological Footprints (Abdallah, Thompson, Michaelson, Marks, & Steuer, 2009). Reason of these counter intuitive results is the inclusion of ecological footprint and human impact on nature in their index.

Similar to these initiatives, several other indices or measurement tools were presented in literature including Yang (2017)index of multidimensional wellbeing which incorporate

subjective wellbeing along with other indicators. The Pemberton Happiness Index (PHI) was developed by Hervás and Vázquez (2013) a scale in seven languages to measure the subjective wellbeing. The Sustainable Neighborhoods for Happiness Index (SNHI) developed by Cloutier, Jambeck, and Scott (2014) provided an integrated approach to estimate the community wellbeing on the basis of individual wellbeing/happiness. Multiple initiatives were taken at institutional level. UK's Office for National Statistics have incorporated life satisfaction, happiness and anxiety rating in their national wellbeing survey. Australian Unity, a corporate entity in Australia conducted happiness assessment which covered life satisfaction and wellbeing of the people (Cummins, Eckersley, Pallant, Van Vugt, & Misajon, 2003). Canadian Index of Wellbeing integrate individual as well as community level assessment to measure the subjective wellbeing. In line with these initiatives, OECD have developed guidelines to measure the subjective wellbeing. The guidelines provided a broader definition of subjective wellbeing. It includes good mental state, positive and negative evaluations and reaction to the experiences. It was recommended to cover three components of happiness assessments i.e. life evaluation, affects and "meaningfulness" or "purpose" in life.

The above-mentioned list of subjective wellbeing or happiness indices is neither exclusive nor representative, rather it just highlights that several initiatives have been taken in this regard. Still, there is no consensus among academician and policy makers on the domain and methodology of such initiatives. Questions were raised about the validity and reliability of such assessments. A good amount of literature was produced both in favor of and against the subjective measure on the basis of assessed reliability and validity of such measure (Arthaud-Day, Rode, Mooney, & Near, 2005; Lucas, Diener, & Suh, 1996;

Schimmack & Diener, 2003). It is considered that validity issue can be resolved or even improved, still subjective measure cannot be considered sufficient to assess the wellbeing, in absence of objective measure. In a nutshell, two major criticism remain valid for such subjective measure. First, it is possible that subjective wellbeing may vary over time without any significant change in objective condition. For example, an achieved income level will result in much more happiness at initial stage. However, with the passage of time, positive feeling will decrease, and subjective wellbeing level will be reduced.

Second, People can internalize the harshness of their circumstances so that they desire only those things, what they feel they can achieve. For example, if a person is sick for a long period and internalize the circumstances faced by himself, he will consider himself as a healthy person. Therefore, an evaluation by neutral observer will be important to assess the objective conditions of that person

2.3 OBJECTIVE MEASURES OF WELLBEING

Objective measure of wellbeing can be broadly categorized either on the basis of conceptual approach or computational approach. Conceptually, two different type of approaches can be opted. First approach is rooted in Sen's capability approach. As per the capability approach, a person's life is combination of functioning and capabilities. He described that individuals are different from each other in their abilities, and not everyone is able to convert the same resources into valuable functioning. So, it is insufficient to just evaluate the availability of or access to some service or need. It is also imperative to consider that either individuals have the ability to utilize these resources and convert them

into productive 'functioning'. For example, a bicycle has the ability to support in transportation, but it is useless for the person who doesn't have legs. This can be generalized to all other spheres of wellbeing. This approach also redresses the above-mentioned critique on subjective wellbeing. People, who never (or for a long time) experience a healthy life, will consider hem/herself as a healthy, as such person lake the capability of transforming the opportunity into functioning. This approach focused on achieved functioning not only available functioning (Clark, 2005).

Further to this, another approach developed in economics is related to the notion of fair allocation. This approach incorporates several non-monetary aspects of life that can affect the wellbeing and capture the people's preferences for those aspects.

On computational criteria, objective indices can be categorized into two major groups, i.e. composite indices and monitory valuation indices. Best example of first category is Human Development Index, which is based upon a set of outcome level well-being indicators. Whereas for second category, Index of Sustainable Economic Welfare or Genuine Progress Index can be referred. Some examples of both type of indices are given below.

2.3.1 Composite Indices

Plenty of composite indices were proposed in literature and a lot of them being calculated on regular intervals. Such indices differ from others either in term of defining the components of wellbeing or in term of methodology. To adopt or to evaluate any index, purpose of such index need to be considered first. Few of such index followed the holistic

approach and tried to incorporate as much dimension of wellbeing as possible. Few have limited thematic scope, like on environment or on peace. Similarly, a range of diverse approaches were opted for methodological underpinning and details. Methodology varies at several points including imputation of missing values, normalization of data, weighting of individual indicators, aggregation methods and presentation of such indices. The question of weighting and aggregation is still unresolved. In some cases, equal weights were assigned to the indicators to avoid subjective judgment. However, it is widely accepted that all dimensions of wellbeing are not equally contributing into the overall wellbeing. Similarly, variation of equal amount in different indicators have different meaning. For example, 5 per cent increase in malnutrition rate and 5 per cent decrease in access to leisure services have absolutely different effects, though in both cases, reduction of 5 per cent was report. Therefore, equal weighting criteria appeared as an illogical approach. To avoid this, three different type of approached opted. First, subjective judgment was used to assign the weight. Second, some objective statistical methods were used like principle component analysis (PCA). Third, it is left for the reader or user of the index to decide about the weights. PCA and some other similar techniques remained famous among researchers, however, it appeared that PCA results do not vary much from equal weighting criteria. Similarly, in few cases, sensitivity analysis was carried out to assess the robustness of such indices. Results never remain similar.

The traditional methods of assigning weights like Principle Components Analysis, dynamic multiple indicators model or envelop analysis. All such approaches follow linear space models and restricted to priori assumptions. To overcome this, most notable alternative was proposed by Maasoumi and Racine (2016). The proposed method of

estimation of aggregation function provides robust approach in multidimensional evaluations and multiple indicators setting. In their analysis, they first estimate the quintiles non-parametrically, which were referred as "frontiers" in their analysis. Then a joint probability distribution of key attributes was estimated conditional to joint value of some other attributes.

Another neglected method is multidimensional stochastic dominance (MSD) analysis. This technique was proposed by Duclos, Sahn, and Younger (2006) to overcome the problem of multiplicity on wellbeing indices. In multidimensional scenario, MSD captures the possible relationship among dimensions of wellbeing. Alike from unidimensional analysis, which consider only marginal distributions of dimensions of wellbeing, MDS relied on joint distribution.

One of the major critiques on composite indices was that this approach hides the individual variation in data. Sometime two indicators showed extreme behaviors, but aggregation hide such information and provide only average figures. So, the valuable information on the variation of wellbeing dimension is lost. To avoid this, dashboard of indicators approach was opted. Below are the few examples of composite indices, whereas dashboard approach will be further discussed in the thesis.

Among such indices, one of the most famous index is human development index. It was developed by Pakistani Economist Mahbub-ul-Haq and Indian Nobel Prize winner Amartya Sen. The index was adopted by United Nations' Development Program to measure the country's development. The index of consist of three themes, life expectancy, education and income. HDI follows the human development approach of Mahbub-ul-Haq

and capability approach of Amartya Sen. It is regularly calculated by UNDP and widely cited index. (Sen, 1994)

Another example is Canadian Development Index. It is a composite index consists of eight interconnected indicators including community vitality, democratic engagement, education, environment, healthy population, leisure and culture, living standards and time use. This is non-government initiative though depended on national statistics office for the data availability. It is measured in term of percentage change from base year (1994). Arithmetic mean is used as aggregation method. (Michalos et al., 2011)

Global Peace Index is another non-government initiative. This index was developed by Institute of Economics and Peace, global thinktank based in Australia. It measures the relative position of nations and regions peacefulness. Indicators include internal conflicts, life and property losses due to such conflicts, crimes, political instability, homicides and military capacity. It provide relative score from 1 to 5, in a way that countries follows on bottom line for specific indictors get 1 score. (Estes, 2014a)

Legatum Prosperity Index (LPI) is another relative index which provides the ranking of countries on the basis of five major themes. These themes include wealth, economic growth, health, education and quality of life. Under these themes, 104 indicators are analyzed to develop this index. It was developed by Legatum institute and regularly published from 2007 onward (Gamester & Dengler)

Estes (2014b) proposed an Index of Social Progress which aimed to assess the changes in "adequacy of social provision". The index assesses the progress that how adequately basic social services are provided to the people. This index consists of 46 social indicators which were again divided into 10 sub-indexes: education, health status, women status,

defense effort, economic, demography, geography, political participation, cultural diversity, and welfare effort. These sub-indices form the main index which present the social development and adequacy of social provision of the specific country/area/region.

Index of Living Standards (ILS) was proposed by Sarlo (1998) and catered eight components while constructing this index. These components include household consumption (real per person), household income (real per person), amenities available in the household, education (post-secondary certificate, degree or diploma), life expectancy, employment status and an indicator of wealth of household.

Index of social health analyzes the social wellbeing by examining the range of social issues and problems. Index cover sixteen social indicators including mortality, health, inequality in social health indicators and access to health-related services.

Index of economic well-being was proposed by the economists of Dalhousie University and is based upon four indicators i.e. effective per capita consumption, net societal accumulation of stocks, poverty/inequality and job/employment security.

Quality of Life Index (QOL) was proposed by Diener (1995) and also consider as one of the famous index in this regard. This index is calculated on the basis of seven indicators including purchasing power, homicide rate, fulfillment of basic needs, suicide rate, literacy rate, gross human rights violations, and deforestation.

A major contribution in this regard was OECD's Better Life Index. This index was developed following the recommendations of Stiglitz Commission report. It covers 11 headline indicators including housing, income, job, community, education, environment, civic engagement, health, life satisfaction, safety and work-life balance. They avoided to

provide any researcher's defined weights to aggregate the index, rather, it was left on the user of this index to change the relative weight of any indicator.

2.3.2 Indices based upon monetary valuation

The monitory valuation approach for wellbeing indices was first proposed by Nordhaus and Tobin (1973) in their "Measure of Economic Welfare (MEW)" index, which can be considered as a common ancestor in this domain. They took private consumption expenditure from national accounts as a starting point and subtracted several components that do not affect wellbeing positively (for example commuting and defensive expenditures). Similarly, imputed monitory value of such components that can contribute positively to the wellbeing (for example value of domestic work and leisure) was added to the index. Detailed formula is given below:

$$MEW = C_{MEW} + V_L + V_H - d \qquad \text{(Eq 2.1)}$$

C_{MEW}= Personal consumption expenditure (adjusted for regrettable expenditure like expenditure on defense, police and negative externalities, expenditure on consumer durable replace with imputed value of services from those goods and private expenditure on health and education)

V_L= Imputed value of leisure time

V_H= Imputed value of unpaid work

d= Disamenity correction (correction of estimated cost of living as, in urban areas living cost remain relatively higher as compared to rural areas. As a proxy indicator, difference between rural and urban wages rate can be used)

Imputation of leisure time and unpaid work remains one of the challenging part to calculate the MEW. Nordhaus and Tobin (1973) discussed about conceptual as well as methodological issues in imputation.

At second stage, MEW was converted into "Sustainable Measure of Economic Welfare (SMEW)" which consider the sustainability component by calculating two things. First, net change in capital stock, second the growth requirement. Growth requirement is calculated through estimating requirement of capital stock to keep the pace with changes in the size of the labour force. Productivity factor also incorporated. The MEW capital stock consists of the physical capital stock, land, net foreign assets, education capital, and health capital.

On the footprints of Nordhaus and Tobin (1973), several other attempts were made including Index of Sustainable Economic Welfare (ISEW), Genuine Progress Index, Green GDP and Sustainable Net Benefits Index (SNBI).

ISEW was initially proposed by Daly et al. (1989) and was extensively used in subsequent years in many countries. Daly et al. (1989) calculated ISEW for United States from 1950 to 1986. After that ISEW was calculated for several other including UK (Tim Jackson & Marks, 1994), Germany (Diefenbacher, 1994), The Netherlands (Rosenberg & Oegema, 1995), Austria (Stockhammer et al., 1997), British Columbia (Gustavson & Lonergan, 1994), Sweden (Tim Jackson & Stymne, 1996), Chile (Castaneda, 1999) and Finland (Hoffrén, 2001). Although, ISEW tried to enrich the Nordhaus and Tobin's approach, they deviated from preceding index significantly in methodology. MEW didn't account for impact of climate change in final index, ISEW covered climate related issues using CO_2 emission, ozone layer depletion and other similar indicators. In addition,

inclusion of natural resource depletion, international investment position and net capital growth into the index make it more comprehensive and relevant. Nordhaus and Tobin (1973) made several adjustments to the consumption series without any reference to the theory. ISEW aligned the proposed changes with economic theory, which make these indices more dependable.

The Genuine Progress Index (GPI) is extension and rebranding of ISEW and was proposed by C. Cobb, Halstead, and Rowe (1995). Theoretical foundations of ISEW, GPI and related indices are explained in next section. However, all such indices develop an alternate national accounts system which referred as a "green GDP". The objective of green GDP initiative is to provide a more accurate measure of human's wellbeing as well as to gauge the economy is on sustainable path or not. GPI have been calculated for several countries and regions including Austria (Stockhammer et al., 1997), Belgium (Bleys, 2008), Germany, Italy, Netherlands (Rosenberg & Oegema, 1995), Poland (Gil & Sleszynski, 2003), Sweden (Stymne & Jackson, 2000), United Kingdom (T Jackson et al., 1997), United States (C. Cobb et al., 1995), Chile (Castaneda, 1999), Australia, New Zealand, India, Japan, Thailand and Vietnam (Hong et al., 2008). Using these findings, Kubiszewski et al. (2013) calculated global GPI. Above-mentioned 17 countries counted for 85 per cent of the world populations. After aggregating these statistics, adjustment for discrepancies caused by incomplete dataset was done by comparing global GDP per capita data for all countries.

2.3.3 Theoretical background of wellbeing indices

One of the major critique on monitory valuation-based indices including MEW and ISEW was the lack of theoretical foundations (Guenno & Tiezzi, 1998; Neumayer, 1999). However, proponent of ISEW showed that ISEW and related indices have sufficient theoretical explanation, rather some methodological short coming, specifically related to data availability still underpinning the argument. Few relevant economic theories include "economics of community", "entropic net psychic income" and "threshold hypothesis" (Brennan, 2008).

Orthodox Economics have great focus on market functionalization and GDP is considered as an indicator of healthy market. However, GDP captures only few aspects of welfare, not all. Considering GDP as a measure of welfare is *fallacy of misplaced concreteness* (Daly et al., 1989). ISEW is a critique to orthodox school and strongly adhere the *principle of internalization.* (Brennan, 2008). Growth have negative effects, and someone have to pay the price, either current generation or future one. ISEW considered to collectively socialize the cost of growth and to define the optimal size of economy and optimal scale of growth, which minimize the negative effects. For this, one needs to think as a community, not as an individual. Wellbeing of community is constituted with the wellbeing of individuals and goal should remain to increase the community wellbeing (Brennan, 2008; Daly et al., 1989). So, the economics of community explains the rational of ISEW and related indicators in explicit way.

In addition, linear throughput model and Fisher's concept of psychic income and expenditure explains the rationales behind ISEW computation. Alike the conventional

isolated circular flow model, which explains the flow of goods/services and income among firms and households. However, production also depends upon several natural resources, often non-renewable, which were ignored in conventional model. Similarly, economic activities often produce some hazardous waste, which was also not considered in conventional models. Linear throughput model explains gains and losses from nature as well (Daly, 1991; P. A. Lawn, 2006; Redclift, 2006). ISEW also consider the gains and lost from nature as it is made up of two elements i.e. uncancelled benefits and uncancelled cost.

