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The Green New Deal and the Development Conundrum in India

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ABSTRACT

Growth and development have always been the target of the nations and economies tend to achieve this target via various processes directed towards the demand-supply equilibrium. However, the narrow concept of achieving this demand-supply equilibrium with targeted growth, measured nominally, has undergone a revival in terms of more comprehensive concepts like sustainability linked to development. The proposed *Global Green New Deal* is outcome of such deliberations and is being mooted as a potential policy tool which may settle the *Great Development Dilemma*. Understanding this concept of sustainable development in terms of *ethical foundations* is hence imperative to settle few questions related to dynamics of growth and development especially in India.

The basic aim of this paper is to explore Economics of environment in terms of *GND* and *linked factors* which alters the pattern of development linked to sustainable growth. The paper, therefore, tends to study how factors like Arable land, CO2, Fertilizer Concentration, Green House gas impact Real GDP in India. The time series analysis for the years 1990-2019, done with the use of ARDL models explain a negative long run relationship between GDP and Green house gases. Based on these results, this research deliberates upon the concept of *Eco-Innovation* as a sustainable tool of interaction on the production side. The paper also moots upon the effective role of government in providing impetus to growth via contributions in *Green infrastructure*. The ultimate target is to settle the question of environment directed development via a model which includes interplay of market forces along with extended active role of the State.

Keywords : Growth and development; environment economics; Green GDP; Green Infrastructure; Sustainable Growth Model, Eco-innovations, Green New Deal

Introduction

In the race of becoming economic powers, countries started focusing on expanding their industrial activities and growth was visualized in terms of industrialized strong economy. But this industrialization and growth at the pretext of industrializations, brought numerous changes in the environment. Increase industrial pollution, chemical pollution etc. have led to rising global temperatures and altered the shape of the nature. These visible changes were initially not linked with the narrow conceptualization of growth seen as just rise in per capita income or Gross Domestic Product (GDP) of the economy. This led to issues making Growth increase inconsistent with the development parameters. Though over time the measurement criteria have shifted from quantitative measures of measuring Growth towards the qualitative measure like the inclusion of health, education, gender, poverty etc. Different organizations are constantly trying to improve the methods of measurements to rank the countries for development.

In the race of emerging as an economic power and have a good rank in the development index the focus for years had not been on the cost involved in achieving these. Consciousness, slowly and gradually, incorporated the aforementioned factors in deciding about Growth and also linked exploitation undertaken during industrialization in terms of impact factors on the weaker sections of the society; but the literature for years considerably ignored to incorporate the cost as well as the main exploited factor: The Environment while discussing about growth. However, recent studies now contemplate environment as an important factor impacting the economy of the nation. For instance, as per the report by World Economic Forum (WEF) the sole problem of air pollution annually costs the Indian economy $95 billion. A growing amount of literature highlights that reduction in pollution factors can significantly give boost to economic growth. Further, the nations are now delving into concepts like Green GDP and concentrating on innovations mooted in Green New Deals (GNDs) as a way out to settling this growth and development conundrum. The **World Economic**

Forum (WEP) recently published its report titled "**Mission 2070: A Green New Deal for a Net-Zero India**" to provide a roadmap for India's energy transition. Report highlights that India's transition towards a green economy could contribute about $1 trillion in economic impact by 2030. It will create more than 50 million jobs (Rajendran et al. 2021).

With this brief, it is easier to point out where the paper is leading and what it wants to express. The paper aims to highlight how GDP is impacted with various factors which pollute the environment. The study explains how factors like Arable land, CO2, Fertilizer Concentration, Green House gas, Population Growth impact Real GDP in India. The time series analysis for the years 1990-2019, explain a negative long-run relationship between GDP and these factors. Based on these results, this research deliberates upon the concept of *Eco-Innovation* as a sustainable tool of interaction and explains that it is the time for ecology and economy to meet at the crossroads in the GNDs. For the past few years, the focus has been shifted towards health industrialization however, the pace is not matching the required rate to save the planet. The reason could be that the efforts lack a holistic approach. With sustainable development through eco-innovations there is still hope.

