Investigating the long run relationship between Ecological footprint and an index of Wellbeing: Focus on Asian experience

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Abstract-The study has examined whether the Ecological Footprint (EF) shows a trend towards sustainable development using data from 9 Asian countries (India, Pakistan, Bangladesh, Nepal, China, Indonesia, Myanmar, Malaysia, and Philippines), covering annual observations from 1980 to 2008. We have also constructed Physical Quality of Life Indicator (PQLI) as an index of wellbeing, and we find upward trends in both EF and PQLI for individual countries as well as all considered countries in the Asian regions over the time period. Moreover, the panel unit root results of Levin, Lin & Chu t, Im, Pesaran and Shin W-stat, ADF - Fisher Chi-square, PP - Fisher Chi-square test confirm non-stationarity at level but stationarity at first difference. We have also tested for cointegrating relationship between EF and PQLI using the Pedroni Residual Cointegration Test, Kao Residual Cointegration Test and Johansen Fisher Panel Cointegration Test. All the tests indicate the presence of long run cointegrating relationship between EF and PQLI. Thus, we can confirm that there is long term relationship between environmental degradation and wellbeing. Lastly, suggestions have been provided for attaining the desired goal of better sustainable society.

Keywords: Ecological Footprint, Physical Quality of Life Indicator, Unit root, Cointegration, Sustainability, Asia

1. INTRODUCTION

The growth of consumerism in the last decades has resulted in ever-growing demand for resources, i.e., for food and drink, energy, transport, electronic products, living space and space to dispose of wastes like carbon dioxide from burning fossil fuels. This has led to wanton extraction of environmental resources and has exerted direct pressure on the biodiversity in the form of - 1. Habitat loss due to alteration and fragmentation of land - conversion of land for agriculture or aquaculture into land for industrial or urban use. 2. Over-exploitation of wild species population, harvesting of animals and plants for food, materials, or medicine at a rate above the reproductive capacity. 3. Pollution mainly from excessive pesticide use in agriculture and aquaculture; urban and industrial effluents; mining waste; and excessive fertilizer use in agriculture. 4. Climate change due to rising levels of greenhouse gases in the atmosphere, caused mainly by the burning of fossil fuels, forest clearing and industrial processes. 5. Invasive species which were introduced deliberately or inadvertently to one part of the world from another and they then become competitors, predators, or parasites of native species (Living planet report, 2010). Various organisations of the world like United Nations Environment Programme (UNEP), Organisation for Economic Cooperation and Development (OECD), World Wildlife Fund (WWF) etc have taken initiatives in drawing attention of the world to the services provided by our ecosystem, the increasing costs of biodiversity loss and ecosystem degradation. As a result of the joint efforts of these organisations, environmentalists, economists, NGOs focus is being laid on how to measure these anthropogenic pressures on our ecosystem.

Introduced by Wackernagel and Rees in 1996, the Ecological Footprint (EF) is a comprehensive tool to analyze the effect of human activities on nature. The ecological footprint measures the pressure of human demands in terms of cropland (area needed for food), grazing land (area needed for livestock), forest (for paper and wood production), build-up land (area needed for infrastructure and housing), CO_2 footprint (forest needed for CO_2 absorption), and ocean (required for seafood production) required to produce the resources consumed and to assimilate the wastes generated by a given population. It is a field-based indicator that measures the intensity of natural resource use and waste absorption capacity in a particular area and helps in gauging sustainability by providing a wide-ranging perspective assessment (Wackernagel and Rees, 1996). Thus, if the ecological footprint is higher than the existing land area, current consumption is not sustainable, since the carrying capacity of the land is exceeded and correspondingly the economic activity responsible for the ecological footprint is unsustainable. Many recent environmental studies have employed the ecological footprint to measure the consequences of human demand due to its comprehensive nature and ability to capture the direct and indirect impact of production and consumption (Wang et al., 2013; Gao and Tian, 2016; Ozturk et al., 2016; Charfeddine, 2017).

But again, it is important to note that human activity and well being, both in terms of material and cultural, are interconnected and are within the environment. Accelerated and unabated environmental degradation is dangerous for the people's health and livelihoods and is deleterious to the survival of species, and uninterrupted flow of ecosystem services. The depletion of natural resources, biodiversity loss, and soil erosion experienced by several countries in recent times is the result of intensified crop and livestock production that has contributed to increased production of chemical and organic wastes. In recent times, developing countries face the problems of an adequate supply of clean water, explosive growth in population, and the artificial methods of cultivation. Furthermore, in these countries water quality has been infected by sewage, industrial effluent, urban and agricultural runoff, and saline intrusion. Degradation and depletion of resources such as forests and fisheries, freshwater resources, wetlands, agricultural lands, grazing lands, etc., and poor human health as a result of air and water pollution severely affects the goals of poverty reduction and sustainable development.