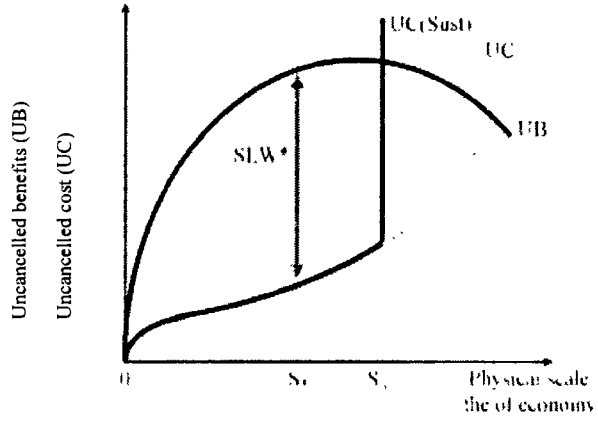

Figure 2.1: Relationship among uncancelled benefits, uncancelled cost and sustainable economic welfare[2]

Uncancelled benefits or psychic income, as defined by Fisher elucidate final net benefits of the economy and covers distributional inequality, services from consumer durable, non-paid work as well as services from public expenditures and natural resources. Whereas uncancelled cost or psychic outgo include defensive expenditure, cost of commuting,

[2] The graph was presented by P. A. Lawn, 2006

pollution, accidents, crimes etc. As presented in below graph, uncancelled benefits of economic activity increases at diminish rates however uncancelled cost rise at increasing rate. The maximum difference from uncancelled benefits and cost reflects the sustainable level of economic welfare.

Further to this, Max-Neef's threshold hypothesis also provide theoretical foundations of ISEW and related indices. Max-Neef (1995) showed that economic growth can increase the human wellbeing to a certain level, called threshold point, after that growth may lead to the reduction in wellbeing and quality of life. Threshold hypothesis theory was largely supported by the empirical evidences from developed as well as developing countries (Castaneda, 1999; Diefenbacher, 1994; Guenno & Tiezzi, 1998; Tim Jackson & Marks, 1994; T Jackson et al., 1997; Tim Jackson & Stymne, 1996; Osberg & Sharpe, 1998; Rosenberg & Oegema, 1995; Stockhammer et al., 1997). Following to this, (P. Lawn and Clarke (2010)) presented contracting threshold hypothesis and showed that, as global economy is expending, there is a contraction over the time in the threshold level of wellbeing. It was reflected from their analysis that countries which started their journey on growth path earlier, took more time to reach to the threshold level with higher per capita GDP and higher wellbeing level. The late comer countries on growth path are reaching to the threshold point at quite low level of wellbeing. So poorer and late comer countries can never enjoy the wellbeing level, as enjoyed by wealthier nations.

In addition, reference can be made to other welfare economic theories including Social Welfare Function by Bergson and Samuelson and Sen's approach. The fundamental theorem of welfare economics and Preto optimality are referred as a common ancienter for the theories of welfare economics. The first theorem explains the conditions for a

competitive market to reach to a Preto-optimal state. Second theorem explains the conditions in which any Preto optimal stage can be achieved, out of many possible Preto optimal stages in a competitive market through redistribution of resources by market forces. Though Preto optimality may not be desirable always, it explains the state in which no one can be made better-off without making at least one worse-off.

Considering the Preto optimality, improvement in welfare can be justified when at least one person gets benefits without making anyone worse-off. Collective welfare can be estimated by aggregating individual welfare level. However, interpersonal comparisons of welfare gain are not possible considering the Preto's conditions. In real life, policies may benefit few at the cost of others. Samuelson (1948) proposed to use value judgment for interpersonal comparisons, and to consider collective social welfare at society level. Thus, an increase in collective social welfare become possible, where few of the individuals are getting worse-off but collective gain is more than the loss in welfare. For example, imposing tax on richer community members to decrease the inequalities may increase the social welfare, still few of the people are getting worse-off. This theory provides direction to the governments to achieve optimal distribution of income.

The Kaldor-Hicks welfare criterion (Hicks, 1939; Kaldor, 1939) based on compensation principles explains the conditions for the change in social welfare, where change in economic policy makes one section of the society better-off and other worse-off, given that gain compensates the loss and still few people get additional benefits. While criticizing Kaldor-Kicks' work, Scitovsky (1976) presented a paradox and highlighted that if an allocation is considered superior to other based on Kaldor-Hicks criteria, the reverse allocation can also be proved superior using the same criteria. To resolve the contradiction,

he proposed "Scitovsky double criterion", and recommended to fulfil the both criteria simultaneously, i.e. Kaldor-Hicks conditions and non-fulfilment of reversal conditions.

2.4 INDICES RELATED TO SUSTAINABILITY

The concept of sustainability for wellbeing analysis is of crucial importance. Government policies should focus not only one current wellbeing but also the future wellbeing of the inhabitants of their countries. Without considering sustainability, we might be enhancing current wellbeing on the cost of future wellbeing.

Sustainability component has been incorporated in many indices in different ways. First, few indices incorporated sustainability in the form of 'flow variable'. Means whatever non-renewable resources are depleted in specific year or the damage occurred to the nature is incorporated in the index as a negative contribution. However, Stiglitz et al. (2010) argued that this is one component of sustainability and second component is missing. The remaining question is "how far we from the sustainability target are?". So, question of overconsumption or underinvestment need to be focused. This second type received less attention in the literature

The common ancestor in this regards is Sustainable Measure of Economic Welfare (SMEW) proposed by Nordhaus and Tobin (1973). This index is added up to the MEW and considered the sustainability component by calculating two things. First, net change in capital stock, second the growth requirement. Growth requirement is calculated through estimating requirement of capital stock to keep the pace with changes in the size of the

labour force. Productivity factor also incorporated. The MEW capital stock consists of the physical capital stock, land, net foreign assets, education capital, and health capital.

$$SMEW = \Delta K_r + \Delta K_{nr} + V_{edu} + V_h - K_{gr} \qquad \text{(Eq 2.2)}$$

ΔK_r= Net reproducible capital representing investment in structures, machinery and equipment and inventories

ΔK_{nr}= Non-reproducible capital consisting of the value of land and net foreign assets.

V_{edu}= An estimated value of education spending invested in the labour force. An average cost per student is multiplied by the average years of educational attainment per individual in the labour force

V_h= Cumulated public and private spending on health reduced by an annual exponential depreciation rate of 20 percent

K_{gr}= Capital according to growth requirement

Nordhaus and Tobin (1973) also provided theoretical and computational details for the estimation of MEW Capital for Growth Requirement. Summary is given below.

Instead of GNP, Net National Product (NNP) represent the level of consumption that one economy can sustain indefinitely. But, when we discuss about welfare analysis, per capita or household level consumption is more relevant as compared to aggregate consumption level. So, to ensure same level of consumption, investment must be required. Therefore, capital stock should increase at least with the rate of population growth. In this way, consumption level can be maintained at same level with the increased labor force.

Consider the neoclassical model without technological change. When labor force is growing at rate g, the capital-labor ratio is k, gross product per worker is $f(k)$, net product

with non-renewable resources in particular year, but how far we are from sustainability target is still unclear.

Adjusted Net Saving, also refer as a genuine saving is being estimated in a way that consider stock of extended wealth and relative change in the stock. Extended wealth includes natural, physical, productive as well as human resources. Idea behind ANS is that for sustainable development, stock of extended wealth should remain constant. ANS is derived from standard national account data through some adjustments. Through deduction of capital consumption, net national savings are obtained. Current expenditure on education are added to the ANS as such expenditure are considered investment for human capital. Further, depletion of non-renewable resources is incorporated into ANS to cover the natural assets deduction. Monetary value of resource depletion is estimated using resource rent method (Bolt, Matete, & Clemens, 2002). ANS is considered as a strong candidate index for sustainability due to its relevance with theory and notion of considering sustainability in term of stock. Though, there are many critiques on ANS approach on the basis of choice of indicators/dimensions as well as due to the methods adopted for monetary valuation. In term of indicators, air pollution damages are restricted to carbon dioxide emissions only, loss to wetland, farmland, biodiversity loss, underground water depletion and soil degradation are not considered in the index. Resource rent estimation is also criticized specifically for such items whose market value don't exist. Findings of the ANS provide an opportunity to make comparisons among the countries. It appeared from the analysis that most of the developed countries are on sustainable path, whereas developing countries are on un-sustainable or declining path. As, most of the developing countries are natural resource exporters and developed countries are importers or users (Stiglitz et al., 2010).

Table 2.1: Analysis of different dimensions of wellbeing in selected wellbeing indices

Index\Dimensions	Material living conditions	Education	Health	Personal activities (work and leisure)	Governance and democracy	Environment	Political and economic security	Civic engagement and Culture	Inequality	Sustainability (As a flow variable)	Sustainability (As a stock variable)	Subjective satisfaction	Life expectancy
MEW	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No
SMEW	No	Yes	Yes	No	No	No	No	No	No	No	Yes	No	No
ISEW	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No
GPI	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No
HDI	Yes	Yes	No	No	No	No	No	No	No	No	No	No	Yes
HPI	No	No	No	No	No	Yes	No	No	Yes	No	No	Yes	Yes
GNHi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
GNHb	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No
CDI	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No
GPeI	No	No	No	No	Yes	No	Yes	No	No	No	No	No	No
LPI	Yes	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No
SPI	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No
ILS	Yes	Yes	No	No	Yes	No	No	No	No	Yes	No	No	Yes
ISH	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No	Yes
IEW	Yes	No	No	No	No	No	Yes	No	Yes	Yes	No	No	No
QOL	Yes	Yes	No	No	Yes	Yes	No	No	No	No	No	Yes	No

per worker is $f(k) - \delta(k)$, then the net investment requirement is gk, and sustainable consumption per worker is f(k)-$\delta(k) - gk$. Denoting the capital-output ratio as $\mu = [\frac{k}{f(k)}]$, sustainable consumption per worker can also be written as$f(k)[1 - \mu(\delta + g)]$. Although NNP embodies in principle the depreciation deductionδk, it does not take accountof the capital-widening requirement gk.

As stated above, increase in capital stock is essential for sustainable consumption with increasing population. Proposed Net MEW Investment, which is difference of change in capital stock and growth requirement can represent the issue. Zero net MEW investment represents the level of gross investment which results in increase in consumption level with the rate of change in technological progress. In this case MEW and SMEW will be identical. For negative net MEW investment, current level of consumption is utilizing the resources of future development. On the other hand, for positive net MEW investment, economy is making better provisions for future consumption. Although, keeping sustainable wellbeing measurement separate from current wellbeing is an appealing idea, the scope of SMEW is narrow and do not incorporate environmental damages or natural resource depletion.

Alike SMEW, Daly et al. (1989) enhanced the SMEW through incorporating environmental damages and resource depletion into their famous indices ISEW and GPI. However, sustainability indicators were incorporated in term of flow, not as a stock variable. In both indices, monetary value of environmental degradation, depletion of non-renewable stock, change in international investment position and change in capital were incorporated. Using this measurement criteria, one can get an idea, that what happened

Table 2.1 highlights that there is a significant difference between the different indices in term of choice of sub-indices. The choice was somehow arbitrary and depends upon the way how researcher defined the wellbeing. In some cases, researchers explicitly provided the definition of wellbeing they opted, otherwise can be inferred from the proposed indices. To proceed further, it is pertinent to set the benchmark on the thematic scope of analysis through defining the definition and components of wellbeing.

2.5.1 standardization and Aggregation of Components of Wellbeing

The cross-cutting issue regarding standardization and aggregation method used in wellbeing analysis is of crucial nature. Most of the above-mentioned indices aggregate their sub-domain in any mean. Several different approached were reported in literature. First, composite indices were developed using equal or unequal weights. Second monetary approach was opted to aggregate the indices. Third, indicators or sub-indices were kept separately to observe the diversity in trend.

The composite index approach is quite famous among social scientists due to ease in calculation as well as understanding. The monetary approach is famous among economists as well as policy makers due to several reasons. First, monetary valuation provides all values in common unit of measurement (i.e. LCU or dollar) which makes it comparable to the GDP and related standard indicators. Relative strengths/weaknesses of different dimensions of wellbeing can also compared in monetary indices in a better way due to common unit. Most of composite indices are measured on arbitrary scale and their relative contribution to the main index is either identified by the researcher subjectively, sometime

analysis depends upon the scope of study. Here, a brief comparison of few selected studies has been provided.

The list of wellbeing indices presented in the table-2 neither exclusive nor representative of what has been proposed in literature. However, it gives a broad overview of trend in this domain. As discussed earlier, selection of specific domain and indicators is solely based upon the objectives of such initiatives. Thus, all such indices are fulfilling the specified objectives. Stiglitz et al. (2010) have conducted a thorough comparison of such indices and concluded that at least eight dimensions need to be covered in a comprehensive wellbeing study. These eight themes are "material living conditions (income, consumption and wealth), health, education, personal activities including work, political voice and governance, social connection and relationship, environment (present and future conditions), and insecurity of an economic and physical conditions."

Environmental Sustainability Index (ESI) was developed by the scholars from Yale university and Columbia university to measure the overall progress toward environmental sustainability. It incorporates themes like air quality, water quality, biodiversity, eco-efficiency, environmental governance, environmental health, greenhouse gas emissions, human sustenance, land, natural disaster vulnerability, natural resource management, population pressure, waste management. It provides a comprehensive picture using a comprehensive set of indicators (Esty, Levy, Srebotnjak, & De Sherbinin, 2005).

Environmental Performance Index (EPI) is an extension of ESI. Though methodology of EPI is changed overtime, overall theme remains similar to what has been discussed in ESI. In 2016 report of EPI, index was calculated on the basis of two theme, i.e. environmental health and ecosystem vitality. Under these themes, 9 sub-themes were considered and estimated through relevant indicators. Unequal weights were assigned to themes by the researcher (Hsu & Zomer, 2014).

An extension of such work is Global Green Economy Index (GGEI). GGCI is a performance index which is calculated using qualitative and quantitative data on four major themes, i.e. leadership & climate change, efficiency sectors, markets & investment and the environment. Data is collected through GGEI perception survey, which is analyzed along with secondary data on the subject (Tamanini, Bassi, Hoffman, & Valeciano, 2014).

2.5 DIMENSIONS OF WELLBEING

As discussed earlier, wellbeing is a metaphor and was defined in several ways in previous studies. Which dimension of wellbeing need to be included in the index or

Along with this, for most of the developing countries, there is a little room to progress without relying on natural resources. Though, with the passage of time, such countries can transform their economies to more sustainable path, this cannot be happened without relying on natural resources for some specific time period. To be on fair path, it is imperative to consider first sustainability at global level and then to make policies about resource extraction on inclusive and fair basis.

To consider the worldview of sustainability question, one of the key indicators is Ecological footprints. Ecological footprints are based upon a simple but very relevant idea of measuring the regenerative capacity of biosphere used by the human being for their economic activities. Its estimation are based upon accounting the biological productive land, water and timber require for the living of a specific population and compare it with the capacity of biosphere to provide these resources (Network, 2010). In this way, this measurement method provides a robust method of estimating the sustainability at global level. Results revealed that from 80's human foot prints exceed the capacity of biosphere. There were also some critiques on this approach. First, using ecological footprint, densely populated countries will always be penalized whereas sparsely populated countries will always consider more sustainable. Further, it doesn't incorporate depletion of other non-renewable resources like oil and minerals. In a nutshell, it provides a different view of sustainability as compared to ANS.

There are some other indices proposed in the literature. For example, Living Planet Index which was adopted by the Convention of Biological Diversity, as well as by WWF is a measure of the state of the world's biological diversity based on population trends of vertebrate species from terrestrial, freshwater and marine habitats (Loh et al., 2005).

through some statistical criteria (e.g. PCA) or equal weights are assigned. Compared to this approach, monetary valuation provides robust way of comparison among wellbeing dimensions/sub-indices. Mostly, composite indices are based upon output or outcome level indicators and provide results of economic policies. Monetary valuation indices also consider input level indicators (like government spending on health and education), which align them with policy decisions. Indices based upon monetary valuation method incorporate both positive and negative contributors to the wellbeing, so can provide a critical insight into the conflicting sphere between economy, society and ecology (Brennan, 2008). The problem with monetary valuation approach is more methodological, as in many cases, relevant datasets are not available. In many cases, it is difficult to assign the monetary value for non-monetary phenomenon. In national accounting, there is a mechanism to impute the value of house rent for the houses owned by the user. In similar way, imputation can be done for other themes (Stiglitz et al., 2010). However, as these themes are not part of national accounting system or nation-wide survey, unavailability of relevant data remains a challenge.

