

A Way towards an Inclusive and Green Growth in India

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Abstract: *India is emerging as one of the fastest growing economies, having the status of the sixth largest economy globally by GDP and the third largest economy in Asia. Although the past decades of rapid economic growth have brought many benefits to India, the environment has severely suffered in this process. It is evident from the '2020 Environmental Performance Index', in which India ranked 169 out of 180 countries, indicating that it is lagging in green growth. A green economy or green growth has recently emerged as a key concept on the global sustainable development agenda. In the modern world, climate change, compounded by other stressors such as poverty and inequality, threatens the ability of countries to achieve sustainable development objectives, and for this, the international community has decided to come together. But any type of low - carbon growth trajectory consistent with international aspirations to limit climate change would be significantly more expensive for developing countries and it is not clear that the Indian people would be willing to bear these extra costs as an emerging economy with low GDP and low per capita income. Hence, some combination of accelerated low - carbon innovation, technology transfer from developed countries, and climate finance from outside the country will be needed if green growth is to take root in India. In this context, the present paper critically examines the feasibility and desirability of green growth, points out the challenges and key barriers to achieving it, and throws light on some initiatives taken by the government of India. This paper also proposes a set of strategies to achieve inclusive and green growth in the country, and only through this, the target of turning into the third largest economy with 7 trillion USD may be achievable by 2030.*

Keywords: Environment, Climate, Green Growth, IGG, Renewable Energy.

JEL Classification: O44, O53, Q54, Q56

1. Introduction

Today, the survival of many societies and the biological support systems of the planet are at higher risk as climate change has become one of the greatest challenges of the modern world. The global temperature has already risen 1.1°C above the proto - industrial level, with glaciers melting and the sea level rising. These impacts, along with other climate changes, are seriously affecting coastal areas and low - lying coastal countries, including many least - developed countries [1]. The impacts of climate change also include flooding and drought, displacing millions of people; sinking them into poverty and hunger; denying them access to basic services such as health and education; expanding inequalities; stifling economic growth; and even causing conflict to intellectual property rights. According to the UN, by 2030, an estimated 700 million people will be at risk of displacement by drought alone [2].

On the other hand, natural resource depletion and adverse impacts of environmental degradation, including desertification, land degradation, freshwater scarcity, resource bottlenecks, air and water pollution, and loss of biodiversity add to and exacerbate the list of challenges that humanity faces and these impacts would be irreversible [1]. Usually, poor communities are expected to use natural resources for survival without any environmental consideration. The 'New Nature Economy Report' found over half of the world's GDP depends on nature. As evidence, 12 million hectares of land have been degraded due to its unsustainable use every year, and three - quarters of the land and two - thirds of the marine environment has been significantly altered by human actions [3]. As per a report published by OECD in 2011, 33% of the world's

population could be affected by water scarcity by 2025, while, 10% of the amount of biodiversity lost by 2030 without action to mitigate it [4]. Taking urgent action to combat climate change and its devastating impacts is therefore imperative to save our lives and the planet. For this, all the countries collectively agreed to follow climate - resilient development pathways, which consist of various strategies and actions to mitigate greenhouse gas (GHG) emissions. To limit warming to 1.5° Celsius above pre - industrial levels, as set out in the Paris Agreement, global greenhouse gas emissions will need to peak before 2025. Then they must decline by 43% by 2030 and to net zero by 2050. However, current national commitments are not sufficient to meet the 1.5°C target [2]. Hence, the transition towards green and inclusive economies has been long deliberated both at the national and global levels.

In India, after recording GDP growth of around 7 - 8% for several years, it has started to witness an economic slowdown [5]. Its GDP growth rate in the last 10 years has been at an average of 6 - 7% with a baseline rate of 6.5 in real terms in FY24 as projected by 'The Economic Survey 2022 - 23'. In an uncertain world, real GDP growth of 6 - 6.5% is the new normal, and India is on track to become the third - largest economy by 2029 [6]. However, its remarkable growth record is restricted by the acute environmental challenges (including all mentioned above) and depleting natural resources [7], as most of this growth has come because of the over - exploitation of its natural resource stocks. Currently, India's environment is being plundered at all levels - local, state, and national and it adversely affected economic performance and also resulted in increased poverty, unemployment, and poor health [5]. As per a report, India suffered a loss of 5.4% of its GDP and

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167 billion potential labour hours owing to extreme heat in 2021 [8]. At present, its environmental degradation costs are \$80 billion per year or 5.7% of its economy, which has necessitated taking major steps towards green growth strategies to break the pattern of environmental degradation and natural resource depletion and to achieve a green, sustainable, and decarbonized economy. Current approaches toward growth have largely privileged a mainstream development perspective, promoted privatization and often aggravated existing social inequalities [6]. The creation of the conditions for enhancing prosperity and growing social equity, within the profile of a finite and fragile planet, has become a common challenge for us in today's world [9].

