Green GDP and Economic Openness in India

ABSTRACT

Aim: The vast range of weather conditions in India's climate system is a result of numerous reasons, including growing agricultural activity, altered land use patterns that increased emissions of methane and nitrous oxide as well as other greenhouse gases, automobile use, and so forth. It is necessary to quantify the significant and under-estimated impact of climate change on the natural system through changes in extreme weather. To account for the economic losses of the environment as a result of climate change, the Green GDP concept was introduced. The objective of the paper is to compute the Green GDP for India and test the effect of economic openness on GDP and Green GDP.

Methodology: The World Bank Database, the OECD, and Energy Statistics India 2021 are some of the sources from which information was gathered. Growth Rate, Economic Openness Index and the Green GDP estimation methods are employed. To compute the Green GDP indicator for the years 2011 to 20, the GDP measure is subtracted from the costs associated with the utilization of natural resources and environmental degradation.

Results: According to the outcome, the cost of environmental damage will decline from 11 per cent in 2011 to 9 per cent in 2020. The cost of environmental damage growth rate was -3.07 percent. The Economic Openness Index was 55.62 in the year 2011 and it is gradually declining and attained 36.46 in the year 2020. The lower the index, the lower the impact of trade on domestic activities and the less powerful the economy of that country. The relationship between economic openness and Green GDP per capita shows that less and less economic openness moves the cost of environmental damage to the increasing side.

Conclusion: The cost of environmental damage increased in the year 2020 compared to 2011 but the growth rate shows negative. The government should take several initiatives to assure data availability and accountability to estimate the environmental damage cost and to frame suitable policy options to improve economic performance overall.

Keywords: Climate Change, Economic Openness Index, Economic loss, Environmental Damage, Green GDP.

1. INTRODUCTION

Gross Domestic Product (GDP) is a widely used measure to estimate the growth of the economy over a long period and is most commonly called “the monetary value of final goods and services—that is, those that are bought by the final user—produced in a country in a given time (say a quarter or a year)” (Callen, 2008). “It counts all the output generated within the borders of a country. GDP is composed of goods and services produced for sale in the market and also includes some nonmarket production, such as defense or education services provided by the government” (Callen, 2008). India stands in 6th position in terms of nominal GDP and 3rd position in terms of Purchasing Power Parity. Despite there are several advantages, our traditional economic growth calculation approach named GDP has a major disadvantage in that many of the inputs and outputs which are widely used for producing goods and acquiring by

consumers for satisfaction like natural ecosystems are not included (NRC, 1999). Environmental degradation, such as water contamination, undermines the country's human well-being. For improved economic performance and human well-being, it is necessary to account for economic losses fully caused by environmental degradation. According to my understanding and previous studies, no such accounting system or model is currently being used in India to evaluate environmental losses and their impact on economic growth, and not enough official or institutional data is available in India to calculate environmental damage.

There have been several attempts made by many scientists to develop a new economic growth model with a focus to include a natural accounting system to encounter the deficiencies occurring in our traditional GDP and come up with several green national accounts. “The proponents of ‘green’ national accounts believe that new or corrected national accounting aggregates can be used to change both policies concerning the environment and broader economic policies with the environment and broader economic policies with environmental consequences” (Reppetto, 1989). One of the approaches to meet the lacking details in our traditional GDP is Green GDP.

Green GDP is a new model of economic measure approach which includes the environmental damage and its cost environmental value. The strength of this green GDP accounting is considering the ecosystem value in traditional GDP economic measures and easily recognizing the sustainability of our economy. “The Index of Sustainable Economic Welfare (ISEW) and the Genuine Progress Indicator (GPI) are the two green GDP measuring systems. countries with ISEW data include Austria, Chile, Germany, Italy, etc. while the United States and Australia are nations addressed by GPI” (Neumayer, 2000). “The use of these new accounting techniques reveals an increasing disparity between traditional and green GDP, implying that, over time, more and more economic activity may become self-canceling in terms of welfare”. (Max-Neef, 1995). One of the paper's conclusions is that green accounting aggregates will be key inputs to growth and development policies, although perhaps not in the form initially envisioned. Some of the important points of Green GDP are as follows:

1. Green GDP takes into consideration of the environmental impacts on the productivity of the country.
2. It can improve environmental protection and rational resource utilization and
3. Green GDP provides a more correct measure of welfare and examines the sustainability of the economy.