However, question of aggregating series with diverse type of trends is still valid, as whatever method is used, monetary or composite indexing, it will result in loss of valuable information regarding diversity in trends. Along with this, linear aggregation assumes that all dimensions of sustainability are substitutable. Increase in one dimension of wellbeing may compensate decrease (or no progress) in other components. This assumption makes such indices impractical, as such substitutional assumption cannot be supported by economic theories or general understanding of the economic system. Due to this, another approach is getting popularity, known is dashboard of indicators. For example, monitoring

of SDGs is being carried out using a dashboard of indicators. However, sometimes it becomes too extensive task to look at all the individual indicators and get some idea of progress. In current research, a balanced approach of aggregating only such indicators, which demonstrate the similar trend is adopted. Further details will be presented in chapter 4.

2.6 CONCLUSION AND RECOMMENDATION FOR RESEARCH

The review of literature highlighted several key suppositions that need to consider while proceeding on the research in the domain of wellbeing. Following is the summary of such considerations.

- An explicit and thorough definition of wellbeing should be opted for the research at first instance. Discussion in sections 2.1 and 2.5 covers this component and highlight definition as well as key components of the wellbeing, that will help in devising more inclusive index. The definition as well as selected components are influenced by the work done by Stiglitz et al. (2010).
- A comparison of subjective vs objective type of wellbeing highlighted that both type of approaches generally highlights different dimensions of complex nature of human wellbeing. It is pertinent to consider the objective wellbeing analysis to better cover the wellbeing sphere in the domain of economics. Reasons are already highlighted in section 2.2.

- Within objective wellbeing indices, a choice needs to be made between composite indices and monitory indices. Discussion in section 2.5.1 summarize the discussion on this topic.
- Finally, question around the choice of aggregation method is vital. A comparison is included in section 2.3 and section 2.5.1.

Thus, review of literature not only guided to narrow down the domain of research, with focusing on objective wellbeing indices, measured through monitory valuation approach. But also highlighted the key thematic areas to be included in the wellbeing analysis to make it more inclusive and comprehensive. While comparing the agreed eight dimensions of wellbeing with already proposed monitory index, it appeared that three main dimensions i.e. *political voice and governance*, *social connection and relationship*, and *insecurity of an economic and physical conditions* were largely missing in the indices. This indicted to include missing components into the analysis. However, only one dimensions "*insecurity of an economic and physical conditions*" has been included in the analysis and other two components were dropped mainly due to lack of relevant datasets.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter briefly summarized the research methodology including type of research, data definition, data sources, standardization and imputation of data series as well as definition of statistical methods for similarity measurement.

As described in previous chapters, this study will focus on monitory valuation-based wellbeing indices with two step methodological approach. First step corresponds to the objective-2 of the research and comprises of calculation of "Index of Economic Welfare" for Pakistani dataset and its evaluation. In second step, an improved index will be proposed corresponding to the objective-3 of the research. Chapter 3 explains the methodology opted to measure the "Index of Economic Welfare" for Pakistan, its data sources, imputation methodology and aggregation. As, proposed Multi-dimensional Measure of Economic Wellbeing follows the footprint of ISEW, most of the methodological underpinning are same as of ISEW. Additional component of MMEW methodology will be included in chapter 4. This is because, identification of relevant statistical estimation techniques depends upon the findings of ISEW and hence cannot be presented before the findings.

3.1 ISEW COMPUTATION METHODOLOGY

The Measure of Economic Welfare proposed by Nordhaus and Tobin (1973) can be considered as a pioneer work in the field. Following their work, several other attempts were made including Index of Sustainable Economic Welfare (ISEW), Genuine Progress Index,

Green GDP and Sustainable Net Benefits Index (SNBI). Although, subsequent indices tried to enrich the Nordhaus and Tobin's approach, they deviated from preceding index significantly in methodology. MEW didn't account for impact of climate change in final index, these indices cover climate related issues using CO_2 emission, ozone layer depletion and other similar indicators. In addition, inclusion of natural resource depletion, international investment position and net capital growth into the index make it more comprehensive and relevant.

3.2 VARIABLES USED IN ISEW

Following the footprints of Nordhaus and Tobin (1973), computation of ISEW starts with personal consumption expenditure. Rational of using household expenditure instead of GDP is obvious as material wellbeing is more closely related with income and consumption (Stiglitz et al., 2010), production can expand while income or consumption decrease or vice versa. In addition, household consumption expenditure is further adjusted to income inequality, using Gini index. So, at any time, if income or consumption level of richer people increases, it will elevate the average consumption level. However, ISEW will incorporate the negative effects of increased inequality on the general wellbeing of community.

The index includes other components of uncancelled benefits into the adjusted consumption expenditure including services from consumer durable, non-paid work and services from public expenditures. Now, at this stage, data limitation affected the accuracy of the index. Alike from GDP measure, where very well-defined criteria are in placed to

collect the data, ISEW related indicators need to be included in national accounts and nation-wide surveys to ensure the availability of complete data series. In national accounts, rent of house is imputed for house owners. In a similar way, other imputation can be done, including imputation for the value of education and health services, leisure time and non-market activity. List of all relevant variables used in ISEW computation are presented in table 3.1. Secondary data from multiple sources has been used for the analysis. In most of the cases, initial standardization and imputation of monetary value is being done as per the initially proposed criteria. Details of such standardization and imputation is given in section 3.1.2.

3.3 STANDARDIZATION AND IMPUTATION OF DATA SERIES

Table 3.1 briefly highlight the data sources as well as opted standardization and imputation approach. Few series like "private consumption expenditure" was readily available from national account. Other series were standardized. All the rationales behind standardization, and relevant methodological details are given below.

First component of ISEW analysis is value of domestic or household work. To estimate the monitory value of domestic or household work, two different approaches namely opportunity-cost method and replacement-cost methods can be opted. For opportunity-cost valuation, it is needed to estimate the number of hours spent by the household members in domestic work, and what household member can earn if he/she opted to spend the similar time in some market job. For replacement-cost valuation, it is needed to estimate the value of domestic work, i.e. what cost needed to be paid if same services were taken from market

(Antonopoulos & Hirway, 2010; Budlender, 2010; Dong & An, 2015; Ireland, 1999). Both methods were applied in different contexts in previous studies. In the context of Pakistan, former approach is opted mainly due to the availability of data. Total number of household member who remained involved in domestic work were obtained from WDI data set and Labor Force Participation Surveys. Time use surveys, both national wide, and at sub-national level were helpful to estimate the number of hours spent in domestic work separately for rural and urban areas, as well as for fully employed and un-employed women. By combining these series, total number of hours spent in domestic work were obtained. This was multiplied separately with the urban and rural women's wage rate series to get the monitory value of domestic work using replacement cost method. Arshad (2008) estimated difference among rural and urban wage rates in Pakistan and was used for the valuation purpose.

Monitory valuation of leisure activities is a bit more debatable as compared to domestic work, as replacement cost method cannot be applied for that purpose. In addition, differentiation between, active vs. passive leisure is also an issue, and there is no consensus, how to estimate the value of passive leisure. In case of Pakistan, availability of data remains a central issue, as nation-wide Time Use Survey was conducted only once, in 2007, which provides cross-sectional (not time series) statistics for the time spent in leisure activities. Therefore, monitory value of leisure is dropped from estimation.

Next component is to include the non-defensive public expenditure into the index. Guenno and Tiezzi (1998) showed that half of the government spending on education and health can be considered as a non-defensive expenditure and can be included in ISEW. Further to this, model also includes net international investment position and net capital

growth. Former series was obtained from State Bank of Pakistan and later from World Bank dataset.

Along with the uncancelled benefits, a series of uncancelled costs occurred due to economic activity need to be subtracted from the index. As recommended by the ISEW proponents, cost of commuting, cost of car accidents, cost of noise pollution, water pollution and air pollution, cost climate change (e.g Ozon layer depletion etc.), losses of farmland as well as depletion of non-renewable natural resources need to be imputed and subtracted from the index. For the ISEW for Pakistan, three indicators were dropped mainly due to unavailability of data sets. These include cost of commuting, cost of noise pollution and losses of farmland. A brief overview of imputation criteria for rest of the series is given below.

To assess the monitory value of traffic accidents, data was obtained from multiple sources including Pakistan Bureau of Statistics, UN Asia Pacific Report on traffic accidents and World Road Statistics by International Road Federation. There were still some missing values, so model was estimated for missing value. Automated model selection procedures recommended quadratic model for the data. Estimated series from the quadratic model was used for final analysis. See below graph and model for imputation of missing values related to road accidents

$$Y = \beta_o + \beta_1 t + \beta_1 t^2 + \epsilon \qquad \text{(Eq 3.1)}$$

Estimated model is

$\hat{Y} = -3\ e^{07} + 32502t - 8.147\ t^2$

$R^2 = 0.8767$

Where t is time-lag.

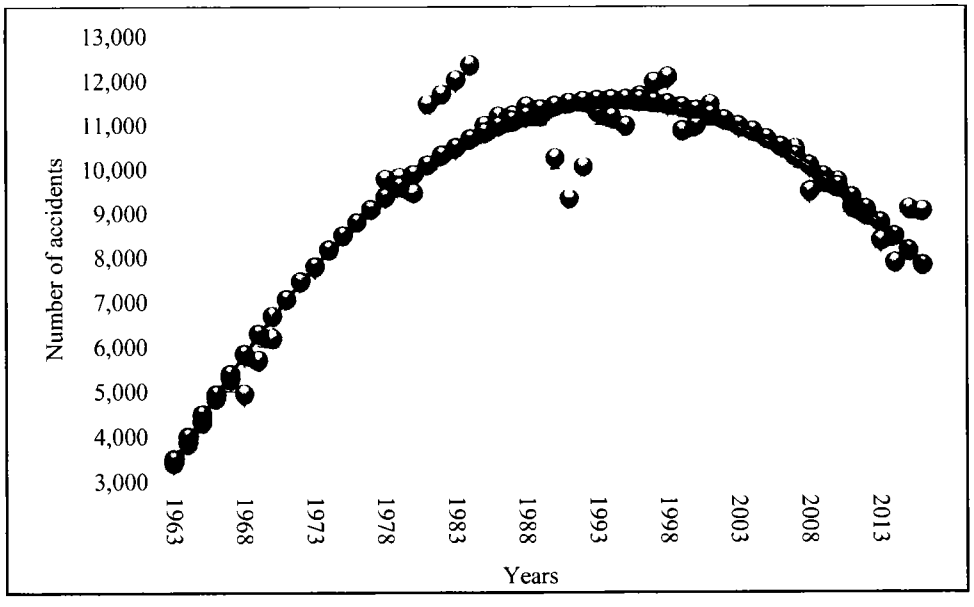

Figure 3.1: Actual and estimated values of traffic accidents in Pakistan (1963-2014)

Cost of road accident was calculated for three segments, cost of life loss, cost of injury and cost of vehicle repair. For cost of life loss, average deaths per accidents were used to estimate the number of total losses. Monitory value was estimated using per capita GDP. For cost of vehicle repair, average cost estimated by Kazmi and Zubair (2014) was used as a starting point and was extrapolated/interpolated for remaining years using inflation rate. On average, per accident, 1.11 cars were crashed/damaged.

To impute the value of cost of water pollution, Disability Adjusted Life Years (DALY) method was used. DALY method was initially developed in early 90s to assess the disease burden. It became increasingly popular among public health practitioners and was widely referred by WHO and other institutions. DALY calculations are based upon the losses of years due to early mortality or morbidity due to any specific disease. For the current analysis, DALY method is used to estimate the life losses, both in term of mortality or morbidity due to water borne diseases. Analysis remained constrained on children under

five, as prevalence of water borne diseases remains higher among children and as disease prevalence data was available only for children. Child mortality rates due to water borne diseases were extracted from UNICEF database and were used to estimate the total number of deaths due to such diseases. Average life of corresponding year is used as expected loss due to water pollution. GDP per capita of the same year is used to impute the monitory value of the life losses. Similar to this, imputed value of morbidity was estimated on the basis of average number of days for the spell of one disease and monitory value was estimated using per day per capita GDP. There were several missing values in the series which were estimated using regression model. Data patterns recommended linear decreasing trend and estimated values were replaced with missing values. Regressions model selected through automated model selection criteria on the basis of least square error and graph of estimated and original values are given below.

$$Y = \beta_o + \beta_1 t + \epsilon \qquad \text{(Eq 3.2)}$$

Estimated model is

$\hat{Y} = 7.2057 - 0.0035t$

$R^2 = 0.9738$

Where t is time-lag.

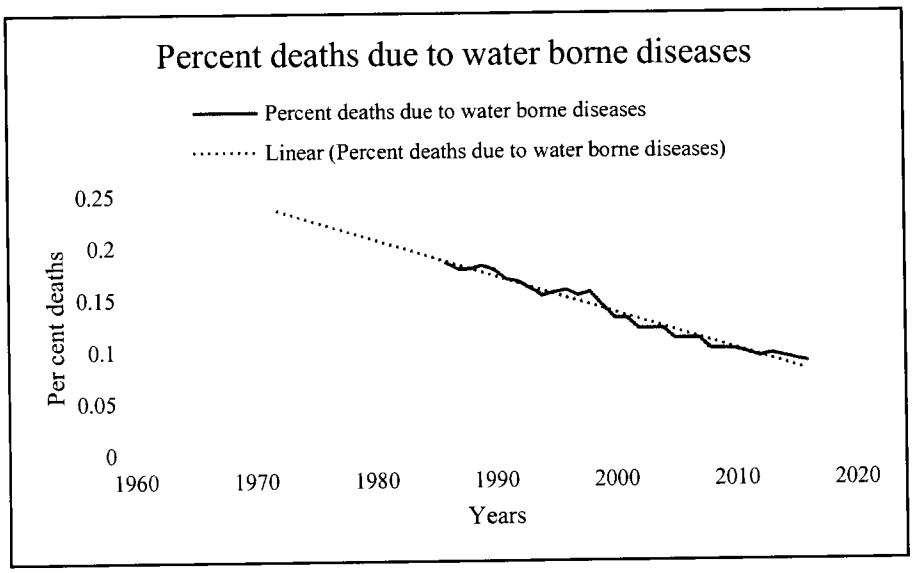

Figure 3.2: Percent deaths due to water borne diseases in Pakistan (1972-2014)

To impute the losses due to air pollution, damages due to carbon dioxide (CO_2) emission were used. World Bank released the estimated value of damages due to CO_2 emissions, estimates were based upon the criteria proposed by Lange, Wodon, and Carey (2018), and used US $30 per ton of CO_2 as an imputed value of damage.

Cost of Ozon layer depletion is also used as one of the indicator to assess the negative impacts of growth on climate. Social cost of emissions of carbon is calculated by several authors and WB use $30 per metric ton, as mentioned in above paragraph. However, social cost of other greenhouse gases, specifically, Chlorofluorocarbons (CFCs) was not estimated. However, relative impact of other greenhouse gases can be estimated using "Global Warming Potential" (GWP) estimation. Global Warming Protentional (GWP) values provide a relative value of how much heat a greenhouse gas can traps as compared to CO_2. In case of CFCs, value was 3800 as estimated on second assessment report. This

value is used in current analysis. CFCs were the prime cause of Ozon layer depletion and used of these gases remained highest during the era from 70s to early current century. With the advancement of technology, use of CFCs is reduced.

For natural resource depletion, data is obtained from WDI. All estimations were based upon criteria proposed by Jarvis et al. (2011). Natural resource depletion includes forest depletion, energy depletion and mineral depletion. Energy depletion covers coal, crude oil and natural gas, whereas mineral depletion covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite and phosphate. Table 3.1 briefly summarized the data used for current analysis.