Hence, it is the need of the day to understand that untainted flow of ecosystem services along with a congenial socio-economic environment is fundamental to the sustenance of peoples' wellbeing. To have a measurable index of wellbeing we have used Physical quality of life index (PQLI), which was produced by Morris (1979) and is comprised of Infant mortality, literacy and life expectation at age one, as a single measure of welfare. Traditionally, level and change in gross domestic product (GDP) per capita have been used as the main yardstick for measuring and comparing living standards across countries. However, the consensus on the use of GDP per capita as a good proxy measure of well-being is becoming less obvious, as the more developed societies are moving from a situation of scarcity to a situation of plenty. The intuitive idea that, once a certain level of material needs has been met, further increments in economic growth will not yield the same improvements in the well-being is backed up by numerous studies. This indicates that there is divergence between added income and added well-being both within and across societies. In recent times, concerns have emerged on how economic growth led in many countries to environmental depletion, an element not included in GDP at all.

Several studies have been published over the last two decades justifying the need for alternative measures of well-being/quality of life/ sustainable development/ societal progress and policy makers and citizens are now concerned with much more than just GDP per capita. In this context, it can be said that social indicators provide information about a number of dimensions of well-being that seem to go beyond what is conveyed by GDP and the PQLI indicator taken in the present study will provide a more holistic view of wellbeing.

The focus of the present study is to understand the factors underlying the relationship between EF and wellbeing in 9 developing countries from Asia. We have studied the cointegrating relationship between EF and PQLI using the Pedroni Residual Cointegration Test, Kao Residual Cointegration Test and Johansen Fisher Panel Cointegration Test.

The contribution of the study is multifaceted, as it - 1. contributes to understanding the nexus among wellbeing and Ecological footprint. 2. Hardly any sound empirical study has been undertaken so far, that studies the long run relationship between Ecological footprint and Wellbeing of the considered countries scattered over Asian region. 3. It includes an extended list of interlinked social variables in the measurement of wellbeing, hardly considered earlier. 4. The estimation procedure has been a robust one, carried out by using appropriate method for panel data and this can be extended to other countries not involved in the sample.

The present study has the following objectives. 1. To study whether the Ecological footprint shows a trend towards sustainable development in the Asian region of the world. 2. To construct PQLI as an index of wellbeing. 3. To study long run cointegration relationship between Ecological footprint and PQLI, of the considered countries scattered over Asian regions over the period 1980 to 2008. 4. To develop relevant policy suggestions that might help reduce environmental/ ecological degradation and take us to a greater level of well-being.

The paper is organized in six sections. After the Introduction, Section 2 briefly presents a literature review. The data and methodology are discussed in Section 3. Section 4 provides the results and discussion. Finally, section 5 presents the conclusion of the study along with policy implications.

2. LITERATURE REVIEW

Grossman and Krueger (1991, 1995) were the first to investigate the environmental Kuznets curve (EKC) relationship between economic progress and ecological deterioration and since then much research has been done on this subject. Many studies examining the correlation between economic progress and environment have used carbon emission as an indicator of ecological deterioration (Abid, 2015; Ahmad et al., 2016; Asıcı and Acar, 2016) have examined the correlation between EF, biocapacity, GDP, openness, population, industry share, ecological regulation, and energy use. They used panel FE econometric method for 116 countries and found evidence in support of EKC hypothesis. Again, Charfeddine and Mrabet (2017) too observed EKC relationship when they conducted panel FMOLS and panel DOLS tests for 15 MENA countries covering 1995–2007, using EF, GDP, energy usage, urbanization, fertility, and life expectancy.

Using OLS and weighted LS, Bagliani et al. (2008) tested the relation between the GDP and EF of the 144 countries for 2001 but they failed to verify the EKC. Similarly, no significant correlation was found between the same variables in the study by Caviglia-Harris et al. (2009). They used panel FE and 2SLS GMM tests for 146 countries in the period 1961–2000. Hervieux and Darne (2015) in the 1961–2007 period conducted time-series cointegration analysis between GDP and EF for 7 Latin American countries. Wang et al. (2013) in their study of 150 countries for the year 2005, added the biocapacity variable and the EF. He also could not confirm the EKC hypothesis in the model using a spatial econometric approach. In their study Al-Mulali et al. (2015) investigated the validity of the EKC hypothesis for 93 countries between 1980 and 2008 using EF, energy usage, GDP, city population, openness, and domestic credit based on panel FE, GMM tests. They concluded that the EKC hypothesis was confirmed in upper-mid-income and high-income nations, however invalid in low, lower middle income and invalid in higher income countries. Moreover, they reported energy consumption, urbanization and openness to have a positive effect on the ecological footprint.