Various factors influencing the adoption of Green GDP measures are acceptance of theoretical issues and estimation problems, and then unable to meet the data requirement are hindering several nations from acceptance. According to several studies, more open trade regimes have the potential to increase economic growth by enhancing the total factor productivity of the economy, for instance. (Dar and Amirkhalkhali, 2003). There is evidence that increased openness is associated with deteriorating socioeconomic conditions and a higher amount of greenhouse gas emissions, as well as an income disparity. (Baten and Fraunholz, 2004; Managi, 2004). In this paper, green GDP and its growth rate for

India are calculated by using time-series data for 2011-20. The openness index is also estimated and its effects on Green GDP per capita are tested.

The plan of the paper is: (1) to compute the Green GDP for India and (2) to test the relationship between economic openness on Green GDP per capita.

2. LITERATURE REVIEW

Kunanuntakij et al.,(2011) calculated "Green GDP for 1990-2020 based on the 2006 IPCC guidelines by focusing only on GHG emissions. They reported that the amount of GHG emissions is 242-459 million tonnes of CO_2 eq/year which is come from 10 economic sectors. They inferred that difference between Thailand's GDP and Green GDP is about 2 per cent due to the degradation cost of GHG emissions with the variability in the ratio of GDP to Green GDP across different sectors".

Qi & Xu (2001) mentioned that "GDP is a poor indicator of social welfare at the national level. Therefore, the conventional GDP is of limited usefulness in making the policies of social welfare and sustainable development. They thought that Integrated environmental-economic (or 'green') GDP is a more accurate measure of social welfare than GDP itself because it captures the disutility due to environmental damages. Overall, they conclude that the growth of GDP and green GDP coincides with almost all countries including developed and developing countries, though the growth rates have some differences in scale. It appears that most countries do not worsen the environmental quality to get the gains of GDP, even for the countries in their early development stages".

SenGupta (2020) analyzed "the dynamic impacts of trade openness on economic growth in India and found that trade openness harms economic growth in India in both the short and long run".

Stjepanović et al., (2019) collected "data from a sample of 44 countries, that includes both developing and developed countries which have been collected from the Eurostat and World Bank database. They analyzed and reported that the developed countries had average GDP growth and Green GDP growth for the developed countries were -0.42 per cent and -1.34 per cent. Developing and under-developed countries are not on the path of sustainable development as the difference between GDP and green GDP tends to grow".

Veklych and Shlapak (2013) evaluated "three methodological approaches to calculating environmentally adjusted domestic product: (1) includes the consideration of natural capital reduction; (2) takes into account environmental degradation due to the accumulation of pollutants and waste, as they affect both economic activity and natural capital; and (3) assumes further deduction of the costs spent on combating environmental degradation".

Vimochana (2017) examined "the impact of environmental accounting and the policy alternatives available to economic decision-makers by analyzing the natural resource value techniques used by several industrialized and developing countries. The author concluded that the adoption of basic features

of green accounting will show the role of the environment in the economy as well as make the study of macroeconomic concerns easier with the use of accounting information systems, and therefore guide the economy to a key route".

3. METHODOLOGY

The following sections describe methods to estimate the green GDP and Openness Index. After characterizing the methods in general form, we used the secondary data collected from various sources and estimated the Green GDP for India.

3.1 Output data

The details of the data and their secondary sources are given in the Table.1

Table.1: Details of variables and their data sources

Variables	Data sources
Gross Domestic Product (GDP)	Ministry of Statistics and Programme Implementation, Government of India
CO_2 Emission	World Bank Database
Gross National Income (GNI)	World Bank Database
Natural Resource Depletion (NRD)	World Bank Database
Population	World Bank Database
Carbon Pricing	Carbon Disclosure Project, India Report 2020 & OECD
Energy production	Energy statistics India 2021

3.2 Green GDP Estimation Method

By ensuring what is an applicable methodology and accurate information for the assessment of economic progress, Stjepanovic suggested a radical change in how we think about sustainability and green development. For assessing and comparing the economies of different countries, they applied a general methodological algorithm. Green GDP is calculated by deducting the cost of natural resource consumption and the cost of environmental depletion from the GDP measure. But they approached Green GDP by separating the real costs of environmental damage and opportunity costs of a lost turnover. Data unavailability was a major obstacle in achieving more extensive work on green GDP. The calculation scheme in general (presented by Stjepanovic, Tomic, and Skare, 2017) is

$$\text{Green GDP} = \text{GDP} - (\text{Kt}CO_2 * P_C) - (\text{Ewaste} * 74\ \text{kWh} * P_{kWh}) - (\text{GNI}/100 * \%\ \text{NRD})$$