Table 3.1: Details of indicators, estimation methodology and data sources for ISEW estimation for Pakistan

Theme	Indicator	Estimation methodology	Data source	Contribution
Basis of index				
Income inequality	GINI		WDI	
Adjusted base				
Non-defensive expenditures	Value of domestic labour	Opportunity-cost methods	WDI, National account, surveys	+
	Public education expenditure		WDI/National accounts	+
Private defensive expenditure				
	Cost of car accidents	Econometric model for missing value	Pakistan Bureau of Statistics, UN Report on traffic	–

		DALY method for life losses	accidents and International Road Federation	
Environmental damage	[illegible]	[illegible]	[illegible]	[illegible]
	Cost of water pollution	Econometric model for missing value, DALY method for life losses	UNICEF, WDI, Health Surveys	–
	[illegible]	[illegible]	[illegible]	[illegible]
	Cost of climate change	Imputation using Global Warming Potential (GWP)	WDI	–
Loss in natural capital	[illegible]	[illegible]	[illegible]	[illegible]
	Depletion of non-renewable resources	Jarvis et al. (2011)	WDI	–
Investment position	[illegible]	[illegible]	[illegible]	[illegible]
Net human capital	Net capital growth		WDI	+

CHAPTER 4

RESULTS

This chapter is divided into four sub-sections. First section covers the findings of Index of Sustainable Economic Welfare. In second sub-section, sensitivity analysis of ISEW is presented. Following to this, rational and methodology of Multi-dimensional Measure of Economic Wellbeing is presented. Last section covers the findings of Multi-dimensional Measure of Economic Wellbeing, separately for current and future wellbeing.

4.1 RESULTS OF INDEX OF SUSTAINABLE ECONOMIC WELFARE

This section will briefly summarize the findings of ISEW analysis for Pakistan and will provide a brief comparison with other countries. All findings presented in this section are converted from current price valuation to constant US$ for the base of 2010.

The overall analysis revealed that GDP and ISEW are not aligned with each other in long run, thus findings support the Max-Neef (1995) hypothesis that wellbeing is not correlated with economic growth in long run. Starting from 1972, where difference between ISWE and GDP was minimal, both series showed some increment. Though, ISEW grew at significantly lower rate, but still both series were showing some improvement. After 1984, GDP series continued to rise, however a sharp decrease in ISEW was observed. This decreasing trend continued, with minor fluctuation till 1998, where ISEW remained at lowest level.

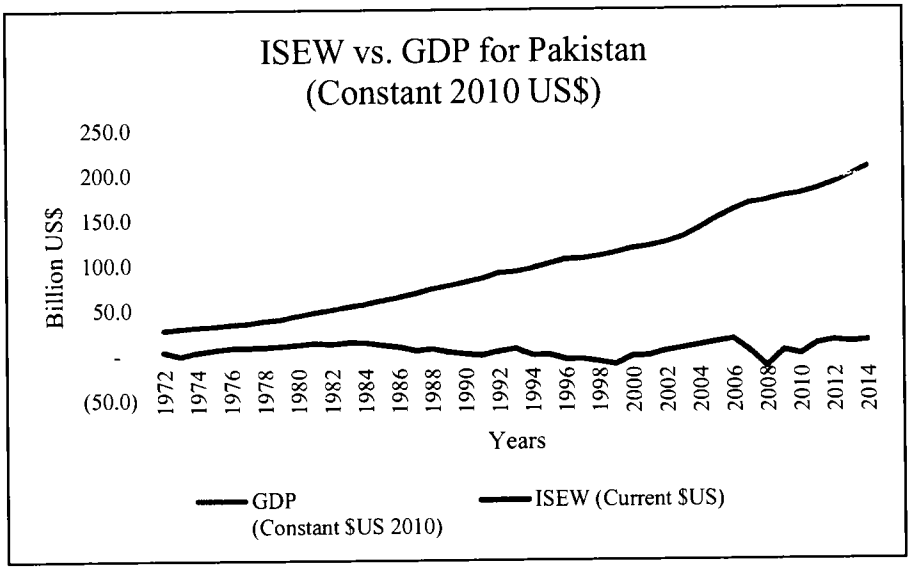

Figure 4.1: Comparison of ISEW and GDP for Pakistan (1972-2014)

After 1998, some major fluctuations were observed during the period of 1998 to 2010. After 2010, a steady improvement is observed. Overall, ISEW and GDP doesn't seem to be correlated with each other, and with the passage of time, gap between ISEW and GDP is increasing.

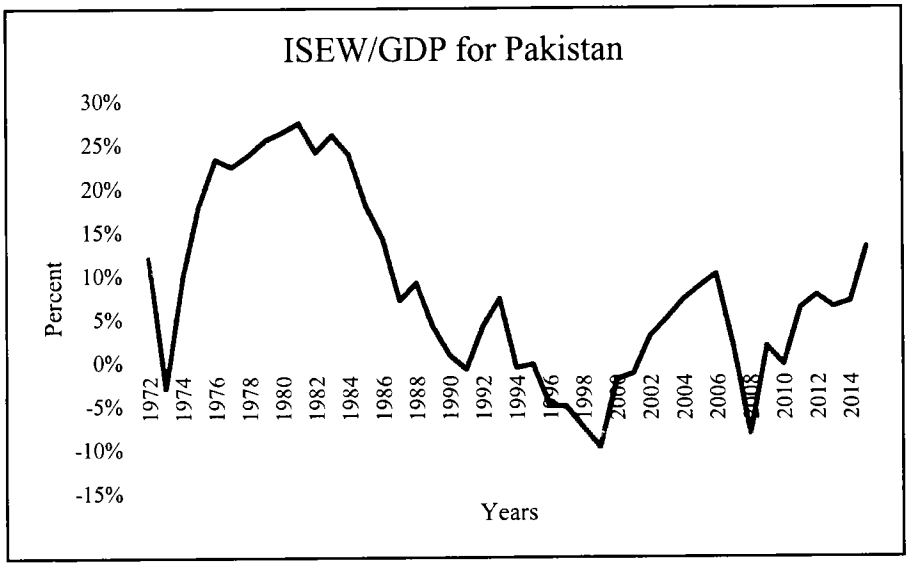

Figure 4.2: Ratio of ISEW to GDP for Pakistan (1972-2014)

While comparing the findings of Pakistan with the global ISEW trends, it appeared that the gap between ISEW and GDP is much wider in Pakistan as compared to other countries. GDP to ISEW ratio increased from 8.32 to 14.1 for Pakistan from 1972 to 2004, whereas during same period, global GDP to ISEW ratio changed from 1.51 to 2.57[3] (Kubiszewski et al., 2013). So, discrepancy between GDP and ISEW was much higher in Pakistan as compared to other world in 1972 and remained at much higher level even after 32 years.

[3] Kubiszewski, Costanza et al. (2013) estimated global per capita index by aggregating data from 17 countries for which GPI or ISEW has been estimated. Discrepancies due to incomplete data were adjusted through comparison with global GDP per capita data.

However, in Pakistan, fluctuation in ISEW after 1998 and steady growth after 2009 is a slightly different behavior while comparing with other countries and world's ISEW.

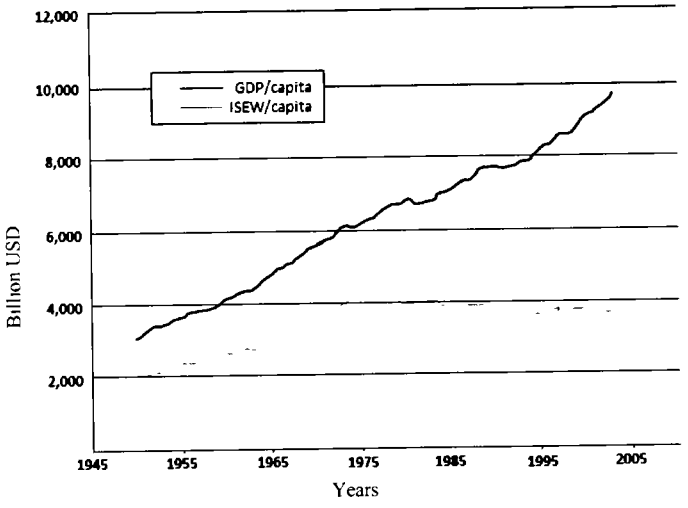

Figure 4.3: Comparison of global GDP per capita and ISEW per capita (1950-2005)[4]

4.2 SENSITIVITY ANALYSIS OF ISEW

To further investigate the reasons of variation in Pakistani ISEW, sensitivity analysis is carried out. Sensitivity analysis is a valuable tool to analyze that either model is strongly determined by the model specification or not. Findings of sensitivity analysis remained helpful to identify the factors that are shaping the ISEW. In addition, sensitivity analysis also highlighted another underlying issue of aggregation criteria of ISEW, due to which valuable information were lost in final analysis.

[4] Calculation of global ISEW presented in this graph were calculated by Kubiszewski et al., 2013

First sensitivity analysis is carried out for income inequality. As presented in figure 4.4, income inequality appeared as a one of the key factor that deviates the ISEW from GDP. If Gini is subtracted from ISEW calculations, ISEW will shift upward, with more ascending trend and with less deviation from GDP series. Negative relationship of income inequality with wellbeing is well understood and most of the economist as well as social scientists highlighted inequality as one of the key factor of dissatisfaction with life (Dynan & Ravina, 2007; Oishi, Kesebir, & Diener, 2011; Okulicz-Kozaryn, 2015).

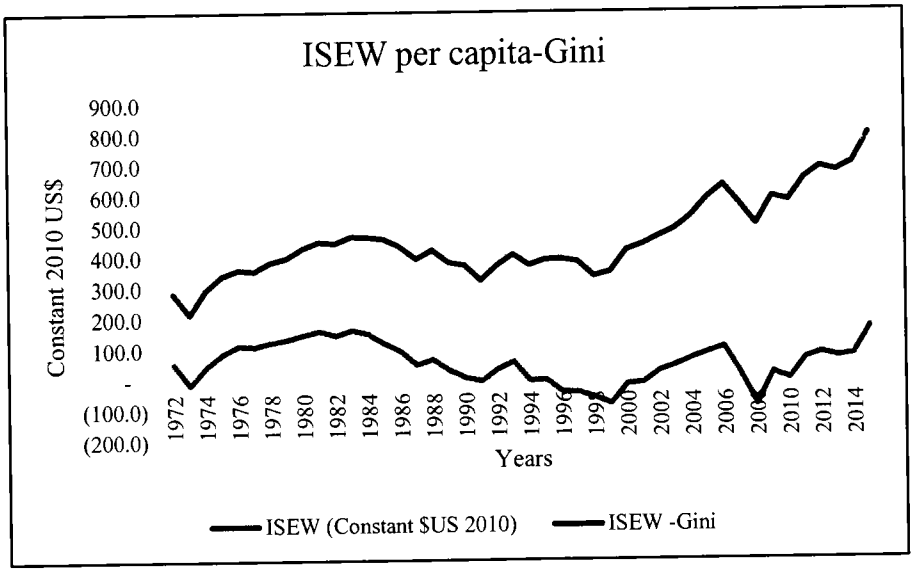

Figure 4.4: Sensitivity analysis for income inequality

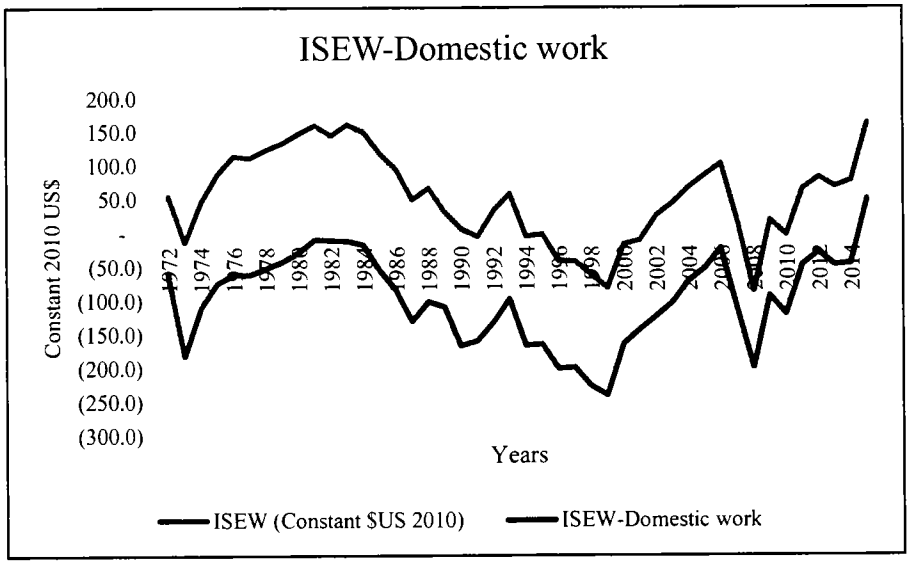

Figure 4.5: Sensitivity analysis for domestic work

Second sensitivity analysis was carried out for value of domestic work. As highlighted in figure-4.5, Value of domestic work have significant effect on ISEW, as in absence of it, ISEW will be shifted downward. Although, there is no notable change in the shape of graph, highlighting that fluctuations in ISEW trend are not caused by this variable. Figure-4.6 presents the sensitivity analysis for non-defensive expenditure. Non-defensive expenditure including expenditures on health and education have negligible impact on overall index.

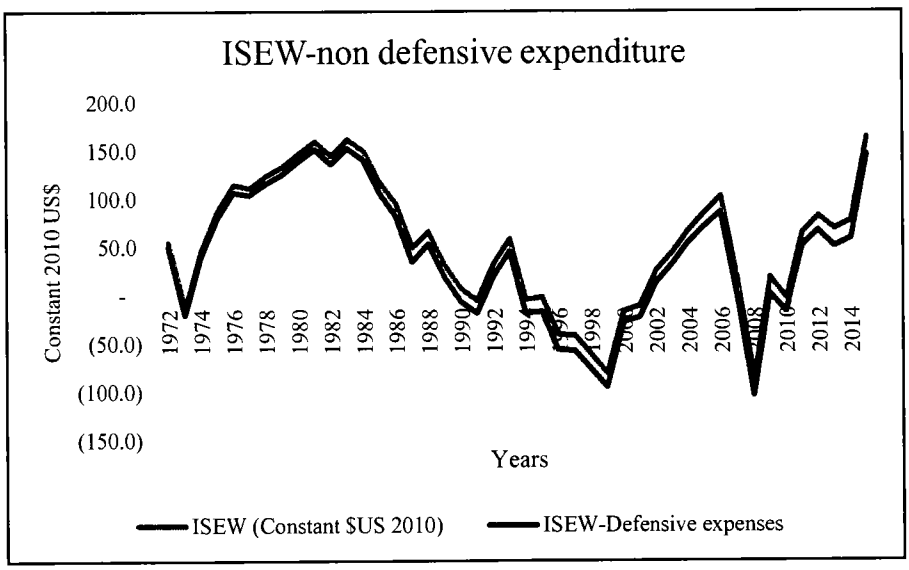

Figure 4.6: Sensitivity analysis for non-defensive expenditures

Figure-4.7 presents the sensitivity analysis for negative externalities of growth. Negative outcomes of growth process showed substantial negative impact on the index.

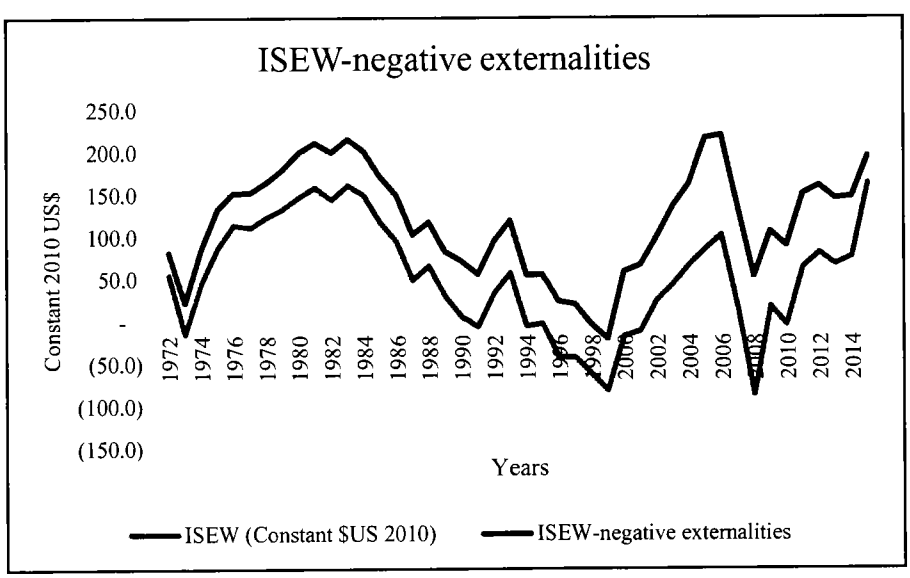

Figure 4.7: Sensitivity analysis for negative externalities

Negative externalities include cost of traffic accidents, cost of water and air pollution, damages due to carbon dioxide emission, ozone layer depletion and depletion of non-renewable resources. Impact of such negative externalities was relatively less in initial years but increased with the passage of time. As presented in figure 4.7, difference between two lines is at highest level during 2008. Slight improvement is observed after 2008.

