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Global inequality in natural resource consumption: evidence from Global ecological Footprint Data

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ABSTRACT

The present study made an attempt to track the population growth pattern of different economic group country's categorized by World Bank. Growth of population was calculated using semi-log quadratic function model, while descriptive statistics was used for inequality estimation. Data were collected from Global Footprint Network and World Bank during 1961-2016. Results from this study proved that per capita consumption has increased manifold of population belonging to the high income countries, while their population growth rate has declined during 1961-2016. Further, differential results were reported for middle income and lower middle income group countries, while results of low income group countries presented deteriorating picture over the study period i.e., 1961-2016. Study suggested that there is an urgent need of resource transfer to the emerging economies, so that they can reduce their ecological footprint

Key words : *Global inequality, Sustainable development, Ecological footprint, Bio-capacity.*

Introduction

Resource utilization and consumption is rudimentary for the existence of human life on earth. The human economy is heavily dependent on nature and its resources. Human beings, however, have failed to use resources sustainably, in the race for economic growth. Ecological footprint has already exceeded the carrying capacity of the earth (Rees, 2002). Intergovernmental Panel on Climate Change (IPCC, 2012) regards anthropogenic factors as the prime cause of the over-exploitation of nature, resulting into climate variability and change (IPCC, 2013; Singh, 2020a). Also, the nature of this exploitation has been very unequal in terms of its cause and impact. While highly industrialized developed economies have consumed much more than their share in the earth's resources, it is the people living in the low and middle income countries, yet struggling to earn a decent living standard, who are bearing its worst impacts (IPCC, 2012).

Ecological footprint has been used as an indicator of sustainability because it measures human demand on the earth's natural resources (Wackernagel and Rees, 1996). Despite certain limitations such as being a static analysis, ignoring underground resources, not providing policy prescriptions, and so on, ecological footprint is a potential and unambiguous measure of humanity's over-consumption of earth's biological capacity (Moffatt, 2000; York *et al.,* 2009; Wiedmann and Barrett, 2010). Ecological footprint can also help to extend the present sustainability debate beyond the climate change issue as it indicates human demand on a wide range of natural resources and ecosystem services (Galli *et al.,* 2011). When the Ecological Footprint value exceeds the bio-capacity, a bio-capacity deficit or overshoot situation occurs, conversely, the bio-capacity

reserve occurs when the ecological footprint is lower than the bio-capacity.

The present study made an attempt to examine the inequality in the natural resource consumption using World Bank and Global Footprint data, and how inadequate access of natural resources leads to weak sustainability in the most and less polluter countries.

Paper is organized into four Sections. Section 1 gives brief introduction along with objectives of the study. Methods and materials were discussed in Section 2, while results and discussion are made in Section 3. Finally concluding remarks made in the Section 4.

Materials and Methods

Data Sources

Study uses World Bank and Global Footprint Network data of 160 countries over 1961-2016. Based on the Per Capital Gross National Income (PCGNI), countries has been divided into four income groups, viz., High Income Group (PCGNI> $12,375), Upper Middle Income Group (PCGNI between $3,996 to $12,375), Lower Middle Income Group (PCGNI between $1,026 to $3,995), and Low Income Group (PCGNI <$1,025). Due to inadequate availability of long-series data, this study covers only 160 out of 213 countries. Out of 160 countries, 50 countries belong to high income group, 42 countries belong to upper middle income group, 40 countries belong to lower middle income group, and 28 countries belong to low income group countries. Our data is representable for 95% of the global population.

Estimation Method

Trends of ecological footprint and population were examined using trends analysis method. Compound Annual Growth Rate (CAGR) of population and ecological footprint was calculated using Semi-log quadratic regression model as follows.

$$Y_t = Y_0 (1+r)^t \quad .. (1)$$

Where r is the compound (i.e., over time) rate of growth of Y. taking the natural equation 1, we can write

$$\ln Yt = \log Y0 + t \ln(1 + r) \quad .. (2)$$

Now letting

$$B1 = \ln Y0 \quad .. (3)$$

$$B2 = \ln(1 + r) \quad .. (4)$$

We can write equation (2) as

$$\ln Yt = \beta 1 + \beta 2T \quad .. (5)$$

Adding this disturbance term to equation (5), we obtain

$$\ln Yt = \beta 1 + \beta 2T + Ut \quad .. (6)$$

Model looks like, equation 6 is called semi regressand, appears in the logarithmic form. Descriptive statistics were also used to analyze the data.