Where,

K_tCO_2 - CO_2 emissions expressed as kilo tonnes

E_{waste} - Total commercial and industrial trash in tonnes

GNI - The sum of value added by all resident producers plus any product taxes

NRD - Variable adjusted savings of natural resource depletion

P_{kWh} - Price in PPP for 1 kilowatt-hour

P_C - Price for carbon

"GDP (in PPP) was obtained as the sum of gross value added by all resident producers in one economy plus any product taxes minus any subsidies not included in the value of the products. It has been calculated without making deductions for the depreciation of fabricated assets or depletion and degradation of natural resources" (WDI, 2017). "The first deduction presents the costs of CO_2 pollution (as CO_2 emissions times carbon market price), the second the opportunity costs of one tonne of waste that could be used in the production of electrical energy), and the third is the adjusted savings of natural resource depletion as a percentage of the gross national income per country. Carbon dioxide emissions (CO_2) expressed as kilotonnes (*Kt*) are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during the consumption of solid, liquid, and gas fuels and gas flaring" (WDI, 2017).

"Total *PCDM* is the average volume-weighted price for carbon in PPP" (Capoor & Ambrosi, 2007). "Total commercial and industrial waste (E_{waste}) is presented in tonnes and data were partially collected from the Eurostat and the World Bank database. To evaluate opportunity costs related to waste problems, knowing that the number of waste nations produces annually is huge, used a waste-to-energy conversion principle. Hence, kilowatts (*kW*) of energy in one tonne of waste present an amount of electrical energy that we can derive from waste. Namely, *74 kWh* is kilowatts-hours of energy in one tonne of waste presents an amount of electrical energy that can be obtained from a waste" (according to the Australian Energy Regulator, 2015; and Renosam, 2006). "The price (*Pelect*) in PPP for 1 kilowatt-hour is calculated as a mean of commercial and industrial prices for each country (Eurostat, 2017). Gross national income or *GNI* (in current U.S. dollars) is the sum of value added by all resident producers plus any product taxes (fewer subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad" (WDI, 2017). "Finally, variable adjusted savings of natural resource depletion (*NRD*), as a percentage of the GNI per country, presents natural resource depletion as a sum of net forest depletion, energy depletion, and mineral depletion" (WDI, 2017).

3.3 Economic Openness Index

According to the theoretical literature, trade openness is critical to the process of economic growth in emerging countries. For a variety of reasons, trade openness is an important component of intellectual and policy debate. First, trade openness is an important component of the structural adjustment programs implemented in many developing nations by the World Bank and the International Monetary Fund. Second, much empirical research has suggested that trade openness is important for

economic growth via the exports-led growth hypothesis and the import-led growth hypothesis (see Balassa 1985; Ram 1987; Bhagwati 1978; Greenaway, Nam 1988; Salvatore, Hatcher 1992; Awokuse 2007, 2008; Mishra et al. 2010; Hye, Boubaker 2011; Shahbaz et al. 2011). Non-domestic transactions (imports and exports) have a significant impact on the size and growth of a country's economy. Exports plus imports as a percentage of GDP are used to compute the Economic Openness Index. Economic openness is associated with higher productivity in countries. Moreover, countries that have improved their economic openness have seen the greatest gains in production.

$$\text{Economic Openness Index} = \frac{X+M}{GDP} * 100$$

4. RESULTS AND DISCUSSION

Results from Table.2 present the green GDP, cost, and percentage of environmental damage for India from the year 2011-2020. The green GDP for the year 2011 was 161934 Billion US dollars and it increased to 237897 Billion US dollars in 2020. The cost of environmental damage was increased to 24400 Billion US dollars in 2020 from 20370 Billion US dollars in 2011. But, the damage cost which is present as per cent of GDP diminished over the years from 11.17 per cent in 2011 to 9.30 per cent in 2020.