Paper begins by discussing the terms sustainable development, eco-innovation and GNDs and what is meant by sustainable development through eco-innovations. The focus will be on further discussion that how with this, we can still make and live with industrialization which is more healthy. How the focus of research and development can be shifted in the eco-innovations. How everything can be kick started with the already existing industrialization but for green growth.

Environment and Economy : Literature Review

Since the very beginning of the industrial revolution, technical change always dominated the natural world. Improving the existing product, service, process, method, practices, and relations evolved the concept of technical change as innovation. According to scholars, innovation refers to 'the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations' (Eurostat, 1999, 2010). Innovation is an important aspect of regional and national development and hence it attracted the interest of the researchers in the economy.

Schumpeter and his followers formalized the concept of innovation by defining it in terms of the expansion of capitalism and by manipulating the natural environment. He is of the view that the engine of capitalist expansion is innovation. In the 1960's, the connection between innovation and sustainability emerged in the academic world. As per the Report Limits to Growth, commissioned by the Club of Rome, economic growth cannot be continued indefinitely because of the limited access to resources. One of the influential critics of the report is given by Neo Classical economist, Robert Solow. He stated in an interview with Newsweek in 1972 that "the authors load their case by letting some things grow exponentially and others not. Population, capital and pollution grow exponentially in all models, but technologies for expanding resources and controlling pollution are permitted to grow, if at all, only in discrete increments." Despite all the criticisms, this report leveraged sustainability with the help of two main branches that are, Environmental Economics and Ecological Economics. The former focuses on environmental externalities whereas the latter focuses on the relationship of economic system and nature. Although those two approaches differ on several points, there is no doubt that in both schools' sustainability has a strong technological component. Borne out of these conceptualizations, is the concept of eco-innovations.

Where innovation adds to the existing processes, products, and services, eco-innovation is considered as a positive contribution to the competitive economy. In simple language, eco-innovation refers to the efficient use of renewable resources and natural resources in an economy. It ensures that the consequences of human activities on the environment are neutralized or reduced. And further helps in strengthening the environment against economic pressures. Thus, ecological innovations, environment innovations, ecological designs, and many other eco-innovation terms in simple language means a positive contribution to the existing competitive economy. Eco-innovations come in various ways and are mainly concerned with reducing waste, reducing the green-house effect, optimizing the use of natural resources, reduction in pollution levels, and increasing the efficiency of energy. Eco-innovations can help trigger sustainable development.

The eco-innovation concept itself is related to the concept of sustainable development. The phrase "sustainable development" was first used in 1980 by the International Union for the Conservation of Nature and Natural Resources in their World Conservation Strategy Report. The Report advocated "the integration of conservation and development to ensure that modifications to the planet do indeed secure the survival and well-being of all the people." Sustainable development means ensuring that the natural resources and ecosystems are sustained in a way that future generations can use it wisely while meeting the human development goals of the present generation. Thus, sustainable development through eco-innovations is the right way of industrial expansion at a point where growth is facing the rising struggle with environment problems. In recent times, as per the Brundtland Report, commissioned by the UN, the concept of sustainable development has spread all around the world. The report defines sustainability "as the capacity to guarantee a decent future for the next generations." This definition limits sustainability to development and growth. The goal of sustainability can be achieved through social and technological transformation of modern industrial society.

Two different visions of sustainability that we usually discuss about are: Ecological Modernization (or Sustainable Development) and Ecological Economy. The first is linked to Schumpeter's idea of innovation. It considered innovation as main factor behind capital expansion and economic growth. This sees eco-innovation in terms of joint emergence of economy and the environment and here the growth is market led and driven by innovation without any government interference. The mainstream economists or the neo-classicals contemplated that eco-innovations should operate within a free market situation where regulations are only restrictive in nature and should only pop up to mitigate the negative affects of emanating from the same. Neoclassical approaches believe that pollution and degradation of environment are the result of externalized costs of industrial mechanisms. It visualizes a company's degradation of environment as a cost to the society as a whole. This conceptualization of neoclassical theory gave birth to the Environmental Economics. Eco-innovation is considered under this conceptualization as an important ingredient to curb the cost externalization done by firms and gain competitive profits under regulations linked to environment. The second approach considers the economic process a sub-system of a wider Planet-System. This significantly increase the domain of eco-innovation from being a mere tool of development to a systemic ingredient behind altering the state of balance between economy and environment.