While examining the validity of EKC hypothesis in Qatar during 1970–2015 Charfeddine (2017) found that the EKC hypothesis was invalid. He also concluded that while electricity consumption and financial development had a positive impact, trade openness and urbanization negatively affected the ecological footprint. Ozturk et al. (2016) investigated the correlation between EF, tourism GDP, volume of foreign trade, city population, and energy usage for 144 nations in 1988–2008. Based on the time series GMM, S-GMM tests, the EKC is confirmed in the upper-mid and high-income nations but not for the low and lower-mid-income nation. They suggested that the positive or negative relationship between the income levels and ecological footprints is yet to reach a decisive point and argued that such a relationship is absent or minimal in higher-income countries.

Gao and Tian (2016) analyzed the impact of natural resources in influencing the ecological footprint of China from 1980 to 2010. Their results suggested the significant role of natural resources in enhancing ecological pressure in the Chinese economy. They found that a rise in natural resource consumption carried a negative impact on ecological footprint and led to enhanced ecological deficit by 66 times from 1983 to 2010. Saboori et al. (2016) examined the oil and ecological footprint relationship in ten OPEC economies from 1977 to 2008 and observed significant EKC link in the economies of Iraq, Nigeria, Kuwait, Algeria, Venezuela and Qatar. They found the presence of an inverted U Shaped type relationship. Furthermore, the study reported that an increase in oil consumption increased the ecological footprint in the considered economies. Figge et al. (2017) examined the connection between ecological footprint and king of fighters (KOF) index of globalization by analyzing panel data of 171 economies for four diverse measures of ecological footprint, i.e., consumption, production, export and import footprints. They reported significant between globalization and three measures of ecological footprint. They concluded that KOF index enhanced environmental degradation by increasing import, export and consumption footprints in the considered economies.

Again, Rudolph and Figge (2017) examined the impact of globalization on environmental degradation by using ecological footprint as a measure of degradation. Based on the data of 146 economies from 1981 to 2009, they found significant effect of overall globalization on the ecological footprint of export and import in the panel estimation. The results also indicated that rise in social globalization decreased the footprints of production and consumption. Again, an increase in social globalization positively affected the footprints of export and import. For economic globalization, they found that economic globalization increased all types of ecological footprints. Lastly, their study failed to find significant links between political globalization and the measures of ecological footprints.

From the above review of literature, it is clear that interactions between human well-being and environmental degradation have not been exhaustively researched by previous studies, especially in the choice of human well-being and environmental indicators. The existing studies also have not been able to achieve consensus on the nature of the relationship between human well-being and environmental degradation, especially in developing countries. Empirical studies such as Steinberger and Roberts (2010) have concluded that human development indicators such as life expectancy, income level, literacy rate and HDI can be moderately enhanced without impacting negatively on the environment by using pooled ordinary least square (OLS) for 156 countries. Similarly, Bedir and Yilmaz (2016) have assessed the causality association between carbon emissions and human development for 33 Organisation for Economic Cooperation and Development (OECD) countries. Their study reported that reduction in carbon emissions does not affect human development. From the above contrasting reviews, it is evident that the relationship between human development and environmental degradation is still debatable, and the major contending issue is the selection of measurement indicators. For instance, in measuring environmental degradation, a significant number of studies have relied on carbon emissions, while only a handful has opted for the broader EF indicator. The present study has taken EF indicator due to its robust suitability to the resource-based composition of developing economies. Furthermore, many studies have employed the GDP or HDI as a proxy for human wellbeing, but we have used PQLI as it is more comprehensive measure. This study extends the literature based on these identified fronts.

3.DATA AND METHODS OF ANALYSIS

3.1. Data source

The present analysis is based on secondary data set using data from a sample of 9 developing countries ($i = 1$ to 9) covering the period 1980 to 2008 ($t = 1$ to 29). Data on ecological footprint per capita for the time period 1980-2007 come from UNEP Environmental Data Explorer – The Environmental Database and for the year 2008, data were obtained from Global Footprint Network (www.footprint network.org/atlas). The required data for computation of PQLI are obtained from World Bank's World Bank Development Indicators (WDI) Database (http://www.worldbank.org/data).

We have taken countries from Asia and the countries included and belonging to Asia are India, Pakistan, Bangladesh, Nepal, China, Indonesia, Myanmar, Malaysia, and Philippines.

3.2 Computation of PQLI

The United Nations Development Programme goalpost method is used to construct the PQLI.

Steps to Calculate Physical Quality of Life:

First, we find the following

1) Percentage of the population that is literate (literacy rate).