The challenge of overcoming poverty and inequality will also be greatly compounded by other climatic challenges, which disproportionately hurt the poor and most vulnerable. Unmitigated warming is expected to reshape the global economy by reducing average global incomes by roughly 23% by 2100 and widening global income inequality further [10]. Therefore, it is suggested that green growth policies must be carefully designed to minimize policies and actions that have irreversible negative impacts on the poor and vulnerable [3], and for this, they must be inclusive at the same time. As green growth is not inherently inclusive, specific policies are needed to ensure that the poor are not excluded from benefits and are not harmed in the transition, and only through this, the welfare impacts of green policies will be greater [11]. In this framework, each country, especially the developing, has to choose an appropriate growth strategy, which incorporates the agenda of green growth and inclusivity along with a remarkable and sustained growth rate.

An Appropriate Growth Model: From Classical to Modern

The 'Classical Growth Theory' postulates that a country's economic growth depends on several factors such as the productivity of labour, markets, intensity of trade, greater specialisation in the form of 'Division of Labour', etc. However, the 'Neoclassical Growth Theory' outlines how a steady economic growth rate results when three economic forces come into play - labor, capital, and technology. In the Solow Growth Model, the simplest and most popular version of the neoclassical theory, at steady state, the only catalyst for economic growth is technology. Further, the 'Endogenous Growth Theory', developed by Paul Romer and Robert Lucas, contrasts with the neoclassical growth model and states that economic growth is generated internally in the economy, i. e., through endogenous forces, and not through exogenous ones. It placed greater emphasis on the concept of human capital and indicates how workers with greater knowledge, education, training, and skill development can help to increase rates of technological advancement.

On the other side, the 'Modern Growth Theory' can rely on entirely different factors such as climatic changes, environmental degradation, availability of natural resources and their alternatives, and more and more on an inclusive and green path of growth. In the context of a developing country, where agriculture contributes mainly to annual GDP growth, temperature change plays a greater role than

technology, as the technology may increase crops productivity to a certain extent, but unusual heat and drought or excessive precipitation and flooding affect the year's agricultural outcomes almost instantly. In addition to agriculture, the industrial output might suffer from extreme weather effects and consequently, the long - term economic growth for a developing country like India will also suffer with a significant rate of temperature change. Thus, the development of a growth model that encompasses climatic changes and green growth issues will open a new path to create more effective and more inclusive policies with even more potential, that improve the lives of more vulnerable populations of the world residing especially in the developing countries [12]. We now have the science, technology, social and economic analysis and through this, we need to design transitions towards a more sustainable and equitable model and one such model is the "Inclusive Green Growth (IGG) Model" [9].

2. Review of Literature

'The Limits to Growth' was a landmark study by Meadows and others (1972) [13], in which they used dynamic computer modeling to predict that the global system would ultimately collapse if the production and consumption practices continued with business - as - usual. Alternative economic models, like green economy and circular economy, are an evolution of findings of This theory. While the report initially created much controversy, it is now almost universally accepted that the national and international communities must deal with the issues related to our environment [14]. Some earlier studies, for instance, Parikh and Gokarn (1993) [15], have shown that the top 10% of the urban population accounts for carbon emissions of 3416 kg per capita per annum, while the bottom 10% of the rural population accounts for only 141 kg per capita per annum. While later studies, as one of them is 'Hiding Behind the Poor' presented by Ananthapadmanabhan, Srinivas, and Gopal (2007) [16], show that the overall per capita emissions in India became low because the high emissions of the rich 'hide behind the poor' whose emissions are quite low. The findings plainly illustrate that the considerably significant carbon footprint of a relatively small wealthy class (1% of the population) in the country is camouflaged by the 823 million poor population of the country, who keep the overall per capita emissions below 2 tonnes of CO₂ per year.

In their policy brief, Bowen and others (2009) [17] focused on greening the economy and argued that this is the right time to be spending on measures to promote energy efficiency and low - carbon technologies, given the urgency of the case for reducing greenhouse gas emissions. In addition, the green economy is also widely touted as the means of eradicating global poverty and redressing social disparities. In his article, Martin Khor (2011) [18] has mentioned in detail the risks of misuse of the Green Economy concept in a one - dimensional manner where stress has more been given to environmental aspects rather than the developmental and equity dimensions. He concluded that care has to be taken to ensure that the 'Green Economy' term and concept is also understood to include the concept of 'Inclusive Growth' with social, equity, and

development dimensions. KP Bholane (2013) [19], in a research paper, highlighted the concept of green growth as a strategy, its benefits, the way to achieve it, and also the policy initiatives taken by the Indian government. In his working paper, Himanshu Gupta (2015) [20] observed that global emissions of CO₂, if allowed unabatedly, lead towards the irreversible path to a rise in temperature. For its remedy, he prescribed low - carbon alternatives that can generate electricity at a sustainable rate. A paper by Pollin and Chakraborty (2015) [21] States that to achieve a dramatic reduction in carbon emissions, India needs to increase its total annual investment in energy efficiency and clean, renewable energy by 1.5% of its GDP. To reach these targets, the carbon tax required will be \$60.4 per metric ton of carbon dioxide, which would increase the average price of electricity from \$0.08 to \$0.10 per kwh.