Taking key inputs from these theoretical underpinnings, one can define Green Business Model Innovation as when a business changes its business model to gain economic profits and also reduces the ecological footprint. More green the business model is more is the chance of a strong eco-innovation. Thus, now it is imperative to focus on green business model innovations. Green New Deals, policy packages that include reduction of environmental degradation and also aim at enhancing economies by focusing on opportunities that create livelihoods and wealth, should formalize such models.

Data and Methodology

This paper makes use of annual data of India for the years 1990-2019 and the data base is compiled from the World Bank, World Development Indicators online data. The Real GDP at factor cost is the proxy variable for growth (Y) and has been taken as the dependent variable and the independent variables chosen for the study are Total greenhouse gas emissions (kt of CO2 equivalent), Arable land (hectares per person), CO2 emissions (metric tons per capita), Level of water stress (freshwater withdrawal as a proportion of available freshwater resources), Methane emissions (kt of CO2 equivalent), Nitrous oxide emissions (thousand metric tons of CO2 equivalent) and Fertilizer consumption (% of fertilizer production). These all variables are transformed into natural logarithms. The long run relationship has been studied by using the basic ARDL Models in econometrics.

ARDL Model

This study made use of Autoregressive Distributed Lag (ARDL) model of Pesaran et al. (2001) to examine the cointegration relationship between Growth and various environmental factors. The ARDL bound test method capture the dynamic effects of lagged Ys and lagged Xs. If a sufficient number of lags of both the variables are included in the model then, we can eliminate autocorrelation in the error term.

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Suppose we have the model:

$$Y_t = \partial_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \cdots \ldots \ldots + \alpha_k Y_{t-K} + \beta_0 X_t + \beta_1 X_{t-1} + \cdots \ldots \ldots + \beta_m X_{t-M} + V_t$$

$$= \partial_o + \sum_{k=1}^{K} \alpha_K Y_{t-K} + \sum_{m=0}^{M} \beta_m X_{t-M} + V_t \quad (1)$$

In equation (1) $\sum_{k=1}^{K}$ and $\sum_{m=0}^{M}$ are the lag operators of the dependent and the independent variables, respectively, whereas K refers to the number of lags present in the dependent variables and M refers the lags of the independent variable.

In long run and equilibrium:

$$Y_t = Y_{t-1} \ldots \ldots \ldots = Y_{t-K}$$

$$X_t = X_{t-1} \ldots \ldots \ldots = X_{t-M}$$

If the Model (1) is estimated using the OLS then the model (1) can be written as:

$$Y_t = \frac{\partial_0}{1 - \sum_{k=1}^{K} \widehat{\alpha_k}} + \frac{\sum_{m=0}^{M} \beta_m}{1 - \sum_{k=1}^{K} \widehat{\alpha_k}} X_t + \frac{1}{1 - \sum_{k=1}^{K} \widehat{\alpha_k}} V_t$$

$$Y_t = \widehat{\partial_o} + \widehat{\partial_1} X_t + e_t \quad (2)$$

Here the Hypothesis is

H_o: There is no cointegration equation

H_1: There is cointegration equation

Bound Test in Eviews

The ARDL bound test approach is used to test the presence of the long run relationship among the variables by conducting the F-test. If the calculated F-statistics is greater than the critical value of the upper bound I(1), then we conclude that there is co-integration. There is presence of the long term relationship. Reject the null hypothesis. Estimate the long run model which is Error Correction Model.

Model:

$$l_{RGDP} = \widehat{\partial_o} + \widehat{\partial_1} l\_Greenhouse + \widehat{\partial_2} l\_NitrousOxide_t + \widehat{\partial_3} l\_CO2_t + \widehat{\partial_4} l\_Waterstress_t + \widehat{\partial_5} l\_methane_t + \widehat{\partial_6} l\_Arable_t + \widehat{\partial_7} l\_FertCon_t \quad (1)$$

After finding the long-run relationship, the study applied short-run parameters that can be obtained by the Error Correction Model (ECM) associated with the long-run estimates of ARDL Model.