2) The infant mortality rates.(out of 1000 births). Indexed Infant Mortality Rate = (166 - infant mortality) × 0.625

3) The Life Expectancy. Indexed Life Expectancy = (Life expectancy - 42) × 2.7

4) Physical Quality of Life = 1/3(Literacy Rate + Indexed Infant Mortality Rate + Indexed Life Expectancy)

3.3. The Econometric Methodology

In this paper, instead of a single country, we use a panel dataset, whose analysis, in the context of time series modelling, differs from a univariate case in terms of unit root tests and estimation methods. The use of panel data sets over the individual time series data brings about several advantages in econometric modelling, such as the capability to control the unobserved heterogeneity, the increase in the degree of freedom, and the more stable parameter estimates. The empirical results from the unit root testing suggest the use of the cointegration analysis.

3.3.1. Panel Unit Root Tests

We have used Levin-Lin-Chu test (LLC), Im, Pesaran, and Shin (IPS), ADF - Fisher Chi-square, and PP - Fisher Chi-square to test for the existence of unit root in our data series. Primarily, LLC and IPS tests are extensions of the traditional augmented Dickey-Fuller (ADF) unit root test for univariate time series modelling, under the very restrictive assumption of individual cross-sectional independency. The LLC test estimates ADF regression on the pooled panel data by using the Ordinary Least Squares (OLS) estimator, assuming the same auto-regressive process across individuals, which is an additional restriction. Under the assumption of common unit root, the LLC test is testing the null $H_0 : \rho_i = \rho = 0$ for all i, against the alternative $H_1 : \rho_i = \rho < 0$ for all i. The IPS test relaxes the latter assumption, allowing the possibility of varying autoregressive processes across individuals, and therefore uses the group-mean of individual t-statistics in statistical inference.

3.3.2. Cointegration Analysis

The null of no cointegration hypothesis in our data series is verified using Pedroni’s (2004) cointegration tests. These tests take into account the heterogeneous dynamic features of the series and do not constraint the cointegration vectors to be the same across the panel members. We also use Kao Residual Cointegration Test and Johansen Fisher Panel Cointegration Test to test for cointegrating relationship between EF and PQLI.

Again, Pedroni (2000, 2001) has showed that between-dimension (group-mean) panel estimators demonstrate minor size distortions in small samples. The between-dimension estimator has an advantage in the form of its testing flexibility. Within-dimension's *t* statistic can be used to test H_0: $\beta_i=\beta_0$ for all *i* versus H_1: $\beta_i=\beta_a\neq\beta_0$ where β_0 is the hypothesized common value for β under the null and β_a is an alternative common value. But, the group-mean estimator allows to test H_0: $\beta_i=\beta_0$ for all *i* versus H_1: $\beta_i\neq\beta_0$ for all *i*, so that the value of β is not necessarily constrained to be the same across the panel members under H_1. Between dimension estimator have two more advantages in the form of: 1) when the true cointegrating vectors are heterogeneous, it provides the mean value of the cointegrating vectors while the within-dimension estimator provides the average regression coefficient, and 2) its *t*-statistic exhibits relatively little distortions in small samples (Pedroni, 2000). Both estimators are used in the present study for the sake of comparison.

4. RESULTS AND DISCUSSIONS

Table 1. manifests the descriptive statistics of the variables including mean, standard deviation, maximum value and minimum value of the EF and PQLI series for the entire panel.

Table 1: Descriptive statistics

Panel	EF	PQLI
Mean	1.753724	0.593668
Median	1.252000	0.596971
Maximum	5.106000	0.751651
Minimum	0.500000	0.466900
Std. Dev.	1.227566	0.065963

Figure-1. shows the box plot of the two series and from the figure we observe that there is greater variation in EF compared to PQLI and there is presence of outliers in the EF series.

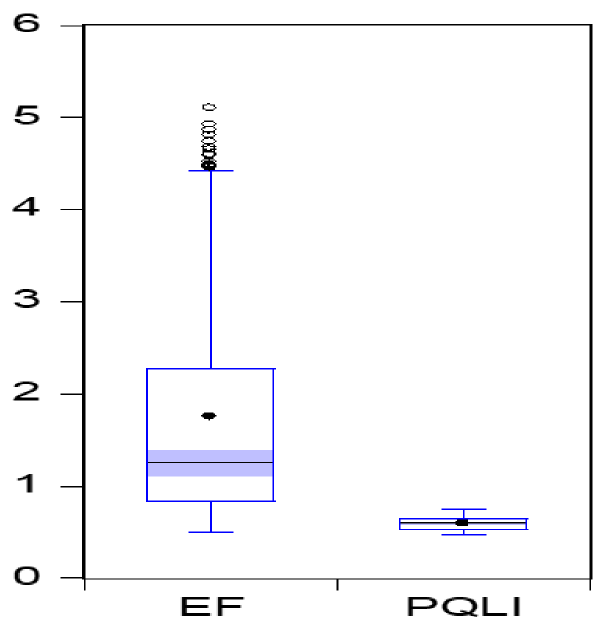

Figure-1 Box Plot of EF and PQLI

Figure 2. plots the Ecological footprint situation across countries at a disaggregate level across Asian

countries. It is seen from the data for all countries that except Nepal all other countries have more or less an upward trend in the given period.