Results and Discussion

CAGR of Population and Ecological Footprint

Theoretically it is assumed that, there is an inverse relationship between bio-capacity and ecological footprint in the context of sustainable development. It suggested that a per capita ecological footprint below the globally available per capita bio-capacity is the minimum requirement for sustainable development (Moran *et al.*, 2008). Higher bio-capacity leads to higher availability of natural resources that leads to lower ecological footprint. Global Footprint Network findings show that bio-capacity has declined from 3.12 to 1.63 global per capita hectare (Gha) during 1961- 2016, while per capita ecological

Table 1. CAGRof Population

Period	High income countries (%)	Upper middle income countries (%)	Lower middle income countries (%)	Low income countries (%)
1961-70	1.07	2.33	2.32	2.38
1971-80	0.86	1.80	2.36	2.53
1981-90	0.69	1.63	2.33	2.62
1991-2000	0.70	1.10	1.93	2.87
2001-10	0.74	0.74	1.62	2.85
2011-16	0.60	0.78	1.47	2.56

Source: Estimated from World Bank population data, 2019

footprint (PCEF) has increased from 2.28 to 2.75 Gha during the same period (Global Footprint Network, 2019). Further, population growth data (CAGR) for different income groups countries show that population growth rate has declined substantially in the high income group countries, while population growth rate has increased in low income countries. Calculated CAGR trends for high income group countries show that CAGR was 1.07% per annum during 1961-70 and has reported 0.60% per annum in 2011-16. On the other hand, population growth rate in low income countries was 2.28% per annum during 1961-70 which was reported by 2.85% per annum during 2001-10. Though marginal decline in population growth of low income countries was reported during 2011-16.

Trends of population, ecological footprint and Bio-capacity shows that population is marginally increasing, while ecological footprint is substantially increasing over the period. On the other hand bio-capacity in declining over the period (Fig. 1). It state that global production system is on unsustainable path which would result in severe natural disasters in near future.

Nexus between Population and Ecological Footprint

Table 2 highlights the relationship between population and ecological footprint. Results from table 2 show that in 1992, about 19% of the population living in high income group (HIG) countries was consuming >46% of global natural resources, while population living in low income countries (LIG) (nearly 6%) was using only 2.54% of global natural resources. Due to demographic transition, population in all income groupcountries has been declining in the preceding years, but still ecological footprint is relatively higher in the HIG countries as com-