ECM can be written as:

$$\Delta Y_t = \partial_o + \partial_1 \Delta X_t - \alpha \hat{e}_{t-1} + v_t \quad (3)$$

e_{t-1} is the error correction term which represents the past error. The ∂_1 is the impact multiplier (short-run effect) that measures the immediate impact a change in X_t will have on a change in Y_t. The α is the convergence parameter or the feedback effect or the adjustment effect and it shows how much the disequilibrium is being corrected- that is the extent to which any disequilibrium in the previous period affects any adjustment in Y_t. α tells about the speed of adjustment. The eq (3) everything is stationary and hence the OLS should perform well.

$$\Delta Y_t = \hat{\partial}_o + \hat{\partial}_1 \Delta X_t - \hat{\alpha}[Y_{t-1} - \widehat{\beta_o} - \widehat{\beta_1} X_{t-1}] + v_t$$

$$\Delta Y_t = \hat{\partial}_o + \hat{\partial}_1 \Delta X_t - \hat{\alpha} Y_{t-1} - \hat{\alpha}\,\widehat{\beta_o} - \hat{\alpha}\,\widehat{\beta_1} X_{t-1} + v_t$$

Here, $\hat{\alpha}$ must be negative and significant to ensure stability of co-integration relationship. Also, if it is annual data the $\frac{1}{\hat{\alpha}}$ shall tell us the no. of years the system will take to restore the equilibrium or cointegration relationship after a shock.

Results and Findings

Before applying the ARDL model, it is imperative to satisfy the conditions of its applicability. It is important to ensure that all the variables in the model should be stationary at either I(0) or I(1) or combination of both. No variable should be used at I(2) otherwise the ARDL model can't be used. To ensure this, the study applied the unit root tests Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test to check the order of stationarity of all the variables. The results of the unit root test (as given in Table 1) confirm that the variables under consideration are stationary at first difference and they are integrated of order 1 i.e I(1). Therefore, ARDL model can be applied.

Table 1. Unit Root Test Results

Variables	ADF Test (With trend and Intercept)		PP Test (With trend and Intercept)	
	Level	First Difference	Level	First Difference
RGDP (Y)	-3.8811**	-4.9513***	-3.8474**	-7.6820***
GH	-1.4884	-3.9622**	-1.7505	-4.1270**
NO	-1.1135	-4.1828**	-1.622	-4.1620**
Meth	-1.2188	-3.9996**	-1.2186	-3.9773**
CO2	-1.4973	-4.6314***	-1.6985	-4.8022***
WS	-1.4250	-5.1225***	-1.4552	-5.1761***
AL	0.0917	-6.7173***	1.7844	-9.7276***
FC	-2.3449	-3.9725**	-1.9704	-4.0800**

Note: *, ** and *** indicate statistical significance at 10%, 5% and 1% levels of significance.

After running for different models (as shown in the appendix), it was found that **Model 1 (no trend, no drift model) is significant. On running the coefficient diagnosis, following results were seen.**

Table 2 reports the results of ARDL bounds test for cointegration. The calculated F-statistic (10.23) for the model are greater than the critical values (3.91) of the upper bound at 1% level of significance. Therefore, the results are significant, and there is a long run relationship between the variables under consideration. Hence, Growth is greatly influenced by the environment linked variables. After confirming this relationship, the study then delves to estimate the long-run coefficients of the variables.

Table 2. Results of ARDL Bounds Test

F-statistics	Significance Level	Critical Bound F-statistics	
		I(0) LCB	*I*(1) UCB
10.2307	1%	2.54	3.91
	5%	1.97	3.18
	10%	1.7	2.83

Table 3 highlights the long run estimated coefficients of the ARDL model. Green House gases, CO2, Arable land and Water Stress significantly impact Growth. It can be seen that factors like Arable land, CO2 and Water Stress have positive impact on RGDP in the long run. This is indicative of the fact that exploitation of environment helps in GDP growth. However, a note worthy point here is that the cumulative effect of green-house gases on RGDP is significantly negative in the long run. It can be stated that 1% increase Green House Gases will lead to fall in GDP by approximate of 3%. This highlights that pollution also has huge negative impact on GDP growth. Therefore, environment should not be considered as a mere tool of exploitation for increasing GDP rather it should be effectively managed so that it boosts the economy of the nation without posing any obstacles to growth.