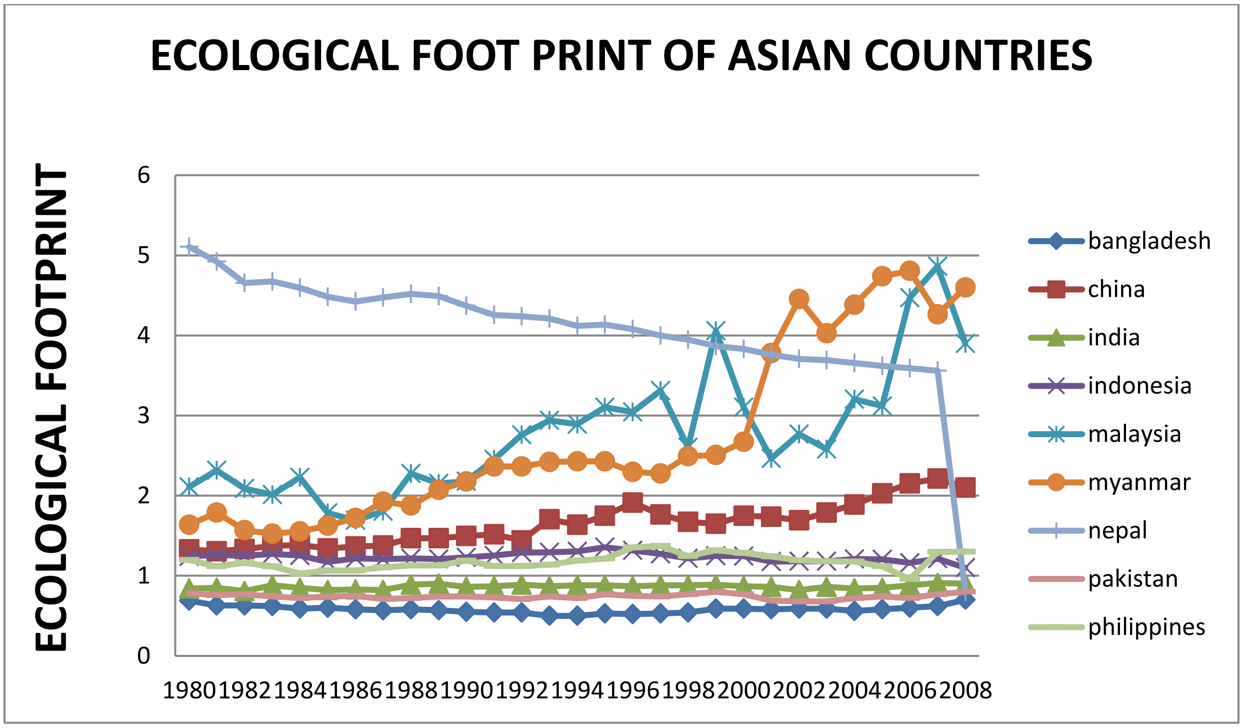

Figure 2. The ecological footprint across Asian countries

Figure 3. plots the PQLI figures for all the considered Asian countries and we observe that like EF all countries have more or less an upward trend in the given period and PQLI lies between 0.4 to 0.7.