Table.2: Green GDP and Environmental Damage Cost of India *(In Billion)*

Year	GDP (Current US$)	Green GDP (Current US$)	Cost of environmental damage (US$)	Damage Cost(% of GDP)
2011	182304.99	161934.02	20370.97	11.17
2012	182763.78	162149.81	20613.97	11.27
2013	185672.21	164719.18	20953.02	11.28
2014	203912.74	181893.67	22019.07	10.79
2015	210358.78	189224.91	21133.86	10.04
2016	229479.79	207971.41	21508.38	9.37
2017	265147.29	242213.02	22934.27	8.64
2018	270111.17	245475.92	24635.26	9.12
2019	287050.40	261679.70	25370.71	8.83
2020	262298.37	237897.44	24400.93	9.30

The Growth Rate (GR) of GDP, Green GDP, and cost of environmental damage was shown in figure.1. The graph shows that the growth rate of GDP, green GDP, and cost of environmental damage were 5.72, 6.09, and -3.07 respectively. During the recent period, GDP growth and Green GDP growth haven't differed dramatically. The negative growth of GDP and green GDP in 2020 shows the covid pandemic overall in the country. Accordingly, we may conclude that environmental quality has been sacrificed to achieve higher economic growth rates and greater benefits. The cost of environmental damage increased to 24400 Billion US dollars in 2020 from 20370 Billion US dollars in 2011 which shows that the environmental deterioration is increasing parallel to the GDP of India. Accordingly, environmental damage has a direct effect on the total value of final goods and services being produced in India.

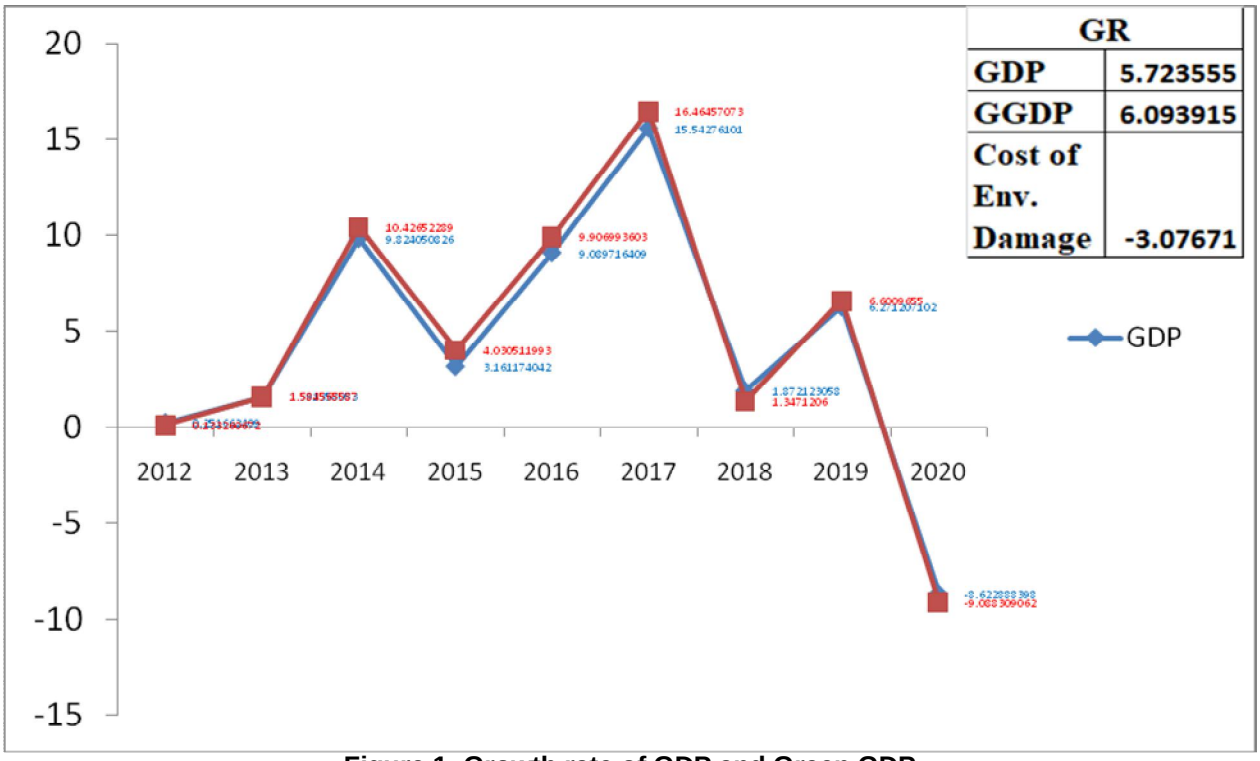

Figure.1: Growth rate of GDP and Green GDP

The Economic Openness Index was 55.62 in the year 2011 and it is gradually declining and attained 36.46 in the year 2020. The index goes on decreasing which shows that the impact of trade on domestic activities is less and has less powerful the economy of that country.

The relationship between Economic Openness Index and Green GDP per capita was shown in Figure.2 which indicates a strong, non-linear, negative correlation and relationship. The relationship proves the various past studies' conclusions between the two. The relationship indicates that less and less economic openness will move the green GDP to the increasing side.