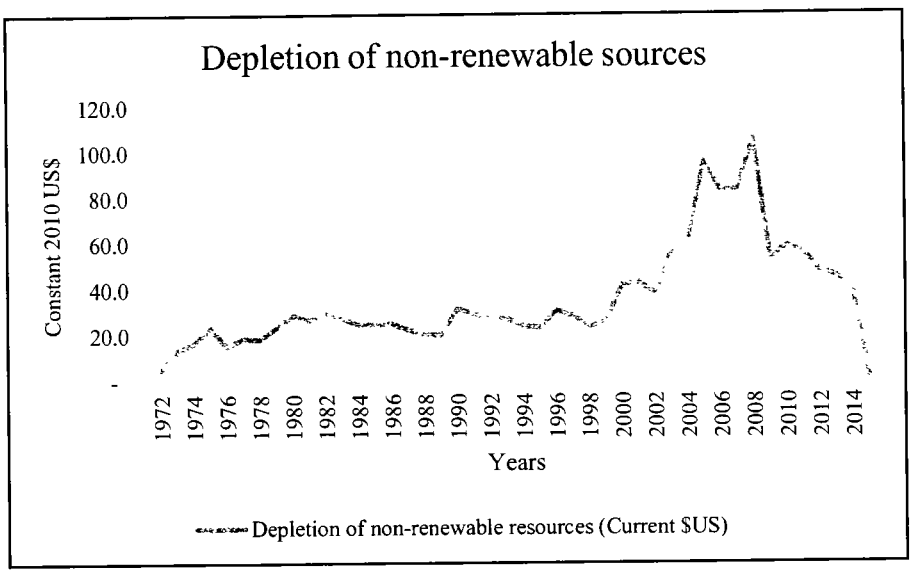

Figure 4.8: Value of depletion of non-renewable resources

To understand the factor behind such variation, it is imperative to see these indicators separately. Figure 4.8 shows the value of depletion of non-renewable sources. After 2000, government of Pakistan started relying more on fossils fuels for power production, as well as, transportation and industry sectors were shifted to natural gas instead of other energy sources, which caused swift depletion of available energy resources in the country. Swift depletion of non-renewable resources can increase the growth for current year however,

this is harmful for the economy in a longer run for the sustainability of development and growth. This is the cost that will be paid by the future generations.

Other than this, cost of water and air pollution also left significant effects in the index overall. However, monitory cost was reportedly on descending pattern after 1990, whereas cost of air pollution depicted increasing trend up till 2000, after that relatively smooth trend was observed. Cost of ozone layer depletion portrayed normal behavior with gradual increase from 1978, achieved highest level in 1994 and then gradually decreased. After 2014, cost of ozone layer depletion is almost negligible. See figure 4.9 for the trends in data.

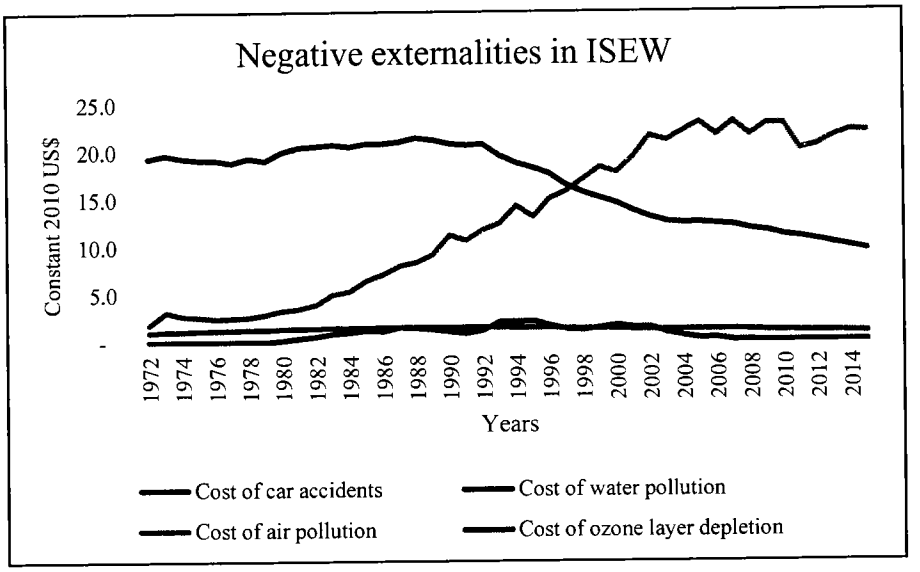

Figure 4.9: Value of negative externalities in ISEW

Next sensitivity analysis was carried out for net international investment position. NIIP appeared as a most important indicator which have significant contribution in shaping the

ISEW in Pakistan. In current analysis, NIIP not only caused the deviation of index of ISEW but also explains the fluctuation in ISEW trend after 1998. Although, international investment position remained negative for whole study period, lowest value was observed during the year of 2008 when aggregate NIIP value was (USD 7.2 billion), around 43% of the whole GDP of Pakistan.

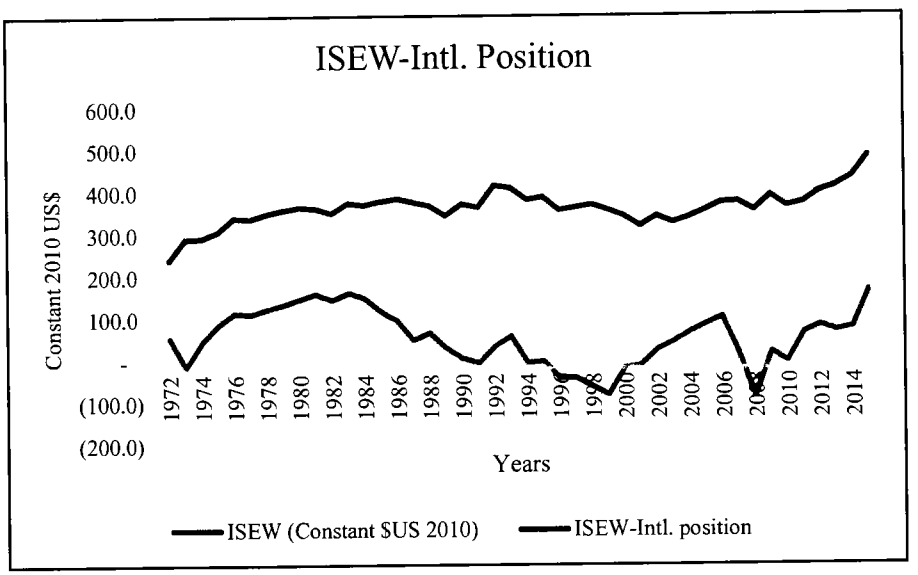

Figure 4.10: Sensitivity analysis for net international investment position

Net capital growth contributed positively to the index. Though accumulated value of growth was not much higher in initial year, it was increased gradually and reached to five times higher level after 40 years. Net capital growth has minor impact on the shape of ISEW.

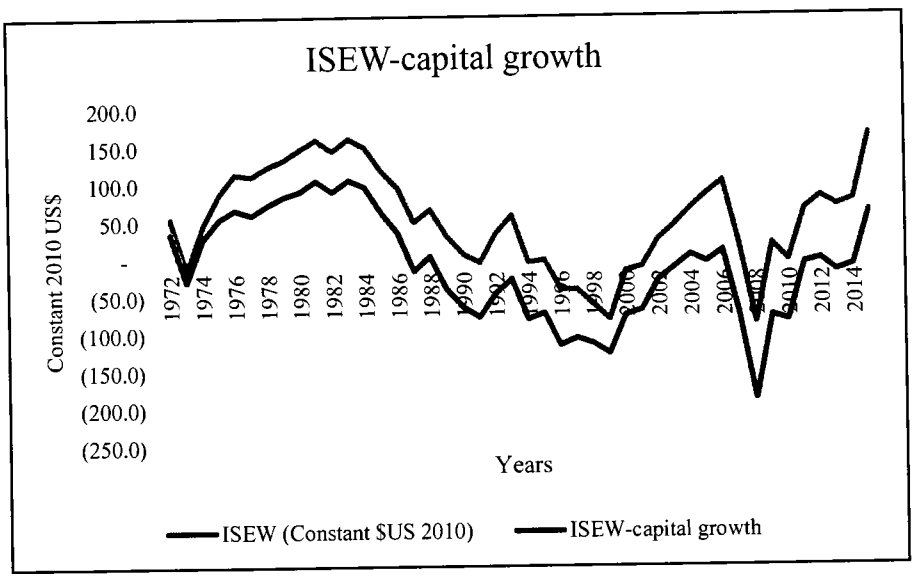

Figure 4.11: Sensitivity analysis for net capital growth

As highlighted in above analysis, when individual indicators are observed, their variation can differ from the overall index over the period of time. Now, relying only on the aggregated series is somehow misleading, as variation in individual indicators is missed due to taking averages or aggregation. The understanding of such variation is much important in policy perspective, as it provides explicit direction for the policy formulation. Due to this, most of the policy makers are relying in dashboard of the indicators instead of aggregated indices. In next chapter, more balanced approach is proposed to aggregate only those series which have similar trends and avoid aggregating series with diverse pattern.

In this chapter, an improved index of economic wellbeing is proposed, referred as a Multi-dimensional Measure of Economic Wellbeing (MMEW). Overall, three major changes are proposed in previous work of monetary indices. First, choice of dimension of wellbeing is discussed and it is proposed to broaden the scope of analysis through including additional dimensions and indicators in to analysis. Second, it is argued that sustainability measurement requires different type of analysis, and analysis of only depleted resources may not serve the purpose. It is also argued that sustainability measurement should be kept separate from current wellbeing analysis. Merging the two may be misleading. Third, it is argued that aggregation or taking average of such indicators that have dissimilar trends will lead in information loss. A local solution is proposed, based upon the data trends. Before planning for aggregation, it is imperative to fist analyze the similarities/dissimilarities in data series. It is proposed to use Multi-Dimensional Scaling and Hierarchical Clustering techniques to identify the similarities/dissimilarities in data set.

A similar approach was proposed by Hirschberg, Maasoumi, and Slottje (2001) who argued that wellbeing has different dimensions and each dimension can have different distribution. It is imperative to compare the whole distribution of income and other dimensions of wellbeing. Authors criticized that dimension reduction for wellbeing analysis through correlation-based approaches are not comprehensive. In statistics, two variables considered same, when they follow the same distribution. So, comparing only mean and variances is not sufficient, instead, whole distribution should be compared. For that purpose, authors compared the differences in distributions using entropy. Authors used cluster analysis technique for dimension reduction.

Details of all three proposed changes, measurement criteria and findings for Pakistan are presented in subsequent sections. Despite above-mentioned changes, computation done in previous chapter were opted for the analysis.

4.3 DEVELOPMENT OF MULTI-DIMENSIONAL MEASURE OF ECONOMIC WELLBEING FOR PAKISTAN

4.3.1 Theoretical framework of proposed index

Physical, economic and political insecurity can leave strong effects on wellbeing. Specifically, when we are talking about economic wellbeing both, economic and personal insecurity directly affect the wellbeing. Personal insecurity includes external factors that put at risk the physical integrity of each person like crime, accidents, natural disasters and climate change. In worst case scenario, these incidents can lead to the death of a persons. However, impact of such event is Although, death toll due to such events remain lesser as compared to the deaths due to other reasons. But, mortality due to such events brings much more psychological and emotional impacts on the remaining population. Specifically, with the advancement of electronic and social media, minor issues can be broadcasted to wider audience and can leave massive emotional impact. While talking about Pakistan, two issues are of crucial importance. First is physical insecurity due to terrorism and second is due to disasters. In next paragraph, details of such events in the context of Pakistan is provided to emphasize on the relevance of these factors.

Pakistan is one of the most severely exposed countries to climate change in the world (ranking 7th in the world). Temperatures have already risen by nearly 2 degrees since 1901,

and rain patterns have also been affected. Due to these climatic conditions, Pakistan is exposed to several types of climate related disaster disasters including floods, flash floods, GLOF, drought, extreme weather events and cyclones. In addition to this, Pakistan is one of most seismically active countries in the world. Country overlaps both the Eurasian and Indian Tectonic plates. Therefore, country faced several severe and moderate level earthquakes in the history. During the study period, from 1972 to 2015, Pakistan have faced above 20 mega and around 100 moderates to severe disasters. Mega disasters include floods in 1973, 1976, 1977, 1978, 1992, 1995, 1996, 1998, 2010, 2011, 2012 and 2014. Also, earthquakes in 1974, 1083, 2005 and 2015. In addition, severe drought spells were faced during 1998-2002 and 2012-15. These disasters overall caused death of above 100,000 people, cumulative figure of affected people crossed 90 million and cumulative financial loss above 28 billion dollars.

Disasters not only cause losses to life and property; it also causes severe psychological and emotional effects. Indirect losses due to disasters are difficult to measure as it reduces the opportunities of economic activities. GDP and related indicators don't capture the negative effects of such events. However, such events bring some reconstruction opportunities with them, which were considered positively in GDP in later years. In this way, standard GDP related measure treat disaster like events in a positive manner. Keeping in view the strong negative effects of such events on people's wellbeing, it is imperative to incorporate in wellbeing analysis.

In addition to the natural hazards, Pakistan also faced multiple man-made crises in the shape of terrorism attacks. Though, organized terrorism initiated in Pakistan in cold war era, it becomes a major and highly destructive phenomenon in recent years. As per the

statistics extracted from Global Terrorism database, country faced above 14,000 noticeable organized terrorist attacks. These attacks include armed conflict, assassination, bombing/explosion, infrastructure attack, armed assault, hijacking and hostage taking/kidnapping. Such events not only caused losses to life, injuries and infrastructure damages, but also caused psychological and emotional losses. Out of the reported incidents, highest occurring event was bombing/explosions, 53% of total reported events and causing above 12,000 life losses. Following to this, armed assaults were around 27% of the total reported incidents and caused around 8,000 life losses. 10% of the reported events were assassinations caused around 2,000 life losses. Direct losses due to terrorist attacked were estimated above 1.5 billion dollars. However, opportunity losses due to terrorist activities specifically in tourism sector, losses due to fear and negative emotions were also difficult to measure. Effect of terrorism activities also considered as an important factor affecting wellbeing negatively.

Second change proposed in multi-dimensional measure of economic wellbeing is to treat sustainability component separately from the current wellbeing analysis. Although, the monetary indices discussed and compared in chapter-3 considered sustainability component and negative effects of economic activities on environment were estimated and deducted from the index. In addition, change in capital stock and change in international investment position was also included in the analysis. However, such analysis only covers one component of sustainability and second component remains missing. This second component is related to estimate the overall *stock* value of resources and discuss about the overconsumption and underinvestment of the resources. Such analysis should tell us that how far are we from the goal of sustainability. Aggregation of such information with

current wellbeing analysis will be misleading, as each analysis provides different type of information. To explain the difference of both approaches, Stiglitz et al. (2010) shared an example of meter of vehicle. While driving, drivers needs several information separately including current speed, RPM and level of petrol in petrol tank. If we provide them a single value through combining all this information, driver will be unable to decide through observing this aggregate index that either he/she is over speeding or in need of refueling. Similarly, a separate analysis of stock of natural resources and level of depleted resources need to be analyzed separately.

A review of some proposed indices to estimate the sustainability is presented in chapter-2. For the ease of understanding, these resources can be categorized in two groups. One of non-renewable natural resources, like minerals. Others are renewable natural resources like wood. Daly et al. (1989) and C. W. Cobb and Cobb (1994) covered only non-renewable resources into their analysis. The assumption behind such analysis is that renewable resources will be recovered after depletion through natural resources. However, recent studies showed that level of depletion of renewable resources must be lesser than the capacity of biosphere to regenerate such resources. Otherwise, such resources will become scarce. In current analysis, a deviation from Daly et al. (1989) methodology is proposed through keeping sustainability analysis separate from current wellbeing analysis, viz a viz scope of analysis is also expended through covering renewable resources into the analysis along with non-renewable resources. For renewable resources, data of ecological footprints have been used. Ecological footprints measure the human demand on nature and compare it with the capacity of biosphere to reproduce the resources required by human being. For non-renewable resources, data of adjusted net savings or genuine savings have been used.