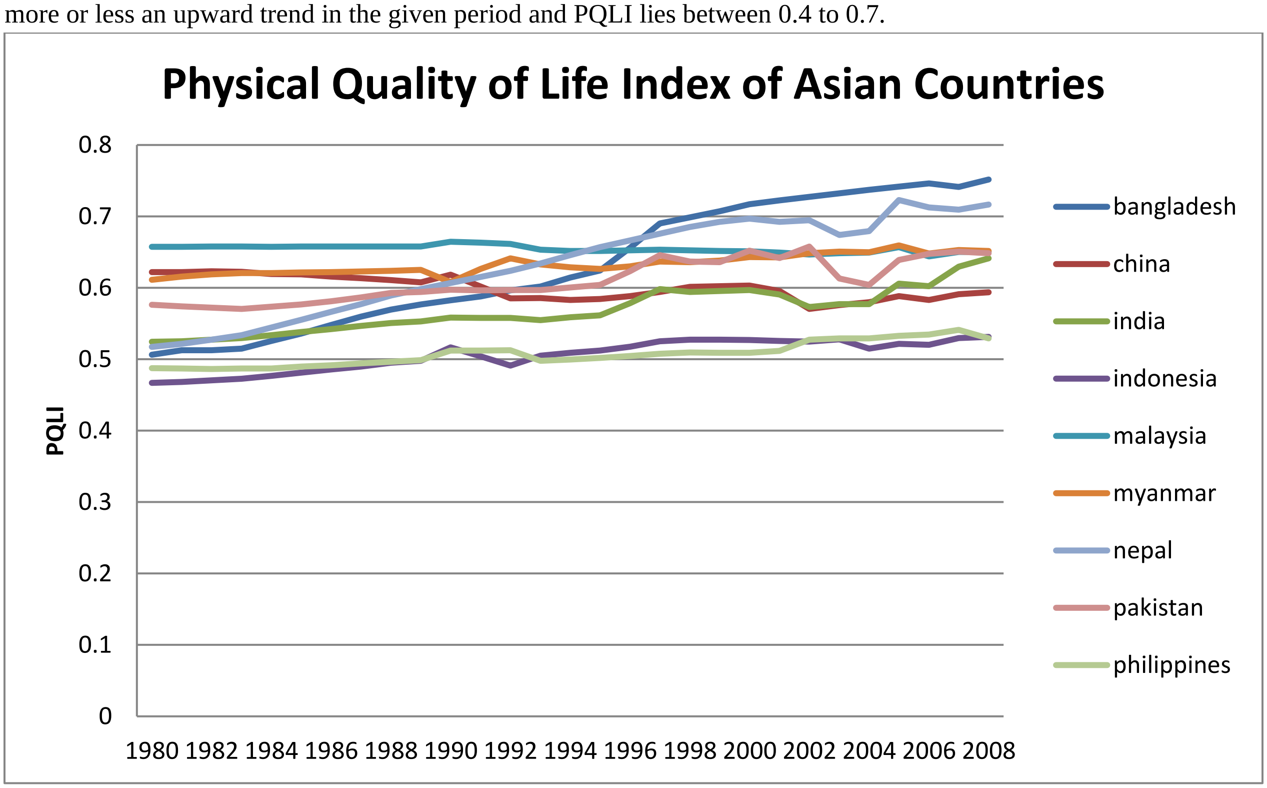

Figure 3. The PQLI across Asian countries

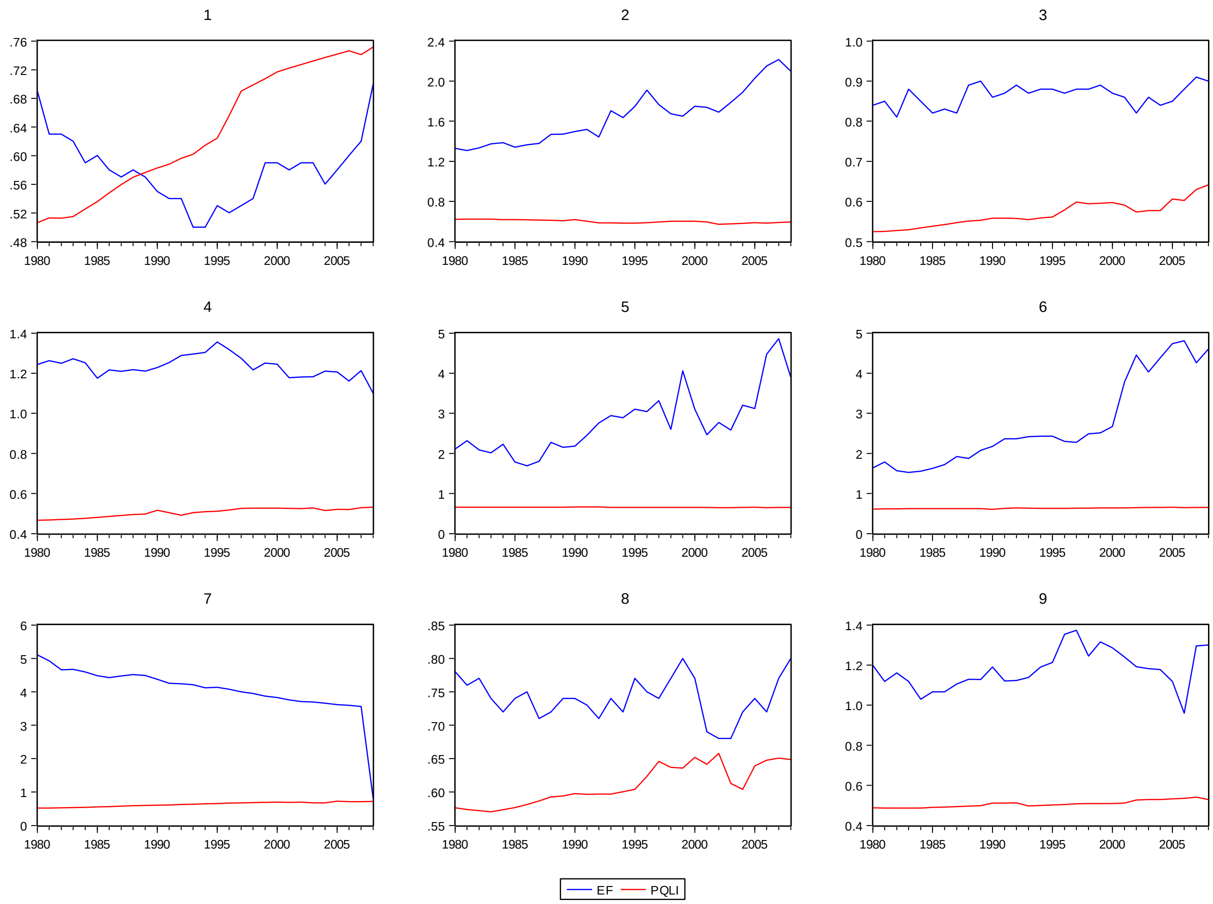

Figure-4 Graphical plots of the EF and PQLI for individual countries

Figure-4 displays the graphical plots of the EF and PQLI for individual countries. Here box 1 is for country Bangladesh, 2 is China, 3 is India, 4 is Indonesia, 5 is Malaysia, 6 is Myanmar, 7 is Nepal, 8 is Pakistan, and 9 is Philippines.

In Table 2. shows the results of the panel unit root tests of EF series at level. From the table we can conclude that EF is non-stationary at level since Levin, Lin & Chu t, Im, Pesaran and Shin W-stat, ADF - Fisher Chi-square, PP - Fisher Chi-square all are insignificant at 1% and 5% level of significance and therefore we fail to reject the null hypothesis of Unit root.

Table :2 Panel unit root test at level: Summary		
Series: EF		
Sample: 1980 2008		
Method	Statistic	Prob.**
Null: Unit root (assumes common unit root process)		
Levin, Lin & Chu t*	3.13974	0.9992
Null: Unit root (assumes individual unit root process)		
Im, Pesaran and Shin W-stat	1.29352	0.9021
ADF - Fisher Chi-square	9.50612	0.4848
PP - Fisher Chi-square	11.5977	0.3129
** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.		

In Table 3. shows the results of the panel unit root tests of EF series after first differencing. From the table we can conclude that EF is stationary after first differencing since Levin, Lin & Chu t, Im, Pesaran and Shin W-stat, ADF - Fisher Chi-square, PP - Fisher Chi-square all are significant at 1% and 5% level of significance and therefore we reject the null hypothesis of Unit root.