Table 3. Estimated Long Run Coefficients from ARDL Model

Dependent Variable: Y				
Variables	Coefficient	Standard Error	T-Ratio	Probability
LnGH	-2.957	0.7607	3.8874*	0.0009
LnNO	-0.4053	0.5748	0.7051	0.4889
LnMeth	1.4298	1.1876	-1.0203	0.2426
LnCO2	2.0401	0.6323	-3.2263	0.0042
LnWS	1.0545	0.3582	-2.9439*	0.008
LnAL	2.6346	0.4427	-5.9504*	0.0000
LnFC	0.13944	0.09117	-1.5294	0.1418

Note: * indicate statistical significant values at 5% level of significance.

The estimated results of short-run dynamic coefficients using Error Correction results of ARDL are given in Table 4. The estimated short-run coefficient of Green House Gases still has a negative impact on the economic growth and is statistically significant at 5% level. The estimated coefficients of Carbon Dioxide, Water Stress and Fertilizer consumption also still show statistically significant positive impact on economic growth. Also in Table 4, the ECM_{t-1} coefficient (0.45112) is not negative although significant at 5% level. It shows that if there is any shock in the short run then will the relation be again established or not. The necessary condition for error term must be negative and significant, so we reject the null hypothesis. Therefore, the short run shocks may not significantly alter the equilibrium.

Table 4. Estimated Short Run Coefficients from ARDL Model

Dependent Variable: Y				
Variables	Coefficient	Standard Error	T-Ratio	Probability
ΔGH	-1.3341	0.4070	3.2773*	0.0038
ΔNO	-0.1828	0.2199	0.8312	0.4156
ΔMeth	0.6450	0.4395	-1.4675	0.1578
ΔCO2	0.9203	0.2620	-3.5125*	0.0022
ΔWS	0.4757	0.2252	-2.1117*	0.0475
ΔAL	1.1885	0.3981	-2.9853*	0.0073
ΔFC	0.0629	0.0351	-1.7013	0.0886
ECM_{t-1}	0.45112	0.1375	-3.2797*	0.0037

Note: * indicate statistical significant values at 5% level of significance

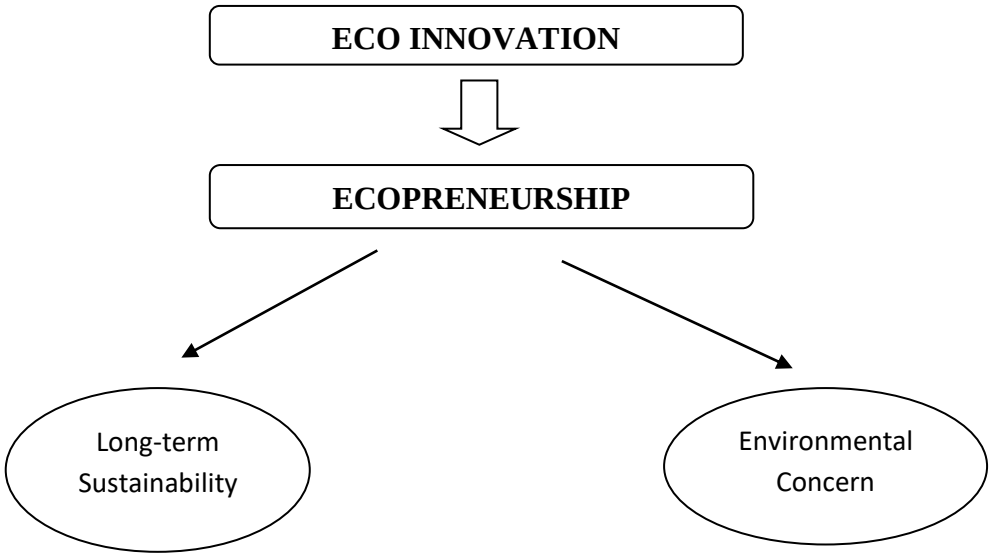
Eco-innovation Model and striking the Green New Deal

The above results explain that environmental factors significantly impact the GDP growth in the long run. While exploitation of environment increase GDP growth, this exploitation can also provide hindrances in the growth process. This is indicative with the fact that Green House gases have negative relationship with GDP in the long run. Therefore,

it is important for the economies to strike for sustainable models by studying these factors which impact the GDP negatively. The eco-innovation models can set the ball rolling.