In his article, Shoibal Chakravarty (2015) [22] is expected to have a moderate impact of the oil crash of 2014 on the global economy. According to him, though its long - term impacts on climate change are difficult to predict, likely, these might even be beneficial to the process of decarbonising the global energy economy. Most countries, including India, could use the opportunity to reduce fossil fuel subsidies and invest in renewable energy instead. Another class - based analysis by Michael and Vakulabharanam (2016) [23] shows the inequality of emissions of the urban/rural elite versus the working people of the country after economic reforms were introduced in 1991. In their paper, using household consumption surveys, they established that the elites in India are major polluters, both in an absolute sense as well as in per capita terms, and found that the inter - class component of emissions explained 28.5% of total inequality compared to a mere 2.5% in 1994 at the onset of market - oriented reforms. In their study, Shahbaz and others (2019) [24] found that growth in the economy and increasing income and wealth inequalities are usually accompanied by a rise in energy consumption. They also found that because the Indian economy is primarily dependent on fossil fuels, this leads to increased levels of carbon emissions. In their paper, Azad and Chakraborty (2020) [25] present an energy proposal for India, in which they propose a carbon tax that generates revenue for investment in a clean green energy programme. This proposed energy policy would help in the fight against climate change in two ways. First of all by garnering broad public support for a potentially unpopular carbon tax by redistributing this revenue back to the households, especially the lower income ones, and second by encouraging these households to move away from fossil fuel consumption like kerosene by giving them access to renewable energy.

3. Methodology and Objectives of the Study

In this research paper, being a conceptual one, descriptive research design is used. It is primarily based on secondary data, which is collected through various research papers; reports; journals; articles; various publications of the UN, World Bank, UNEP, OECD; government publications; and information available on various websites. This is a theoretical paper, hence no statistical tools or techniques are used. Following are the objectives of this research paper:

- To understand the concept and need for IGG in India.

- To examine the status of inclusive and green growth in the Indian context.
- To differentiate between sustainable and green growth.
- To identify the challenges and key barriers to IGG in India.
- To review the green growth initiatives taken by the Indian government.
- To find out the ways to finance India's green growth.
- To draw key policy choices and strategies to promote IGG in India.
- To explore the opportunities with India's G20 presidency in the context of IGG.

4. Defining Inclusive and Green Growth

Following the announcement of new 'Sustainable Development Goals' (SDGs) in March 2016, many countries began to implement new development strategies centered on 'Inclusive Green Growth' (IGG) [26] as IGG provides a perfect growth trajectory to the developing countries with the joint objectives of economic growth and environmental sustainability. In addition, it emphasizes the balanced relationship among the economy, society, and environmental systems [27]. The reality is that the world needs green growth, and it needs it now. But what exactly does "Green Growth" mean? Several studies and working papers have established various definitions to assess the concept of green growth internationally as:

World Bank: Green Growth is growth that is efficient, clean, and resilient — efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards, and the role of environmental management and natural capital in preventing physical disasters [11].

United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP): Green Growth is growth that emphasizes environmentally sustainable economic progress to foster low - carbon and socially inclusive development.

OECD: Green Growth is growth that fosters economic development while ensuring that natural assets continue to provide the resources and environmental services on which our well - being relies [28].

Thirteenth Finance Commission Report, Para 3.15 (India): Green growth involves thinking of growth strategies again and again in a better way with their consequences on environmental sustainability and the environmental resources available to poor and vulnerable groups.

In India, the Ministry of Environment, Forest, and Climate Change recognized green growth in its vision of sustainable development, wherein 'poverty eradication' along with green growth is seen to be central. Thus, it is clear from the articulation by the Finance Commission as well as the Ministry that inclusivity is central to green growth in India [29]. However, the overall objective of IGG can be summarized as "economic growth that results in wider

access to sustainable socioeconomic opportunities for a broader number of people, regions, or countries, while protecting the vulnerable, all being done in an environment of fairness, equal justice, and political plurality” [26].