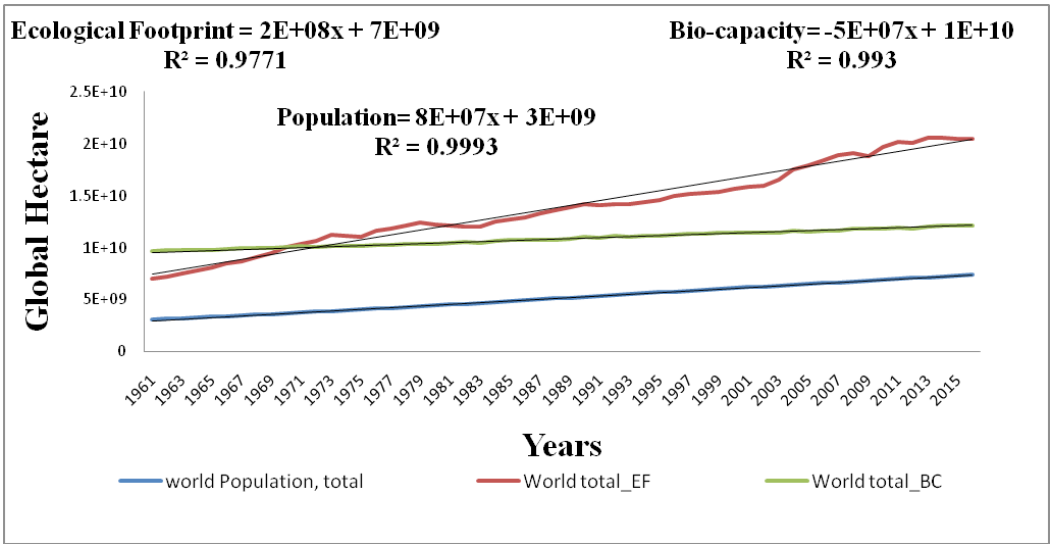

Fig. 1. Trends of Population, Ecological Footprint and Bio-capacity

Source: Global Footprint Network, 2019

Table 2. Income Group wise Share of Ecological Footprint and Population

Year	Share(%)	High income countries	Upper middle income countries	Lower middle income countries	Low income countries
1992	Population	18.71	39.24	36.40	5.65
	Ecological Footprint	46.48	35.89	15.09	2.54
2002	Population	17.36	37.71	38.52	6.42
	Ecological Footprint	45.40	36.06	15.94	2.60
2010	Population	16.72	36.29	39.76	7.23
	Ecological Footprint	37.68	42.24	17.43	2.64
2016	Population share	16.16	35.47	40.55	7.82
	Ecological Footprint	34.30	43.70	19.38	2.63

Source: Estimated from World Bank population data and Global Footprint Network, 2019

pared with LIG countries. In 1992, the population share of Upper Middle Income (UMI) countries was 39.24% in the global population and they were using 35.89% of global resource base, which is relatively lower from HIG countries. Though marginal decline in population share of UMI countries was reported, while ecological footprint has substantially increased in 2016. It was found that population share belonging to the UMI countries has declined by about 5%, while ecological footprint share has increased by 8%. Similarly, population belonging to the lower middle income (LMI) countries have relatively higher ecological footprint compared with (LIG) countries. In 1992, about 37% of population of LMI countries population were using about 15% of natural resource base, which has increased to >19% in 2016 for 40% of the population.

Status of Ecological Sustainability

Table 3 highlights that overall ecological sustainability of the various economic groups as classified by World Bank. As far as per capita ecological footprint in concern, it was found that countries belonging to the High Income group (HIG) have relatively higher ecological footprint compared with low income countries over the study period. Further, comparison of bio-capacity between HIG countries and LIG countries also shows wide difference over the period of time. On the contrary, differential results of ecological footprint and bio-capacity shows that the rate of natural resource utilization is relatively higher from the rate of resource re-generation in countries belonging to the high income group. It was reported from the Table 3 that in 1992, the average per capita bio-capacity of high income group countries was 3.78, while their ecological footprint was 5.98. It means they are over-utilizing their natural resources. Similar statistics were also observed in 2016 for high income group countries. Furthermore, rest of the groups are in the path of sustainable development. Their resource utilization rate is relatively lower than their bio-capacity over the period.

Conclusion and Policy Recommentations

The study successfully concludes that there has been wide inequality around the world in terms of natural resource consumption. It also brings out the fact that our growth process has not been sustainable. Most of the countries belonging to the high income groups are utilizing natural resource beyond the bio-capacity. Results from this study proved that per capita consumption has increased manifold of population belonging to the high income countries, while their population growth rate has declined during 1961-2016. Further, differential results were reported for upper middle income and lower middle income group countries, while results of lower income group countries presented deteriorating picture over the study period i.e., 1961-2016. Now policy question is that whether we categorically impose environmental tax on the high income countries? Answer is not so simple, we should also look to the Upper Middle Income group resource consumption pattern. Our study finds that countries belongings to the upper middle income groups and lower middle income groups are rapidly using their

Table 3. Income Group wise Status of Ecological Sustainability

Year	Average Per Capita	High income countries	Upper middle income countries	Lower middle income countries	Low income countries
1992	Ecological Footprint	5.98	2.41	1.60	1.18
	Bio-Capacity	3.78	4.93	2.73	1.83
	Difference	-2.20	2.52	1.13	0.65
2002	Ecological Footprint	6.59	2.65	1.69	1.14
	Bio-Capacity	3.58	4.67	2.43	1.55
	Difference	-3.02	2.02	0.74	0.41
2010	Ecological Footprint	6.20	2.84	1.76	1.12
	Bio-Capacity	3.36	4.44	2.23	1.38
	Difference	-2.85	1.60	0.47	0.26
2016	Ecological Footprint	5.73	2.77	1.86	1.06
	Bio-Capacity	3.28	4.19	2.07	1.26
	Difference	-2.45	1.42	0.20	0.20