ANS data is calculated in term of stock of extended wealth. Extended wealth includes natural, physical, productive as well as human resources.

Third, proposed methodology is different from traditional monetary indices in term of aggregation. As discussed earlier, aggregating time series with different nature of trends will results in loss of information. Impact of aggregation is presented through sensitivity analysis in chapter-3. What is proposed in current analysis is to use Multi-Dimensional Scaling (MDS) and Hierarchical clustering to first identify the similarities/dissimilarities in trends. The aggregate such series that exhibit similar trend and aimed to estimate the same or similar dimension of wellbeing. In this way, it becomes possible to reduce the number of individual indicators for the efficiency of analysis but will not lose the valuable information about the diversity in dataset. In this way, this approach will be more practical as compared to aggregated indices or dashboard of indicator's approach.

4.3.2 Data and methodology

4.3.2.1 Computation of economic and social security

In the proposed index, losses due to disasters in the category of 'physical and economic insecurity' have been included. A comprehensive dataset provided by EMDAT was used for the analysis. Monetary value of disaster includes losses to life, cost of curing injuries and losses to infrastructure and private property. Longer term losses due to disaster are not included in analysis due to lack of data and measurement criteria.

In current analysis, human cost of terrorism was calculated using the Institute for Economics and Peace's cost-of-violence methodology. This methodology includes lost life-time earnings and cost of medical treatments from incidents of terrorism. To estimate the lost lifetime earnings, lifetime losses were estimated on the basis of life expectancy, cost was estimated using per capita GDP of same year. Cost of property losses were obtained from global terrorism data base. Cost of injures was estimated using DALY method. Following the work of _ENREF_4 Arce (2018), who estimated the life losses at global level using GTD data. Their estimations were based upon global statistics and sampled detailed information. They differentiated between the type of attack, as every type brings different type of injury, resulting in different level of life losses. Once they calculate the life losses separately for each type, they aggregate it using GTD data. GTD data contained desegregated information for each type of attack. They concluded that injuries cause 51% addition into life losses every year.

These estimations exclude several aspects of terrorist activities due to lack of data. This include opportunity losses, losses due to internal displacement, economic burden due to refugee arrivals from Afghanistan and emotional losses due to terrorism.

For the analysis of sustainability, data from ecological footprint was used. Concept of Ecological footprint has been explained in chapter-2. The data of EF is available separately for biocapacity and human's footprint in a common unit of global hectares. Taking differences of both can tell us about the impact of human activities on the nature. Data is available separately for six dimensions including build land, carbon, cropland, fishing ground, forest product and grazing land. By aggregating these series, one can get the overall ecological footprint series. As discussed, the data is presented in the unit of global hectares.

To ensure the harmony in analysis, first data is transformed into monetary value. For that purpose, monetary estimation done by Costanza et al. (1997) was used. Monetary valuation of Costanza et al. (1997) was based upon the idea that valuation always done keeping in mind a specific goal and how effectively one component is contributing toward that goal. They argued that Ecological economics have roots in three integrated objectives. First is sustainable scale, second is social fairness and third is efficiency of economic system. Therefore, their valuation approach should incorporate all such objectives. Other than this, adjusted net saving data is already calculated in term of monetary value. Adjusted net saving series is composed of three components i.e. energy depletion, mineral depletion and net forest depletion. As per the definition of WB, "energy depletion is the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil, and natural gas. Mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate. Net forest depletion is calculated as the product of unit resource rents and the excess of round wood harvest over natural growth."

4.3.2.2 Multi-dimensional scaling and hierarchical clustering

In this section, a brief explanation of estimation methodology of multi-dimensional scaling and hierarchical clustering will be presented along with the rational of using these techniques in current analysis.

Multi-dimensional scaling referred as MDS is a technique to assess the similarity or sameness in the dataset. Through MDS, analyst can obtain quantitative estimates of similarity among data series. It not only reduces the complexity of data set but also provides visual appreciation of the underlying structure of relationship among variables/data series. Broadly, MDS can be considered an important technique of exploratory data analysis and dimension reduction technique. Input for MDS can be some qualitative variables, in term of ranking or quantitative variables. The outcome of MDS is a "map" that spatially represents the relationships among indicators. In this map, similar indicators are located close to each other whereas dissimilar indicators are located further apart from each other. Using the spatial presentation of the results, underlying dimensions of the dataset can be comprehended.

For the estimation of MDS, first step is to develop a 'proximity matrix'. Proximity, in MDS analysis can be defined the relationship for pairs of the objects. If the dataset is composed of Y items, total $(Y * (Y - 1))/2$ proximities will be required. In this way, each item will be compared with every other item at least once. Larger sample will yield a complex proximity matrix, which make it impractical to do the estimations manually. Rather advance statistical packages will be required for such analysis. One of the strengths of MDS technique is that this technique is flexible to treat any type of data. Many different types of data, ranging from ratio to interval and ordinal scale can be used to estimate the proximities. Even it can treat data from multiple sources in same analysis (Jacoby, 2012).

To explain the estimation procedure of MDS, let assume a square matrix of K x K, referred as Δ in this section. The Δ matrix represent data of proximities among k items. The single proximity referred as a δ_{ij} and representing the proximity in i_{th} row and j_{th} column

of Δ matrix. As, Δ matrix is a symmetric matrix, it means that $\delta_{ij} = \delta_{ji}$. The proximity data is represented in term of dissimilarities instead of similarities. Means that if the value of proximity between the items i and j is higher, it means that these items are relatively closer to each other and vice versa. What MDS do is to find the set of k points in m-dimensional space in a way that distance between pair of points on map represent the dissimilarity among two items. Or in other words, MDS estimates a KxM matrix X, comprising of distances, referred as Euclidian distances and estimated on the basis of Δ. The distances between items i and j are referred as d_{ij} is calculated on the basis of δ_{ij}. Famous Pythagorean formula is used for the calculation of Euclidian distances.

$$d_{ij} = [\,(x_{i1} - x_{j1})^2 + (x_{i2} - x_{j2})^2 + \ldots + (x_{im} - x_{jm})^2\,]^{1/2} \qquad \text{(Eq 4.1)}$$

In this way, d_{ij} is calculated for all possible pairs in a way that $d_{ij} \approx \delta_{ij}$. Or in other words, MDS estimated matrix X using the proximity data of matrix Δ. So, for all pairs of i and j, where $i \neq j$,

$$d_{ij} = f(\delta_{ij}) + \varepsilon_{ij} \qquad \text{(Eq 4.2)}$$

So, the distance between items i and j are the function of proximities between i and j, with some error. The nature of function can be determined on the basis of objectives of analysis. In the analysis, it is tried to minimize the error term. The measure of goodness of fit for MDS is calculated from the error term. Means if the function f transform proximities into distances in efficient way (least differences between proximities and distances) then good of fit measure will be high.

The Multidimensional Scaling estimation techniques can be divided into two broad categories, matric MDS and non-matric MDS. Matric MDS can be employed if the input

data is on ratio scale, whereas non-matric MDS deals with the data on nominal, ordinal or interval scale. Despite the nature of input dataset, output of MDS is always on ratio scale. Metric MDS assumes that the distances on the map can be represented through a linear parametric function of dissimilarities. For example:

$$d_{ij} = a + b\delta_{ij} + e_{ij} \qquad \text{(Eq 4.3)}$$

In sum, MDS provides a readily comprehensible presentation of similarity/dissimilarity information. MDS can be used in such research where either researcher wants to determine the systematic underlying structure among the indicators. Researcher has to discuss the distances on map on theoretical ground. Such discussion can provide understandings of the underlying variability in the dataset. It explains the reasons of similarities and dissimilarities in the dataset. The output of MDS facilitates this process as it is easier to understand the findings as compared to the original, numeric information about the relationship among indicators. Another similar analysis is cluster analysis.

MDS provides spatial representation of similarities or dissimilative in data set, cluster analysis conducts a similar task through grouping the similar items or set of objects. Cluster analysis is also considered an important exploratory data analysis technique as well as dimension reduction technique. Cluster analysis in not a specific algorithm, rather it is a group of algorithms to achieve a similar task. Similar to MDS, cluster analysis also starts estimation on the basis of Euclidian distances. Euclidian distance can be defined as an ordinary straight-line distance between two points in Euclidian space. Few famous clustering algorithms include centroid-based clustering, connectivity based or hierarchical clustering and distribution-based clustering. In centroid-based of k-mean clustering, clusters are represented by a central vector, which may not necessarily be a member of the

data set. It starts with fixing the number of clusters and algorithm starts finding k cluster centers and assigning objects to anyone of the center. In distribution-based clustering, clusters can be defined as objects belonging to the same statistical distribution. In connectivity based or hierarchical clustering, core idea is to group such items that shows more similarity with each other and keep different items away from each other. These algorithms connect "objects" to form "clusters" based on their similarity. Different similarity measures are proposed in the literature. In current research Euclidian distance as defined in below equation is used for analysis.

$$d(x,y) = \sqrt{\sum_{i=1}^{n}(xi - yi)^2} \qquad \text{(Eq 4.4)}$$

A cluster can be defined as a group of items with minimum/less distances. Now, the term minimum or less is a relative term. Instead of defining any threshold point, hierarchical clustering form multiple clusters at multiple stages. Findings are represented in dendrogram, a graphical presentation of hierarchical clustering. The x-axis of dendrogram present the objects or items to be clustered, whereas y-axis presents the linkages between these items/objects. The higher the distance between objects or group of objects, the longer will be the connecting line between these objects/group of objects.

Keeping in view the objective of current analysis, both MDS and hierarchical clustering can be considered as appropriate techniques. The intention is to identify similarities and dissimilarities among different series so that to avoid combining dissimilar trends in one series. Findings of MDS and hierarchical clustering along with the findings of multidimensional measure of economic wellbeing are presented in next section

4.4 RESULTS OF MULTI-DIMENSIONAL MEASURE OF ECONOMIC WELLING

4.4.1.1 Multi-dimensional measure of current economic wellbeing

As discussed earlier, it is preferred to keep sustainability analysis separate from current wellbeing analysis. Therefore, current analysis only entails indicators related to current wellbeing. List of indicators is same as presented in chapter-3, only two additional indicators, losses due to natural disasters and cost of terrorism included in the analysis.

To proceed further, first multi-dimensional scaling is conducted on the data series to observe the similarities / dissimilarities in dataset. MDS is conducted in two-phases. In first phase, indicators related to 'material living conditions' and 'personal activities and work' appeared too different from other data sets. Please see figure-4.12 below in this regard. The distance between two points represents similarity/dissimilarity among the variables.

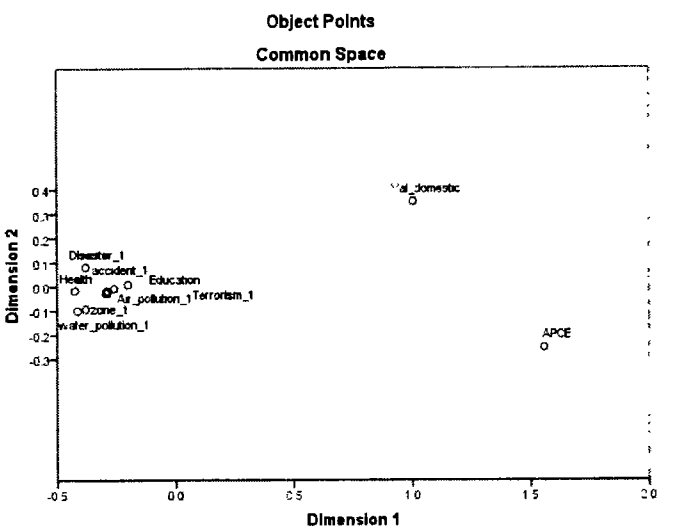

Figure 4.12: Multi-dimensional scaling for current wellbeing -1

Once, it appeared that inequality adjusted personal consumption expenditure, a proxy indicator of 'material living condition' and value of domestic labor, a proxy indicator for 'personal activities and work' exhibit dissimilar trend from remaining indicators, these two indicators were excluded from analysis and repeated the MDS. As, in presence of these indicators, internal variation among remaining indicators was hidden. Figure 4.13 presented the findings of MDS for remaining indicators.

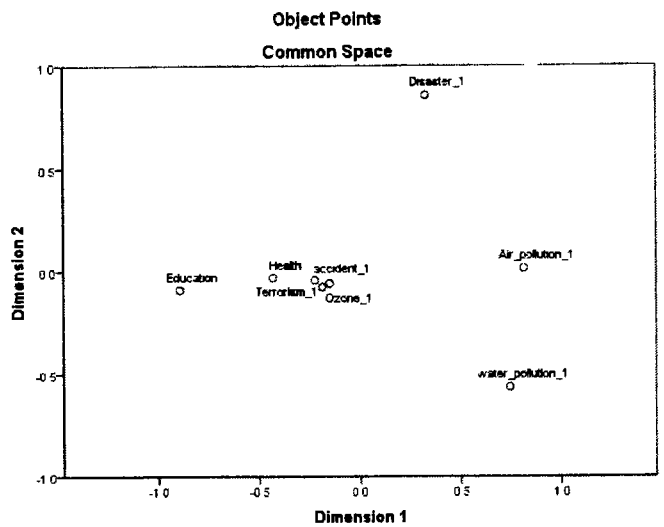

Figure 4.13: Multi-dimensional scaling for current wellbeing -2

Figure 4.13 showed that external hazards (disasters) appeared very different from other set of information. Whereas environmental issues like water pollution and air pollution also located at significant difference from other variables. Apparently, merging water pollution and air pollution may lead in less information loss. Rest of the indicators can be merged or keep separate on theoretical ground. For further confirm these findings, hierarchical cluster

analysis is conducted for same dataset. Figure 4.14 presents the dendrogram of hierarchical cluster analysis. On dendrogram, left axis represents different variables included in the analysis whereas length of connecting line on x-axis represent the closeness among the variables. Similar to previous findings, at first stage, cluster analysis revealed that inequality adjusted personal consumption expenditure and value of domestic work are significantly different from other variables.

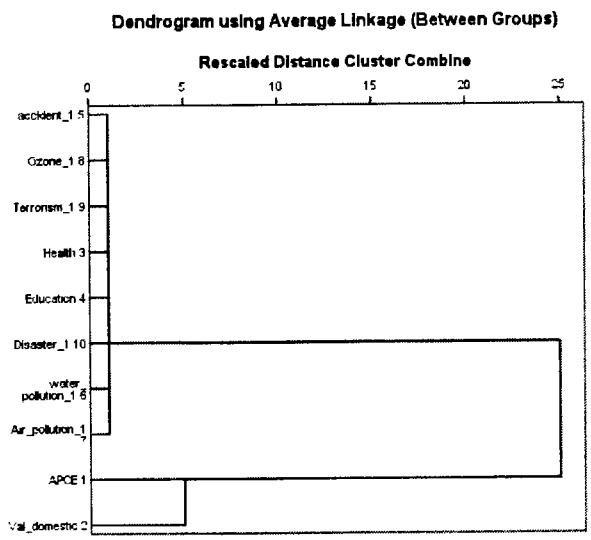

Figure 4.14: Hierarchical cluster analysis for current wellbeing -1

To demonstrate the variation among remaining variables, above-mentioned two variables were excluded from the analysis and hierarchical cluster analysis was repeated. Findings are aligned with the MDS results as water pollution and air pollution appeared very different from other variables. External hazards (disasters) are also dissimilar to other data series.