Year	Openness Index
2011	55.62
2012	55.79
2013	53.84
2014	48.92
2015	41.92
2016	40.08
2017	40.74
2018	43.59
2019	39.38
2020	36.46

Table 3: Yearwise Openness index

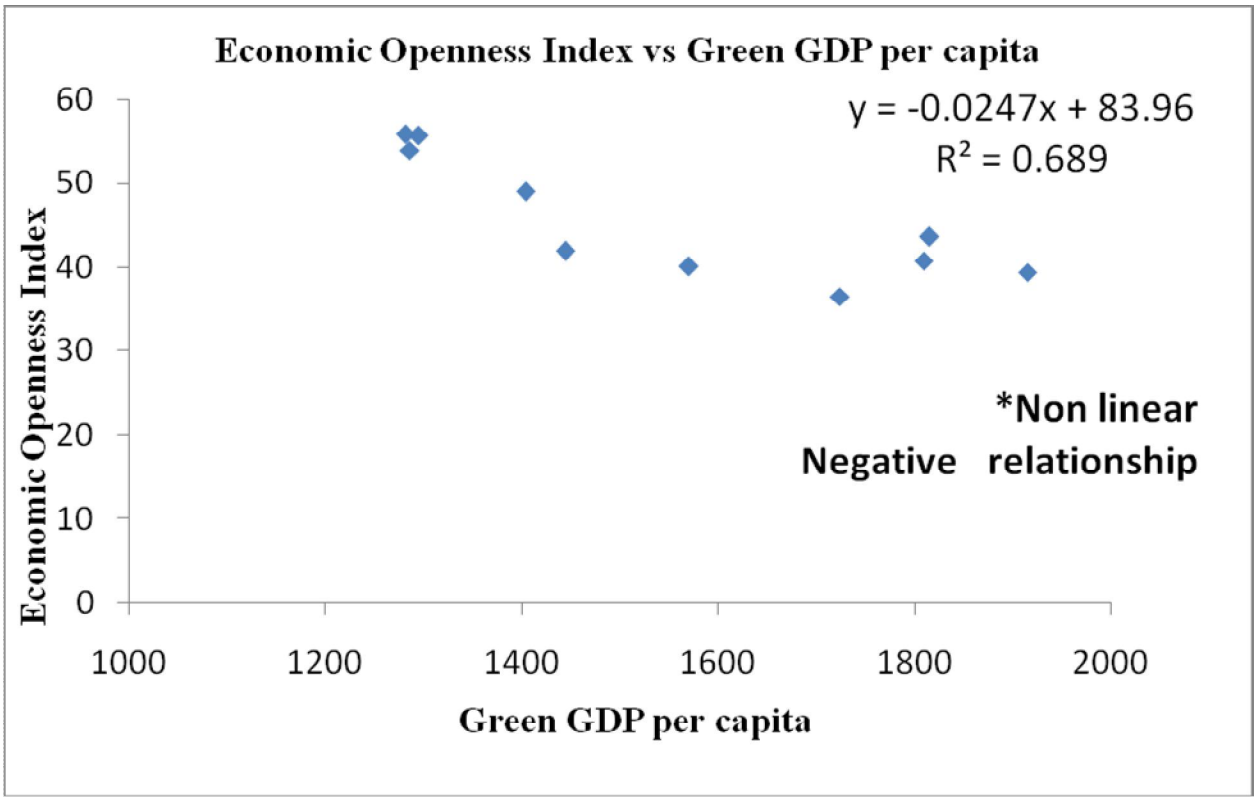

Figure.2: Relationship between Economic Openness and Green GDP per capita

5. SUMMARY AND CONCLUSION

By modifying standard GDP metrics for natural resource depletion or pollution, a realistic picture of green growth and development, known as a green GDP assessment, can be obtained. The cost of environmental damage increased in the year 2020 compared to 2011 but the growth rate shows negative. The government should take several initiatives to assure data availability and accountability to estimate the environmental damage cost and to frame suitable policy options to improve economic performance overall. Green GDP cannot replace standard GDP statistics due to methodological constraints and a lack of interpretation. Become a gauge of public awareness via which a slew of public figures attempt to impose new, ecologically oriented policy orientations. Although green GDP accounting is not yet a commonly acknowledged notion due to its methodological complexity and complication, advances in ideas and approaches are continuing. It will be a difficult effort, particularly in the area of statistics, because many industrialized and developing countries still lack important statistics.

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