Sustainable Development vs Inclusive Green Growth (IGG)

Inclusive green growth is the track to sustainable development. On its seventieth anniversary in 2015, the UN declared the ‘2030 Agenda for Sustainable Development’ with 17 sustainable development goals (SDGs) and 169 targets. It is a plan of action for people, planet, and prosperity in which all countries and all stakeholders have to supposed to act in a collaborative partnership to implement this plan so that it can support the needs of the present and future generations [1]. This approach implies that development and the environment are interdependent and that economic growth can be sustained only if it is inclusive and green [30]. Though sustainable development provides an important context for green growth, it has not been conceived as a replacement for sustainable development but rather should be considered a subset of it [4]. While, the ‘Seoul Action Plan’ (The G20 Seoul Summit Leaders’ Declaration, 2010) stating about the ‘Sustainable Green Growth’ as, “We recognize the sustainable green growth, as it is inherently a part of sustainable development, is a strategy of quality development, enabling countries, especially the developing, to leapfrog old technologies in many sectors, including through the use of energy efficiency and clean energy technology, including technology transfer and capacity building.”

5. Inclusive and Green Growth in the Indian Context

Inclusive Growth in the Indian Context

For the past many years, a major directional change in public policy by having the focus on inclusive development has been engineered by the Indian government but still, it has to cover a long way in this direction with a significant number of poor and lower class communities have been left behind in the society. According to the OECD, inclusive growth is economic growth that is distributed fairly across society and makes equal access to economic opportunities and resources, such as education, healthcare, and infrastructure to all. It also involves addressing inequalities in income and wealth distribution, which can be achieved through progressive taxation and social protection programs. Furthermore, inclusive growth requires promoting the participation of all segments of society in the decision-making process, including women, youth, and marginalized groups. At this juncture, for India, it is time to end poverty and hunger everywhere; combat inequalities within and among states; protect human rights; promote gender equality and the empowerment of women and girls; provide decent work for all; and ensure the protection of our environment and natural resources as well [1].

Green Growth in the Indian Context

There are some specific provisions regarding the protection and improvement of environmental quality in the Constitution of India. Article 48 - A of the Constitution says that “the state shall endeavour to protect and improve the

environment and to safeguard the forests and wildlife of the country.” Article 51 - A (g) says that “It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers, and wildlife and to have compassion for living creatures.” The national conscience for the importance of protecting the environment is highlighted by these provisions. Along with this, the National Environment Policy of the Ministry of Environment, Forests, and Climate Change highlights important principles around sustainable development such as social justice, polluter pays, and entities of incomparable value [29]. In India, green growth aims to promote sustainable development while balancing economic growth and environmental conservation and this entails encouraging renewable energy, lowering pollution, enhancing waste management, and protecting biodiversity [31].

6. India’s Green Growth Landscape

For many developing nations, the current climate policy agenda means relying heavily on financial and technical assistance from developed countries. Additionally, many developing nations are not solely concerned about climate change but also prioritize expanding energy access to their people to move toward a developed country along with a better standard of living for their population and one such country that faces this dichotomy is India [12]. Rapid economic growth in India during the last two decades has accentuated the demand for energy and natural resources related to water, land, and forests [6]. With this, it became the world’s third - largest emitter of greenhouse gases (GHGs), after China and US. In 2021, it emitted 3.9 billion metric tons of carbon dioxide equivalent (GtCO_{2e}), accounting for roughly 7% of the global total. The negative relationship between changes in temperature and growth rate creates a challenge to the Indian economy. Policymakers in India realised this challenge and have taken significant steps towards it. India has recently made two major global commitments: the 2030 Global Development Agenda (popularly known as the Sustainable Development Goals) and the ratification of the Paris Agreement, which aims for the holistic well – being of all, today and in the future [32]. Also, under the Copenhagen Accord, India communicated its domestic mitigation action as an endeavor to reduce the emissions intensity of its GDP by 20–25% by 2020 in comparison to the 2005 level and more recently in its Intended Nationally Determined Contributions (INDCs), it has announced to reduce the emissions intensity of its GDP by 33– 35% by 2030 in comparison to the 2005 level [29]. We have also witnessed favorable signs during the last few years towards renewable energy generation, despite that it requires continued effort, strong implementation, and improved utilization of capacity. As a result, India’s greenhouse emissions rate dropped by a faster - than - expected 33% in 14 years from 2005 to 2019. India’s average rate of reduction in emissions increased to 3% annually in the period 2016 - 2019, from just about 1.5% in the period 2014 - 2016 [33].

7. Inevitability of Inclusive Green Growth (IGG) in India

The first Rio Summit in 1992 was historic for arguing that development has to be sustainable and for this, it must integrate the environmental aspects as well as social and economic dimensions. However, economic growth and expansion have come at a price to the planet and if we do not protect the environment and its natural resources, this expansion could grind to a halt because we will have destroyed or permanently damaged our resources and ecosystem diversity, on which our well-being relies. Now thirty years on, sustainable development is not a reality. Even if we are not aware now and do not change our growth strategy, it will impact our quality of life and health with an increasing economic burden as more and more financial and human resources will need to correct it [34]. In this consideration, inclusive and green growth is essential for each and every country and the strategies regarding this should take priority, especially by developing nations. In India, the feasibility and inevitability of IGG can be drawn as:

- Enhancing productivity through incentives for greater efficiency in the use of resources and natural assets, for reducing waste and energy consumption, and for making resources available to their highest value use.
- Making opportunities for innovation, spurred by policies and framework conditions that allow for new ways of creating value and addressing environmental problems.
- Creating new job opportunities through the transformation of key sectors such as agriculture, energy, construction, and transport to a greener economy. It has already created millions of jobs worldwide and could generate 15 to 60 million additional jobs over the next two decades. Through this, it will eventually affect at least half of the global workforce and Indian as well, by lifting them out of poverty.
- Inviting investment through boosting the confidence of investors with greater predictability and continuity around how governments deal with major environmental issues.
- Creating new markets by stimulating demand for green technologies, goods, and services.
- Maintaining stability via more balanced macroeconomic conditions, reduced resource price volatility, and improved fiscal consolidation through increasing revenues by putting a price on pollution and environmental degradation [4].

8. India's Green Growth Challenges

It is observed that countries with higher human development have a higher ecological footprint. Therefore, as India accelerates its development journey, the challenge before it is to provide improved quality of life to its citizens within the ecological space and constraints. The fault lines on key green growth indicators create a serious challenge to India's journey towards a green economy. Some of them are:

8.1 Air and Water Pollution

More than 1, 10, 000 infants are likely to have been killed by air pollution in India in 2019, almost immediately after being born, while long-term exposure to outdoor and household air pollution was estimated to be responsible for about 1.67 million annual deaths amongst the adult population in the country [35]. The economic cost was over US \$36, 000 million, equivalent to 1.36% of India's GDP. The overall assessment is that our air and water quality is under stress and this has massive impacts on our health. Even during the lockdown, data shows that river pollution did not reduce. "Clearly, we need to do much more to improve the quality of the air we breathe and the water we drink," said Sunita Narain, director general, CSE and editor, Down to Earth, while releasing the annual publication [36].

8.2 Health Risk

Climate-induced health costs are huge in India since, extreme weather events like cyclones, floods, and droughts have claimed thousands of lives and displaced millions. Mortality attributable to hot and cold ambient temperatures in India alone is 6.3% of all deaths or around 8 lakhs per year [37]. While, the health risk from industry-induced contamination of land and water is one of the most stressful factors for humanity, and its impacts are borne to the largest extent by disadvantaged and vulnerable populations, including children and women [9].

8.3 Forests

As per the 'India State of Forest Report - 2021', forest and tree cover in the country increased by 2, 261 square Km since the last assessment in 2019. India's total forest and tree cover was 80.9 million hectares, which accounted for 24.62% of the geographical area of the country. According to the National Forest Policy of India, the ideal percentage of the total geographical area under forest should be at least 33% to maintain ecological stability. However, it currently covers just 24.62% of the country's land and is shrinking rapidly.

8.4 Biodiversity

India's diverse physical features and climatic conditions have resulted in a variety of ecosystems such as forests, wetlands, grasslands, deserts, and coastal and marine ecosystems which harbour and sustain high biodiversity and contribute to human well-being. It is a mega diverse country with only 2.4% of the world's land area and accounts for 7 - 8% of all recorded species, including over 45, 000 species of plants and 91, 000 species of animals. Four of 34 globally identified biodiversity hotspots: The Himalayas, the Western Ghats, the North-East, and the Nicobar Islands, can be found in India. But, in 2022, the International Union for Conservation of Nature (IUCN) Red List, during the COP15 biodiversity conference held in Canada, found 1, 355 of over 9, 472 species of plants, animals, and fungi across India's land, freshwater, and seas are considered to be under threat, classed as critically endangered, endangered, or vulnerable to extinction. According to the data shared by IUCN, 239 new species

analysed in India have entered the list and of these, 29 are threatened [38].

8.5. Availability of Water

As per a study conducted by the Central Water Commission, the average annual per capita water availability for the years 2021 and 2031 has been assessed as 1486 cubic meters and 1367 cubic meters respectively in India. Annual per - capita water availability of less than 1700 cubic meters is considered as water - stressed condition, whereas below 1000 cubic meters is considered as a water scarcity condition. Hence, there is an urgent need for water efficiency measures in all sectors, especially in irrigation. In this direction, the Bureau of Water Use Efficiency (BWUE) has been set up for the promotion, regulation, and control of efficient use of water across various sectors namely irrigation, domestic sector, power generation, industries, etc. in the country [39].