It should be noted that existing businesses and industries cannot be transformed into a green business model innovation overnight. Eco-innovation is triggered by a mixture of internal and external drivers (Cai and Zhou 2014). With continuous efforts with the aim of green and economic effects, the business can be categorized as green business model innovation. Measures for some businesses might end up being hindrances for others or other initiatives and aims. Such as the environmental benefits of an innovation may come up as hindrances in other targets or initiatives (Machiba, 2008, 2010).

Eco-innovation Model



The basic model should focus on directing entrepreneurship towards the goals of sustainability. This includes developments towards both input and output side. Investment on financial and human resources grounds are required to trigger eco-innovation activities. As seen above the green house gases emissions significantly pose a negative threat to real GDP, therefore the focus of the economies should be towards building of such channels which help in reducing these emissions. The entrepreneurship should be directed towards this.

To achieve sustainable development the economies, have to focus on green growth. Several job opportunities can be created through green and healthy competition. The green growth is beneficial for curbing the problem of unemployment as well. Before creating demand for greener products and services, information, processes, and management a proper industry is required to take charge of it. And it is not a one-man job. It is another segment in every sector that will require a good amount of personnel. Thus, creating job opportunities. With the availability of greener goods and services, consumers will start to shift spending to greener brands within a category. A further number of jobs can be created in green sectors such as renewable energy and waste recycling. Arable land (hectares per person) is seen as having positive relation with the Real GDP. Its development for productive uses can further help in boosting growth. But it is easier said than done.

When it comes to sustainable development through eco-innovations there are a lot of barriers. Especially, people understanding the changes. It is more about accepting the changes rather than understanding them. Everyone would agree about the importance of sustainable development and the changes one needs to do but no one is ready to accept the changes. Thus, among various barriers to sustainable development change in the existing lifestyle is the major one, but once a proportion accepts it others follow. Other than that, there are mainly barriers to implementation such as market uncertainty, negligible culture of excluding eco-innovation from an organisation's strategy and uncertain return on investment. But all these are somewhat related to how consumers react to the change. One of the biggest irony is that we want to find clues of life on Mars, but are not concerned about life on Earth. We want to build homes on Mars but at

the cost of Earth. If we start and accept sustainable development through eco-innovations, we don't need to find new homes on new planets.

The focus of the Green New Deal should be on the building of right eco-innovation model and countries should aim at mitigating the barriers linked to eco-innovations. The countries can improve the institutional framework (innovation ecosystems) and promote green infrastructure for stimulating eco-innovation on regional level. This could be done in collaboration with other regional and local actors from business and research. A new social contract is need of the hour which shall involve public–private partnerships, public procurement contracts and bailout deals etc (Mazzucato 2022). A Support for eco-innovation should innovative. It should deploy a set of tested instruments and approaches. Studies highlight that movement toward a Circular economy depends on "systemic" Eco-innovation, that is, not only deep in technology but also involve dynamic and holistic combinations of service innovations and novel organizational set-ups (de Jesus et al. 2016). Further, it is needed that government frames stringent policies which could help support eco-innovations (Ekins 2010). Studies found that regulations and market pull factors are main factors driving eco-innovation in firms and regulations remain a dominating driving force for different eco-innovation types (product, process and organizational eco-innovation, environmental technology and, environmental R&D); (Hojnik and Ruzzier 2016). Therefore, both market and government synergies are needed here.

Conclusion

Environmental factors significantly impact growth in the long run. Greenhouse gas emissions is seen impacting GDP negatively in India. The effective tool for implementing the concept of sustainable development is eco-innovations. Eco-innovations, on one hand, help in improving balances between economy and the environment, and on the other hand, they contribute to technical progress as integral instrument behind building competitively advantageous systems. It is therefore important to strengthen eco-innovation systems by building resilient Eco-entrepreneurship models. The Green New deals should focus on such synergies which may help in striking the right balance in between economy and environment. Inter-organizational collaborations, partnership models between private and government sector and sharing of R&D information are needed for establishing eco-industrial business initiatives in future. Therefore, the focus of Green New deal in India should be on building eco-entrepreneurship models and starting the process of eco-innovations based on aforementioned relationships.

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