Table 3.Panel unit root test after first differencing : Summary
Series: D(EF)
Sample: 1980 2008

Method	Statistic	Prob.**
Null: Unit root (assumes common unit root process)		
Levin, Lin & Chu t*	-6.01261	0.0000
Null: Unit root (assumes individual unit root process)		
Im, Pesaran and Shin W-stat	-6.18834	0.0000
ADF - Fisher Chi-square	49.6416	0.0000
PP - Fisher Chi-square	88.9707	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Table 4 & 5 shows that PQLI is non stationary at level but it is stationary at first difference. Thus our results indicate that our two variables EF and PQLI are I(1) and we can further test the presence of long run relationship between them.

Table 4. Panel unit root test at level: Summary
Series: PQLI
Sample: 1980 2008

Method	Statistic	Prob.**
Null: Unit root (assumes common unit root process)		
Levin, Lin & Chu t*	-0.67733	0.2491
Null: Unit root (assumes individual unit root process)		
Im, Pesaran and Shin W-stat	0.85196	0.8029
ADF - Fisher Chi-square	4.76650	0.9062
PP - Fisher Chi-square	5.30874	0.8696

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution.
All other tests assume asymptotic normality.

Table 5. Panel unit root test at first difference: Summary
Series: D(PQLI)
Sample: 1980 2008

Method	Statistic	Prob.**
Null: Unit root (assumes common unit root process)		
Levin, Lin & Chu t*	-3.32598	0.0004
Null: Unit root (assumes individual unit root process)		
Im, Pesaran and Shin W-stat	-6.07913	0.0000
ADF - Fisher Chi-square	60.2789	0.0000
PP - Fisher Chi-square	97.3524	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution.
All other tests assume asymptotic normality.