8.6. Food Security

Today, we produce almost one - third more than the amount needed to feed the world population, but still, a large population of the world is hungry and chronically undernourished as much of it becomes wasted and it is perhaps the most humiliating failure of modern society [9]. The Global Food Policy Report 2022 by the 'International Food Policy Research Institute' has stated that globally, around 65 million people are at risk due to climate change - induced hunger, with 17 million people in India facing hunger by 2030, the highest among all countries. The report further notes that although global food production may increase by 60% by 2050, 50 crores of Indians would still be at the risk of going hungry. Of these 50 crores, seven crore people would suffer from hunger due to climate change [40]. Climate change and global warming are influencing weather patterns, causing heat waves, heavy rainfall, and droughts [41], which can impede crop growth, reduce yields, and influence irrigation, soil quality, and the ecosystem on which agriculture depends [42]. At the same time, the way that food is often produced today is a big part of the problem. It's recently been estimated that the global food system is responsible for about a third of greenhouse gas emissions, second only to the energy sector and the no.1 source of methane and biodiversity loss [41].

8.7. Climate change

"The sky blazes like an 'atomic bomb', the heat from it is a 'slap in the face', the eyes sting and 'everything was tan and beige and a brilliant, unbearable white' and soon..." Mr. Robinson's dystopian tale about global heating even portray a horror reality about India as heat waves killed more than 22, 000 people between 1992 and 2015, according to official figures [43]. As per the analysis by an international team of scientists with the World Weather Attribution Group, climate change makes heat waves in India 30 times more likely with experiencing 314 days of extreme weather events in the previous year (2022) [8]. Average temperatures in India have risen by around 0.7% between 1901 and 2018, partly due to climate change [43]. The situation could be much worse as

projections for 2030 also indicate a warming trend for the Indian sub - continent [29].

8.8. Energy

India's continued industrialisation and urbanization have made huge demands of its energy sector. Energy consumption has more than doubled since 2000, propelled upwards by a growing population. Energy supply in India is heavily dependent on fossil fuels, coal, and petroleum products accounting for about 80% of the total energy supply. Petroleum consumption and imports have grown rapidly on account of rising vehicle ownership and road transport use, while biomass, primarily fuel wood, makes up a declining share of the energy mix, but is still widely used as a cooking fuel. Despite recent success in expanding coverage of LPG in rural areas, 660 million Indians have not fully switched to modern, clean cooking fuels or technologies, and due to this, India is the third - largest global emitter of CO₂ [44]. According to Census 2011, 43% of rural households still used kerosene as a primary energy source for lighting as more than 300 million people were deprived of electricity [29]. As of 2021, approximately 2% of the Indian population was multidimensionally poor and deprived in the electricity indicator. Health, education, and standard of living are the three equally weighted dimensions of multidimensional poverty and electricity is among the six indicators of the standard of living dimension [45].

8.9. Urbanization

Emerging countries such as India have the potential to transform the economy by harnessing the opportunities offered by urbanization, mainly driven by the growing population and accelerated industrialization [7]. Over the period to 2040, an estimated 270 million people are likely to be added to India's urban population, the equivalent of adding a new city the size of Los Angeles every year [46]. Though cities contribute to almost two - thirds of India's GDP, at the same time, they face severe challenges related to the quality and availability of infrastructure, such as power, telecom, roads, water supply, sanitation and mass transportation, which could pose serious constraints to our environment as well as to our growth, if left unaddressed [29].

9. Key Barriers to Green and Inclusive Growth in India

Key Barriers to Green Growth

- The larger perception among businesses and policymakers remains that environmental protection comes at the cost of economic growth and thus, they hesitate to adopt the green growth policies.
- Financial markets for green investments are at an initiatory stage and systems to direct funding towards green and responsible investments is inadequate.
- The general thinking about green technology is that it is unreliable and not cost - competitive.
- The idea of 'clean up later' with the thinking that India cannot afford the cost of correcting the environment now,

has still not gained mainstream acceptance of green growth.

- Greening the economy is not fully recognized as a tool to achieve inclusivity, social prosperity and environmental sustainability [32], [47].
- Managing public debt and fiscal deficits are the main issues that create hurdles in the making of national policy and obstruct the technological changes required for green growth [7].

Key Barriers to Inclusive Growth

- The long - run challenges of economic restructuring and a changing geography of growth, that has benefited especially the urban centres and create difficulties for rural areas in adjusting to a more knowledge - based economy, creating barriers to inclusive growth.
- Structural skills and the labour market issues including a low - skill and low - wage equilibrium, skill mismatch, and significant learning and skill deficits have made it more difficult to move towards an inclusive growth path.
- The lack of affordable and good quality houses, which is a major cause of increasing slums in metropolitan cities, makes poor and marginalised people more prone to economic exclusion.
- With the slow progress of the financial inclusion mechanism, the poor access to finance for new businesses, especially start - ups, and small businesses, often creates barriers to inclusion of all segments of the society.
- Stronger transport infrastructure is regarded as a key means of connecting more people to economic opportunity, but its insufficiency excluded the poorer and lower - skilled workers, having limited labour market mobility, from taking part in the growth process.
- Poor health is a key driver of economic exclusion. As ill health and deprivation are strongly associated with unequal growth, constraining the supply of quality and potential labour further makes them out of the good opportunity.
- Welfare reforms and pressure on public services have adversely impacted the poorest communities, as this is undermining the basic conditions for inclusive growth [48].