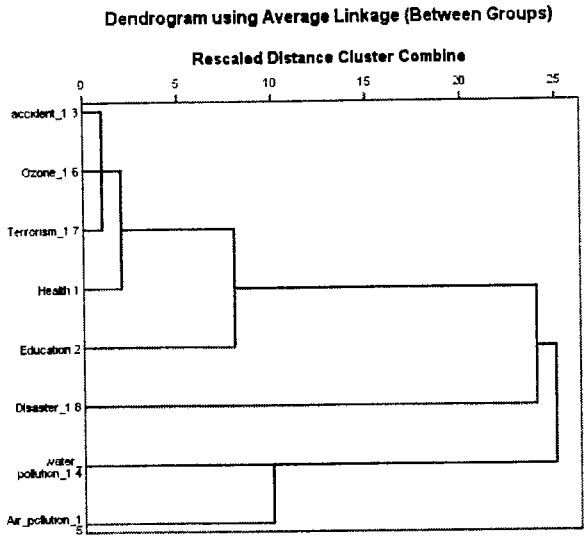

Figure 4.15: Hierarchical cluster analysis for current wellbeing -2

Keeping in view the both findings, it can be concluded that merging all series in one series may be misleading and will cause information loss. To be on safe side, all variables can be divided in 6 groups, on the basis of similarity/dissimilarity analysis. Figure 4.16 to Figure 4.21 are presenting findings of these six groups.

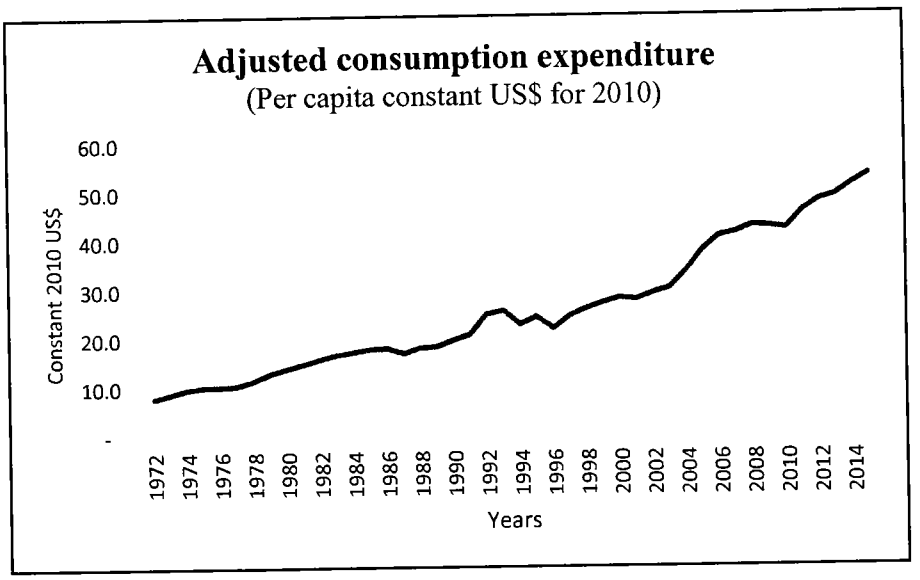

Figure 4.16: Value of adjusted consumption expenditures

Inequality adjusted personal consumption expenditure were included in analysis as a proxy indicator of "material living conditions". Data trend revealed that overall there was an increasing trend in PCE. Though, some minor fluctuation were observed after 1986, between 1992 to 1996 and between 2008-2010.

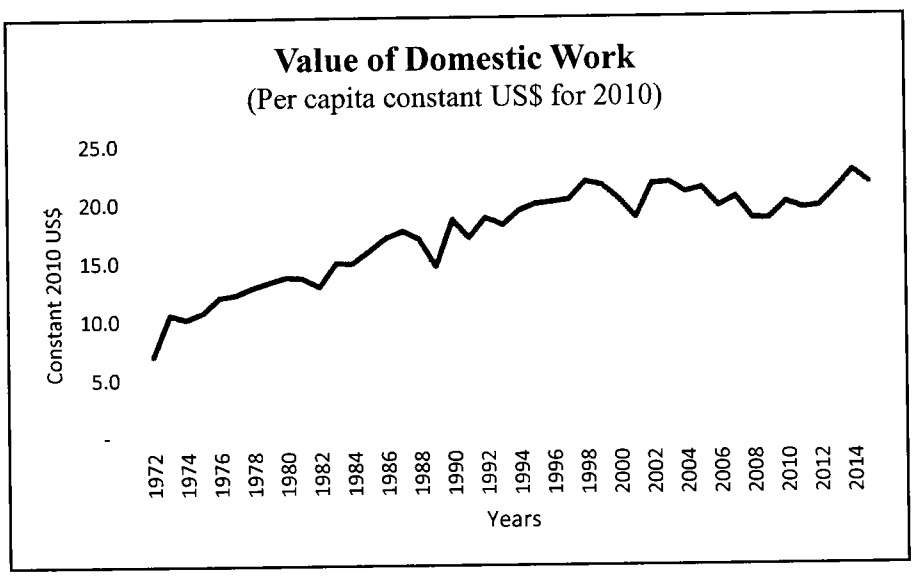

Figure 4.17: Value of domestic work

Value of domestic work is included in analysis as a proxy indicator for "personal activities and work". Though, data related to leisure activities should also be included in this domain, it was withdrawn from this indicator due to lack of data. The value of domestic work increases with the passage of time but with more fluctuations as compared to personal consumption expenditures.

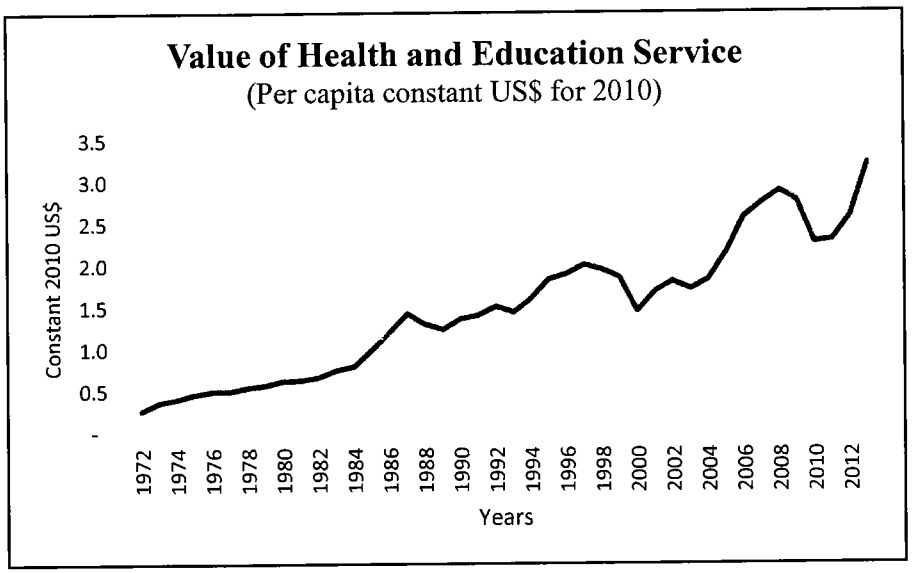

Figure 4.18: Value of health and education services

Health and education are considered as separate dimensions of wellbeing in the framework. However, similarity analysis revealed that both series can be merged. Situation of health and education was also increasing overtime, several fluctuations were observed after 1998, as presented in figure 4.18.

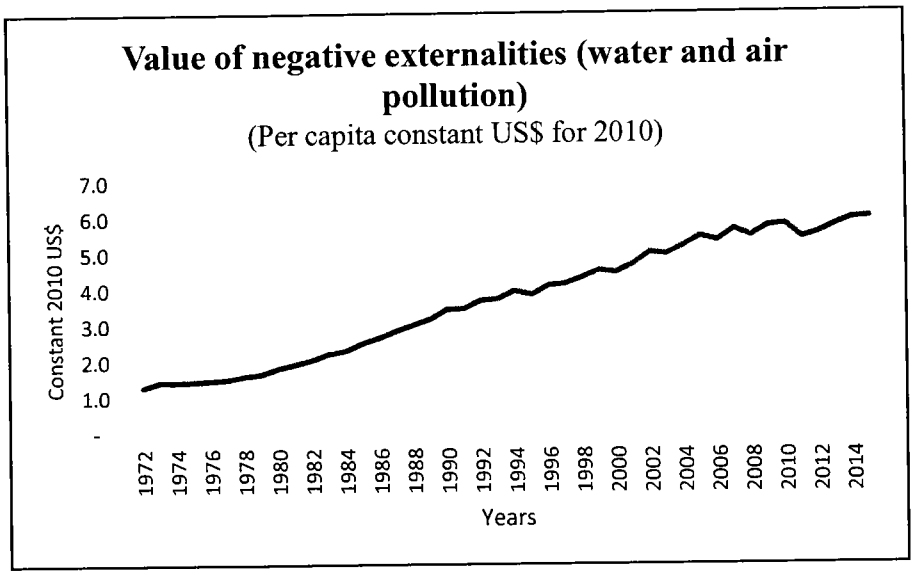

Figure 4.19: Value of negative externalities (water and air pollution)

Water air pollution are the negative externalities of growth process. Along with the growth in population, industrial sector is also growing in Pakistan. From 1972 to 2014, population of Pakistan grew from 61 million to 185 million. In the same time, population density also grew from 79 persons per KM to 246 persons per KM. With this high rate of population increase, human footprint on natural resources also increased. Along with this, industrial sector as well as transportation sector also grew with rapid rates. Due to this, water and air pollution also increased rapidly. This has negative impact on overall wellbeing of the community members.

Internal hazards included cost of car accidents as well as cost of terrorism activities. Below graph showed the trend of internal hazards over the time. Cost of internal hazards remained minimal from 1972-1985, then a sharp increase was reported in 1987 and 1987. After slight reduction in 1998, a gradual increase was observed till 2004. After that, a sharp

increase was observed, mainly due to war on terror and subsequent militancy wave in Pakistan. In 2014, as sharp decrease was observed.

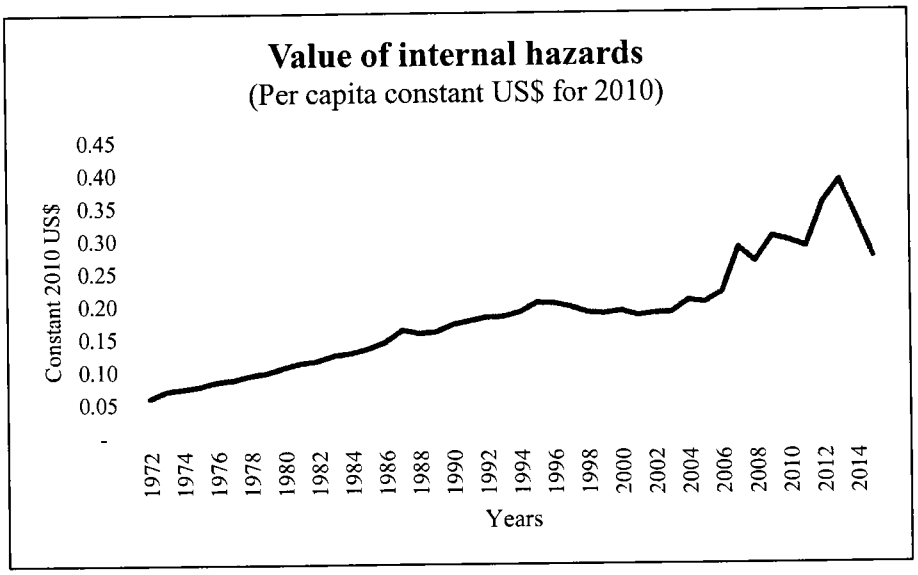

Figure 4.20: Value of internal hazards

As discussed in previous section, such internal hazards have significant negative correlation with human wellbeing. Such events not only leave direct impact on human life and property, indirect impacts on psychological and emotional status can also be observed.

Along with internal hazard natural disasters are also significant to consider for human wellbeing. Trend of natural disasters in Pakistan is irregular overall, but frequency as well as intensity of natural disasters increased rapidly after 2004. These findings are aligned with the earlier studies highlighting the impact of climate change. Losses due to disasters cannot only be considered as threatening/security factor for wellbeing, it can also be considered as a consequence of environmental damages, as most of the climatic disasters are caused by change in environment.

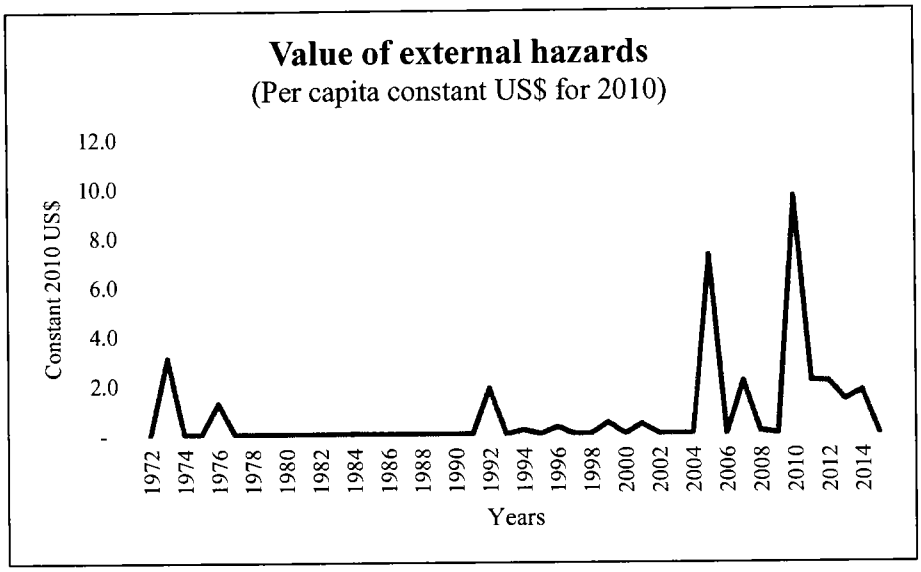

Figure 4.21: Value of external hazards

The above-mentioned findings highlight that each of the presented components portray different nature of trend over the time. Hence it is not imperative to combine all data in one series. Although, proposed approach provides a local solution, and categorization done for Pakistan can be unique for Pakistan. Analysis for other countries or global analysis may bring different type of grouping, based upon the pattern in data. It is argued that, data patterns contain lot of valuable information and such information should not be discarded for the sake of uniformity.

4.4.1.2 Multi-dimensional measure of sustainability of economic wellbeing

As discussed in previous section, for sustainability analysis, it is preferred to opt such indicators that present the depletion in term of 'stock' not in term of flow variable. 5 indicators were selected for renewable resources from ecological footprint analysis and three indicators were selected for non-renewable resources from adjusted net saving analysis. Similar to the approach opted in previous section, it is avoided to aggregate these series before doing similarity/dissimilarity analysis. Multidimensional scaling was carried out in two stages. In first stage, analysis showed that two renewable resources, footprint on carbon and fishing land exhibit different trend as compared to other indicators, as presented in figure 4.22.

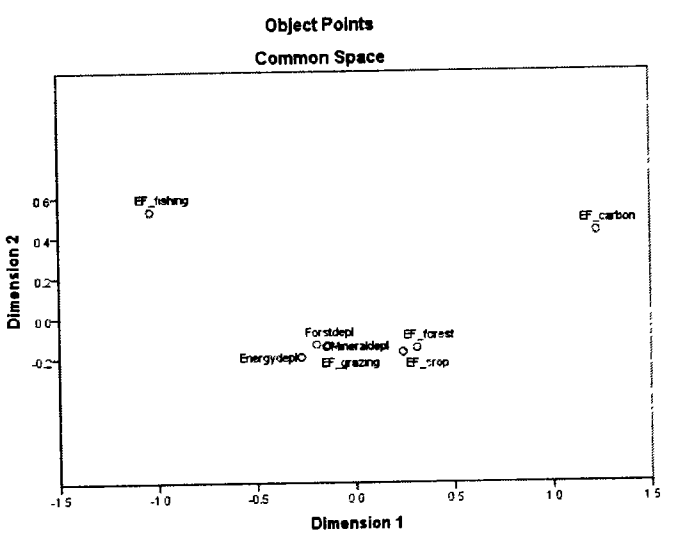

Figure 4.22: Multi-dimensional scaling for future wellbeing -1

At second stage, above-mentioned two indicators were separated from the analysis and same analysis for repeated for rest of the indicators. Results of repeated analysis is shown in figure 4.23.