Source: Estimated from Global Footprint Network, 2019. Note: values are in Global Hectares

natural resources and in the near future their ecological footprint would outreach the ecological footprint of countries belonging to the high income groups. It is well documented that deterioration of natural resources leads to the abrupt changes in the ecosystem, i.e. climate change. Hence, it is expected that countries belonging to the low income group which are less contributor will have to pay much higher cost (Srivastava and Sanatan, 2021). They are having relatively lower bio-capacity with highest poverty and unemployment rate.

As far policy recommendations are concerned, world needs a holistic approach as adopted in the Paris Agreement on climate change. There is urgent need of resource transfer to the emerging economies, so that they can reduce their ecological footprint. The present study confirmed that ecological footprint of upper middle income group countries and middle income group countries is still lower, while their per capita income is rapidly increasing, it means that in near future, their ecological footprint would increase. Further, majority of energy demand is met from non-renewable resources. Hence, if we develop and harvest the flow of renewable energy sources across nations it will help in reduction in the multiple emission driven process of fossil fuel and also enhanced the system's bio-capacity. Finally, policymakers should carefully design their path of economic development and capital accumulation to consider the sustainability of their production. Ecological Sustainability covers multidimensional aspects of livelihood security, and present study just examined the trends of global ecological foot prints with limited data. For future research, it perquisites for the assessment of the regional dimensions of ecological sustainability.

References

Gajurati, N.D. 2004. *Basic Econometrics.* fourth eds. Tata McGraw Hill Company Inc., New York, USA.

Galli, A., Justin K., Valentina, N., Mathis, W., Yoshihiko, W. and Nadia, M. 2011. Assessing the global environmental consequences of economic growth through the Ecological Footprint: A focus on China and India. *Ecological Indicators*. 17 : 99-107.

Global Footprint Network, 2019. https://data.footprintnetwork.org/?_ga2.173248166.404752813.1622014841-1873924512.1622014841#/

IPCC, 2012. Summary for Policymakers. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* [Field, C.B., V.R. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 3-21.

IPCC, 2013. Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 3-29.

Moffatt, Ian, 2000. Ecological footprints and sustainable development. *Ecological Economics*. 32 : 359-362.

Moran, D. D., Wackernagel, M., Kitzes, J. A., Goldfinger, S. H. and Boutaud, A. 2008. Measuring sustainable development—Nation by nation. *Ecological Economics*. 64 (3) : 470-474.

Rees, William, E. 2002. Globalization and sustainability: Conflict or convergence?. *Bulletin of Science, Technology & Society.* 22(4) : 249-268.

Singh, S. 2020a. Farmers' perception of Climate Change and Adaptation decisions: A Micro-level Evidence from Bundelkhand Region, India. *Ecological Indicators*. 116 : 1-13.

Srivastava, E. and Sanatan, N. 2021. Globalization and Natural Resource Consumption in India: A Comparative Study of Pre and Post-Economic Reforms Period. *Utkal Historical Research Journal*, ISSN: 0976-2132 Vol.-34(X): 151-157.

Wackernagel, M. and Rees, W.E. 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth*, New Society Publishers, Gabriola Island, BC.

Wiedmann, Thomas, John B., 2010. A Review of the Ecological Footprint Indicator—Perceptions and Methods. *Sustainability*. 2 : 1645-1693.

World Bank, 2019. World Bank database. access on (date) web link- https://data.worldbank.org/indicator/SP.POP.TOTL

York, R., Eugene A., Rosa, Thomas, Dietz 2009. A Tale of Contrasting Trends: Three Measures of the Ecological Footprint in China, India, Japan, and the United States, 1961-2003, *American Sociological Association*. 15(2) : 134-146.