In Table 6, 7 & 8, the cointegration tests conducted to question the long-term correlation between the series are reported. Table 6 shows the results of Pedroni Residual Cointegration Test. The table shows the results without the trend, the null hypothesis is rejected, claiming that there is no cointegration correlation between the series at 5 % level of significance. In three of the eleven tests, a cointegrated correlation exists between these series exists at 5% level of significance, while in the rest eight it exists at 1% level of significance.

Table 6 Pedroni Residual Cointegration Test
Series: EF PQLI
Null Hypothesis: No cointegration
Automatic lag length selection based on AIC with a max lag of 6
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	6.874215	0.0000	2.076957	0.0189
Panel rho-Statistic	-5.082956	0.0000	-4.321558	0.0000
Panel PP-Statistic	-2.769759	0.0028	-3.472739	0.0003
Panel ADF-Statistic	-4.199651	0.0000	-3.730574	0.0001

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	-2.074387	0.0190
Group PP-Statistic	-1.679840	0.0465
Group ADF-Statistic	-2.567394	0.0051

Table 7 shows the results of Kao Residual Cointegration Test. The null hypothesis is defined as no cointegration correlation. According to the result of the tests, the null hypothesis is rejected at 1% level of significance and we conclude there is long run relationship between EF and PQLI.

Table 7: Kao Residual Cointegration Test
Series: EF PQLI
Null Hypothesis: No cointegration
Automatic lag length selection based on SIC with a max lag of 7
Newey-West automatic bandwidth selection and Bartlett kernel

	t-Statistic	Prob.
ADF	2.591402	0.0048
Residual variance	0.077305	
HAC variance	0.065030	

Table 8 shows the results of Johansen Fisher Panel Cointegration Test. The null hypothesis is defined as no cointegration correlation. According to the result of the tests, there is at least one cointegrate vector at 5% significance level according to the trace test and at least one at 5% significance level according to the max-eigen test results.

Table 8: Johansen Fisher Panel Cointegration Test

Series: EF PQLI

Trend assumption: Linear deterministic trend (restricted)

Lags interval (in first differences): 1 1

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	22.48	0.0325	21.65	0.0416
At most 1	9.520	0.6580	9.520	0.6580

* Probabilities are computed using asymptotic Chi-square distribution.

Thus, all the three tests point towards the presence of long run relationship between EF and PQLI and these results are in lines with the findings of Bagliani et al., 2008; Caviglia-Harris et al., 2009; Wang et al., 2013 and Hervieux and Darne, 2015 where they found significant relationship between economic growth and environmental degradation.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study has used data from 9 Asian countries covering annual observations from 1980 to 2008. The study has examined whether the Ecological footprint shows a trend towards sustainable development and from the plots of the Ecological footprints for individual countries as well as all considered countries in the Asian regions we find upward trends. This implies that we are consuming mindlessly and are using up our natural resources and degrading the environment. Thus, we can say that the present consumption pattern and economic activity behind is moving towards an unsustainable path. Moreover, we have also constructed PQLI as an index of wellbeing and we find it to be rising for all considered countries over the time period. This indicates that the level of wellbeing is increasing overtime. But we should not be complacent with these results because this improvement in wellbeing is happening at the expense of degrading and depleting the environmental resources.

After checking for unit root and confirming stationarity at first difference, we have tested for cointegrating relationship between EF and PQLI using the Pedroni Residual Cointegration Test, Kao Residual Cointegration Test and Johansen Fisher Panel Cointegration Test. All the tests indicate the presence of long run cointegrating relationship between EF and PQLI. Thus, we can confirm that there is long term relationship between environmental degradation and wellbeing.

It cannot be denied that socio-physical achievements are critical component of wellbeing and much of this is influenced by economic security. However economic security is itself shaped by shift to greener economies. In an era of increasing pressure on natural resources for achieving development goals, attaining resource and energy efficiency and their conservation counts together with socio- physical indicators of wellbeing. Therefore, environmental safety together with enhanced human capability should count high in the agenda of countries aspiring after betterment in human wellbeing.

Efforts should be made to offset the depletion of natural resource stock with sufficient investment in physical and human capital. Most of the developing countries are rich in natural resources, providing ample opportunities to improve welfare by investing natural resource rents into other productive capital for development. The rich biodiversity, fertile land and variety of natural resources provides a strong ground for economic development and poverty reduction in these countries. There are also sufficient scopes for thematic (eco, cultural, adventure) tourism, based on principles of sustainable development and community development. Furthermore, development of renewable energy sources (solar, wind and hydro power, geothermal energy, and biofuels) and even shifting to low-carbon economies is possible. All these suggestions if implemented can deliver the desired goal of attaining a better sustainable society.

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