10. Drivers of IGG in India

Some high - impact sectors key to the 'Inclusive and Green Economy' in India are as follows:

10.1 Sustainable Agriculture/Green Farming

Sustainable agriculture or green farming, an approach to farming that aims to minimize the negative environmental impacts, is a key sector for the green economy in India. For this, it is necessary to encourage farmers to adopt eco - friendly and sustainable agricultural practices such as organic farming, crop rotation, agroforestry, and integrated pest management, as these methods reduce the dependence on chemical fertilizers and pesticides, preserving soil fertility and biodiversity [49]. In India, organic farming has been transforming over the past few years. Recently, several measures have been taken by the government towards an

inclusive and green agenda to improve farmers' livelihoods, especially small farmers, including raising minimum support prices, improving access to credit, developing climate resilient seeds as well as some technological interventions like 'Soil Health Card', so that farmers can judge the state of their soils [47], [32].

10.2 Construction/Green Building

Green buildings are a growing trend in India that is projected to grow by 20%. These buildings are defined as those that are designed to increase energy efficiency and improve environmental quality by reducing carbon emissions, and then reducing the overall carbon footprint. We can make a building green by using energy - efficient design through energy conservation measures like passive cooling systems, natural lighting systems, etc.; by using high - performance materials; and by using recycled materials (like fly ash) in the construction [50]. Fly ash utilization in the construction sector has witnessed a steady upward trend. According to the Ministry of Environment, Forests, and Climate Change, fly ash utilization in the country was 57% in 2014 against just 13% in 1999 [47], [32]. To promote green buildings, the government has set up various schemes, such as the 'National Buildings Code of India' (NBCI) and the 'Energy Conservation Building Code' (ECBC) [50]. Further, the Model Building Bye - Laws of 2016 mandate that all buildings on various plot sizes above 100 square meters comply with the green norms [47], [32]. All of these aim to promote high - performance and energy - efficient construction of buildings.

10.3 Renewable Energy/Green Energy

With respect to renewable energy, there are great opportunities for India. In emerging markets renewable energy potential is generating new jobs, creating local supply chains, and attracting high levels of foreign investment, as for investors, renewable energy assets are generating robust returns [12]. As per the 'Renewables 2022 Global Status Report' by REN21, an energy - policy think tank, India ranks fourth in renewable energy installed capacity (including large hydro and nuclear), fourth in wind power capacity, and fourth in solar power capacity [51], [52]. As per the information, given by the Union Minister for Power, New and Renewable Energy Mr. RK Singh in the parliament, India's total installed renewable energy capacity (including large hydro and nuclear) touched 168.96 GW (Gigawatts) by February 2023, out of which 64.38 GW is solar power capacity, 51.79 GW is hydro, 42.02 GW is wind and 10.77 GW is bio power capacity [53]. Another latest monthly report by the Central Electricity Authority (CEA) showed that India's total renewable energy capacity (excluding large hydro and nuclear plants), reached 122 GW in February 2023, an increase of almost 15% from February 2022, but still 30% short of the 175 - GW target that the central government had aimed to reach by the end of 2022 [51].

According to the Minister, India's total power generation capacity was at 412.21 GW as of February 28, 2023, in which thermal power plants (which primarily use coal), generated about 78.2% of the total electricity, while

renewable energy accounted for only 12.3% of the total energy, with the share of 7% and 3, respectively for large hydro and nuclear energy (which are not part of the renewable energy mix) [51]. Moreover, another 82.62 GW of green energy capacity is under implementation and 40.89 GW of capacity is under various stages of tendering, as stated by the minister in the parliament [53]. Overall, through the Pancharit Declaration during COP26 (26th United Nations Climate Change Conference of the Parties), India has set a timeline for attaining non - fossil energy capacity of 500 GW by 2030 and also to meet 50% of its energy requirement from renewable energy by 2030 [54]. This is the world's largest expansion plan in renewable energy. India also aims to produce five million tonnes of green hydrogen by 2030 and this will be supported by 125 GW of renewable energy capacity. Moreover, 57 solar parks with an aggregate capacity of 39.28 GW and Wind Energy with an off - shore target of 30 GW by 2030, have been approved in India with potential sites identified [52].

10.4 Green Manufacturing

The manufacturing sector can play a key role in driving green growth in India, despite having just a 16 - 17% share of India's GDP – much less than the 55% of the service sector. Sustainable or green manufacturing in India is still at the take-off stage and it has a long way to go [47], [32]. Green manufacturing involves some input side changes such as using sustainable raw materials and renewable energy sources; process side changes with the adoption of clean manufacturing technologies such as wastewater treatment systems, Carbon - capturing devices, recycling, pollution reduction methods, implementation of less carbon - intensive processes, and renewable energy technologies such as solar panels and wind turbines; and logistics side changes such as adopting electric vehicles for transportation could transform the manufacturing sector into a sustainable one [55]. Realized at its full potential, this sector could generate 25 to 30% of GDP by 2025 and create 60 million to 90 million new jobs in the country, and through green manufacturing, it can drive positive changes and contribute to a greener and cleaner future.