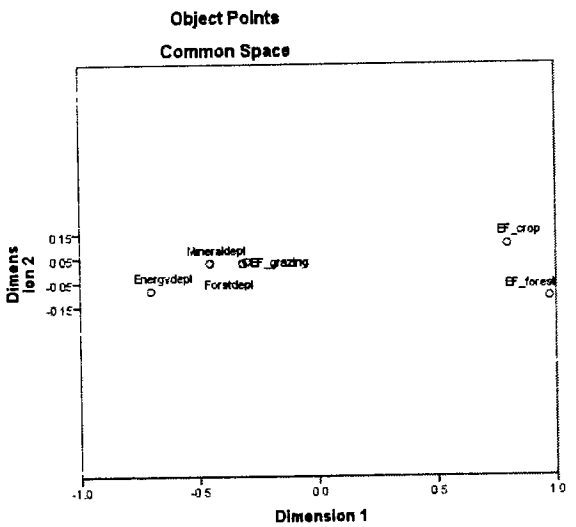

Figure 4.23: Multi-dimensional scaling for future wellbeing -2

Analysis of remaining indicators revealed that ecological footprints on cropland and forest land are similar to each other but located on a reasonable distance from rest of the indicators. This shows that impact of footprints on cropland and forestland can be merged. To further confirm this, alternate analysis approach of hierarchical clustering was carried out.

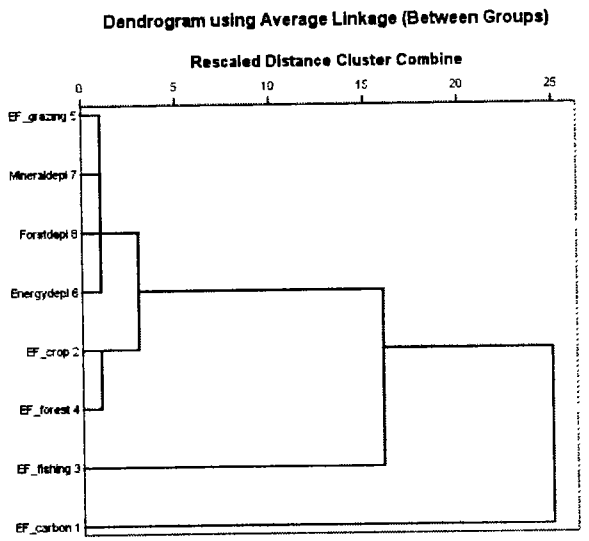

Figure 4.24: Cluster analysis for future wellbeing

Findings of cluster analysis also revealed the same pattern. Ecological footprints in carbon and fishing land appeared as a separate cluster. In remaining analysis, footprints on forestland and cropland appeared in one group. Out of the remaining indicators, it is preferred to keep ecological footprints on grazing land separate from non-renewable resources, not on the basis of similarity analysis but due to the different nature of that indicators. Findings of the sustainability analysis is given in subsequent paragraphs

As defined in earlier section, ecological footprint data represent the difference between capacity of biosphere to regenerate the resources and human footprints. Original data was presented in global hectares, a unit used for ecological footprint analysis. In current analysis, the data is transformed into monetary value (constant US dollars for 2010) and presented per capita per year. All such values presented in negative form represents that

human footprint already exceeds the capacity of biosphere to regenerate the same resources. Numerical quantity depicts the relative strength of same indicator.

One of the most useful components of the Ecological Footprint is the Carbon Footprint. Carbon Footprint can be defined as "the land required to absorb the CO_2 that is released from the burning of fossil fuels and other sources." Regarding emission of carbon in result of human activity and capacity of absorb this carbon and retransform it into oxygen, Pakistan remained deficit country in whole study period. The deficit increased around 260% during last forty years.

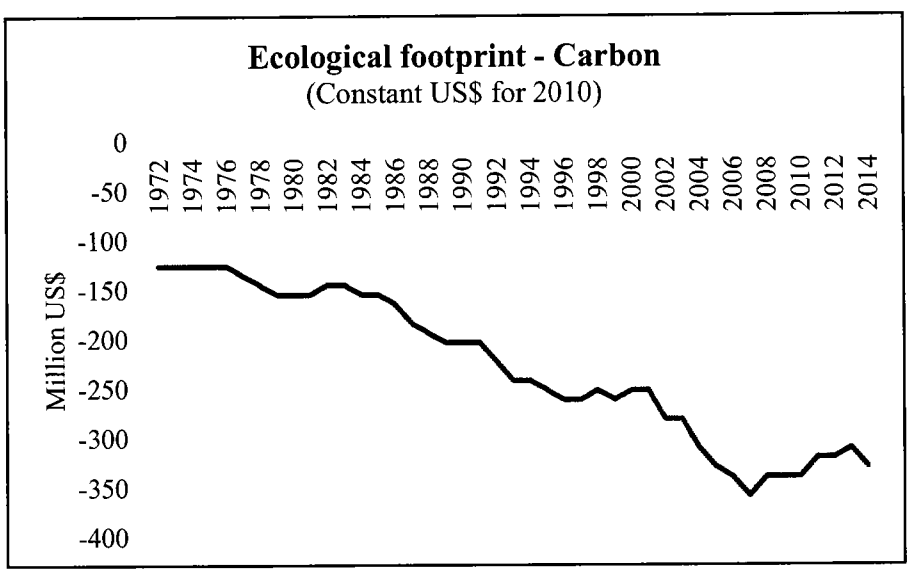

Figure 4.25: Carbon footprint for Pakistan

Forest Footprint represents the area necessary to regenerate all the timber harvested. The cropland footprint consists of the area of land required to grow all crop products, including livestock feed, fish meal, oil crops and rubber. The footprint of each crop type is calculated as the area of cropland that would be required to produce the harvested quantity

at world-average yields. It also incorporates the yield factor, i.e. it accounts for differences between countries in productivity of a given land type. Pakistan is also a deficit country in term of ecological footprints on cropland and forest production. Although fluctuations were observed in relative values of EF of cropland and forest product, overall trend remains stable.

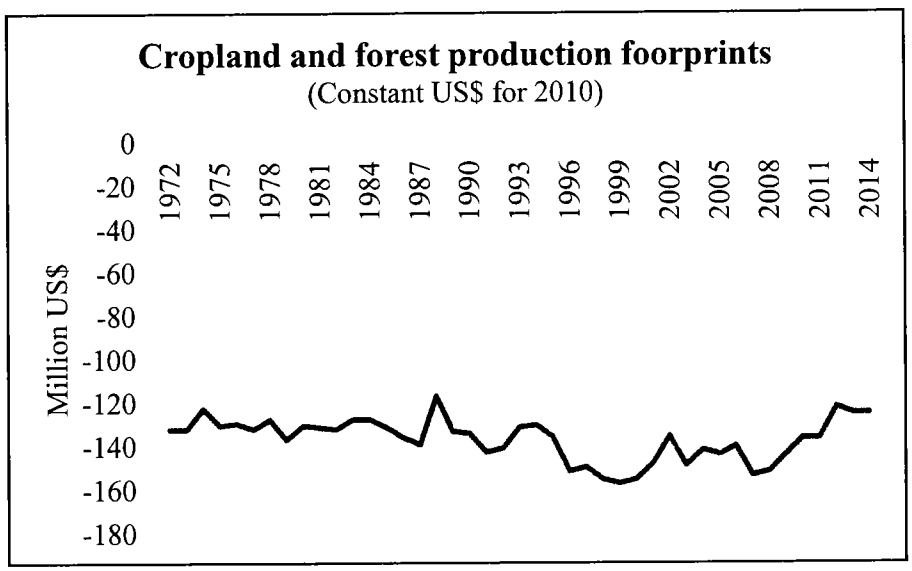

Figure 4.26: Cropland and forest production footprints for Pakistan

The fishing grounds footprint is calculated using the information related to the utilized aquatic livings and annual production of same aquatic livings. The production requirement is the ratio of harvested fish to annual primary production to keep the sustainable level of that species.

In this category, though Pakistan remained sustainable, as for the whole study period, values remained positive. Means that Pakistan is using less aquatic resources as compared to the reproduction capacity. Overall, a decreasing trend was observed.

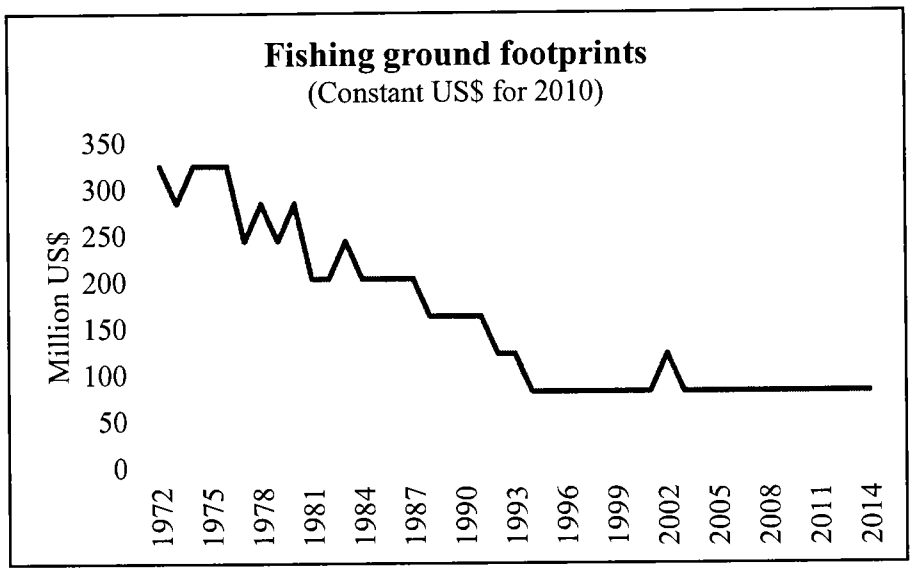

Figure 4.27: Fishing ground footprints for Pakistan

Regarding non-renewable resources, depletion rate increased gradually from 1972 to 2002. After that a rapid increase in depletion of non-renewable resources was observed from 2002 to 2008. A slight reduction was observed in subsequent years. The main contributing factor behind the sharp increase in depletion of resources after 2002 was the use of natural gas as a primary source for energy. After 2002, most of the industries, transport sector as well as power production section was shifted to the natural gas. Consequently, resources were depleted swiftly, and in few years, country was facing severe power shortage crises. This can be considered as a case-study for the importance of sustainability analysis and subsequent sustainable policies.

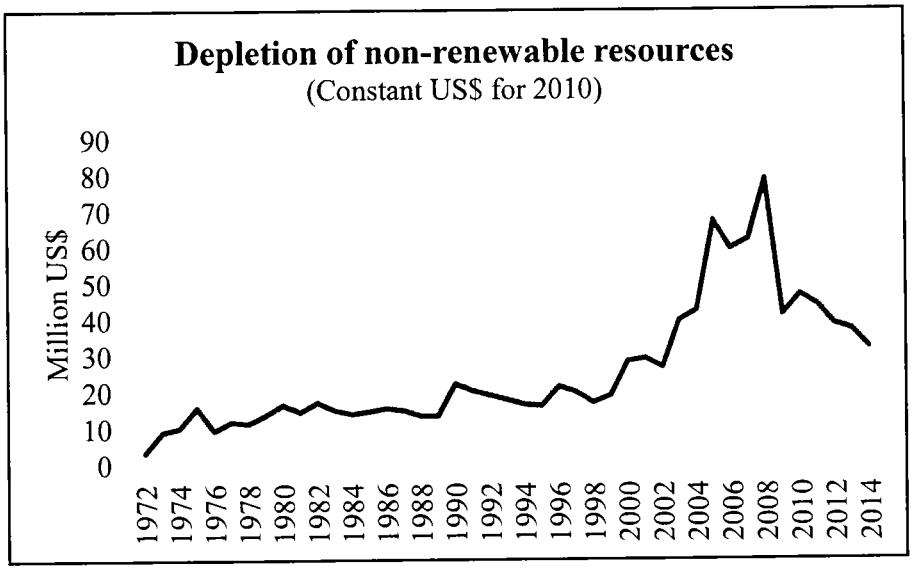

Figure 4.28: Adjusted savings- depletion of non-renewable resources for Pakistan

The above-mentioned analysis highlighted the different components of sustainability analysis and showed the importance of such segregated analysis.

CHAPTER 5

CONCLUSION

Findings of this study shed the light on two broad methodological and conceptual issues. In addition, study also highlighted several policy levels issues. Along with this, some caveats and recommendations for future results are also discussed in this section.

- Findings of the analysis of "Index of Sustainable Economic Welfare (ISEW)" remained align with previous studies and confirmed the hypothesis that absolute growth may have some positive effects on human wellbeing but, in long run, a strong relationship cannot be established.
- Sensitivity analysis revealed that that index is sensitive to more than half of sub-indicators of index and exclusion of such indicators can significantly affect the shape of index. These indicators include income inequality, net international investment position, depletion of natural resources and environmental effects. In this situation, aggregation of sub-indicators into single index will be misleading and will results in loss of valuable information about the diversity in such indicators.
- It also appeared through sustainability discussion that measurement of sustainability of wellbeing should be considered separately from current wellbeing analysis. For sustainability measurement, instead of using 'flow' type variable and considering depletion of non-renewable resources and impact of economic activities on environment, it is imperative to measure the sustainability through

'stock' type indicators and should answer the questions related to overconsumption or underinvestment. Adjusted net saving (genuine saving) and ecological footprint can be considered as an alternate.

5.1 POLICY RECOMMENDATIONS

Analysis also shed light on key areas that affecting wellbeing negatively and provided some policy level recommendations, including

- Government should develop inclusive policies to reduce the income inequality, which is one of the key factor that affecting wellbeing negatively.
- Negative externalities related to economic activities like pollutions have strong negative impacts in wellbeing. Policies should reflect such issues as well.
- Non-renewable resources should be used in more sustainable manner.
- Steps should be taken to increase the resilience to internal and external hazards at household, community and institutional level.
- To improve the carbon and forest footprint, reforestation should be initiated on priority basis.

5.2 RECOMMENDATIONS FOR FUTURE STUDY

During study, several methodological as well as data related issues were observed. Few recommendations in this regard are given below for future studies.

- To assess the impact of government services, government spending is rather a weak indicator. Instead of it, output/outcome-based indicators should be developed and used for wellbeing analysis.
- To measure the value of leisure activities, some criterion needed to be developed. Data on time use is crucial for such analysis.
- To assess the impact of social capital (social connections and relations) on wellbeing, some criterion should be developed. This component remained missing in current analysis.
- For the sustainability analysis, more indicators need to be included in analysis to make it comprehensive analysis of sustainability.

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ANNEXURE

Annex-1

Table A7.1: Examples of wellbeing definitions

Definition	Reference
"*Economic well-being* is defined as having present and future financial security. *Present financial security* includes the ability of individuals, families, and communities to consistently meet their basic needs (including food, housing, utilities, health care, transportation, education, childcare, clothing, and paid taxes), and have control over their day-to-day finances. It also includes the ability to make economic choices and feel a sense of security, satisfaction, and personal fulfillment with one's personal finances and employment pursuits. *Future financial security* includes the ability to absorb financial shocks, meet financial goals, build financial assets, and maintain adequate income throughout the life-span."	Council on Social Work Education, USA

"This is a dynamic state, in which the individual is able to develop their potential, work productively and creatively, build strong and positive relationships with others, and contribute to their community. It is enhanced when an individual is able to fulfil their personal and social goals and achieve a sense of purpose in society."	New Economics Foundation, 2008
"Well-being is a state of being with others, where human needs are met, where one can act meaningfully to pursue one's goals, and where one enjoys a satisfactory quality of life."	ESRC Research Group on Wellbeing in Developing Countries www.welldev.org.uk
"The individual's experience, or perception, of how well he or she lives is taken as the criterion of quality of life."	Naess, 1999
"We find that surveys of well-being utilise one or more of three definitions: 1) satisfaction with life 2) health and ability/disability, and 3) composite indexes of positive functioning."	Kahn and Juster, 2002
"Well-being has been defined by individual characteristics of an inherently positive state (happiness). It has also been defined on a continuum from positive to negative, such as how one might measure self-esteem. Well-being can also be defined in terms of one's context (standard of living), absence of well-	Pollard and Lee, 2003

being (depression), or in a collective manner (shared understanding)."	
"Well-being stems from the degree of fit between individuals' perceptions of their objective situations and their needs, aspirations or values."	Andrews and Withey, 1976
"The key concepts relating to economic wellbeing of people, families or households are the economic resources they have available to support their material living conditions, and their control over these resources and conditions."	Frameworks for Australian Social Statistics, Jun 2015