10.5 Green Transportation

The current patterns and trends of transportation in India are extremely energy intensive and highly unsustainable, producing widespread negative impacts like degradation of air quality, greenhouse gas emissions, and increased threat of global climate change, along with heavy congestion and traffic jams. However, a growing trend in our transportation sector has been seen in the form of on - demand transportation and car pooling platforms, particularly popular in urban areas [47] [32]. With the low vehicle ownership rate of just 22 cars per 1, 000 people in 2018, this trend might not reverse in the future and will give an opportunity to improve the utilization of resources, particularly fossil fuels and create new jobs. However, this rate is expected to grow at a staggering pace, from 22 to 175 cars per 1000 people by 2040 [56]. With a car - pooling idea, since 2016, Uber POOL has reported saving over 32 million km. of vehicle traffic, over 1.5 million litres of fuel, and reduced emissions worth 3.5 million kg. [47], [32].

As well, the Vehicle Scrappage Policy, 2021 (effective from 1st April 2023) was introduced in India to scrap old, unfit, and ill - maintained vehicles, which are one of the prime contributors to environmental pollution. Overall, Smart Mobility Solutions are paving the way for sustainable transportation in Indian cities by providing alternative modes of transportation that are energy - efficient, eco - friendly, and cost - effective (for instance, electric cars, bikes, and buses); by promoting the use of shared transportation services that help to reduce traffic congestion and minimize carbon emissions (for instance, ride - sharing services like Uber and Ola); and educating people about sustainable transportation habits (for instance, initiatives like 'Car - Free Days', 'Cycle - to - Work' and 'Odd - Even Formula' as implemented by the Delhi Govt.). These solutions are helping to create a more sustainable and livable future for Indian cities [57].

10.6 Electric Vehicles (EVs)

At the COP26 summit in Glasgow, India pledged to achieve net - zero emissions status by 2070 and to lower its emission intensity by 45% from 2005 levels by 2030. Electric vehicles could help realize these goals and play a pivotal role in India's green transition. It has emerged as a cleaner and more efficient alternative to traditional ones. In 2022, EV sales in India reached a million units, a significant leap of over 300% from the around 320, 000 units sold over the previous year, according to the Ministry of Road Transport and Highways. While a third of EVs sold were electric three - wheelers, EVs accounted for 4.7% of overall automobile sales of the nearly 3.7 million passenger vehicles in 2022. The country has over 1.88 million registered EVs. The Economic Survey 2023, predicts that India's domestic electric vehicle market will see a 49% compound annual growth rate between 2022 and 2030, with 10 million annual sales by 2030. Additionally, the electric vehicle industry is projected to create around 50 million direct and indirect jobs in the next seven years. According to NITI Aayog, by 2030, 80% of two - and three - wheelers, 40% of buses, and 30% - 70% of cars in India will be EVs [58]. As a step in the direction of electric vehicles, the government of India has introduced a subsidy scheme, named 'FAME' (Faster Adoption and Manufacturing of Hybrid & Electric Vehicles) in 2019, which is exclusively for public and commercial transport in the segments of electric three - wheelers (e - 3W), electric four - wheelers (e - 4W), and electric buses [29]. Thus, EVs lead the green future movement, reflecting a growing environmental consciousness among both the manufacturers and consumers.

10.7 Green Innovation

Besides these main sectors, green innovation is also a long - term key driver for promoting green economic growth, as it is believed that real sustainable economic progress is not possible without green innovations. It not only promotes affordable and environmentally friendly technologies, which can observe, and reduce the patterns of carbon emissions, but also reduces the cost of environmental sustainability by reducing pollution and greenhouse gas (GHG) emissions [59]. Innovation plays a key role in green growth by breaking dependence on established technologies and ways

of doing with which societies are familiar and they are not easily ready to accept any change or a new way of doing even knowing that it could produce a larger benefit [4], [60]. The Environmental Kuznets curve (EKC) indicated the positive association between environmental degradation and economic progress, however, this relationship can be revisited by introducing green innovation which is inclined toward green economic growth [59]. In India, the major constraint towards green innovation is that the environmental externalities are underpriced or not priced at all and so they are not able to encourage any innovation to tackle the issues of climate change and environmental degradation. These externalities should be properly priced in the form of tradable permits and taxes to provide the necessary incentives for some innovative ideas regarding green technology [4], [60].

10.8 MSME Sector

Micro, Small and Medium Enterprises (MSMEs) and small businesses play a crucial role in achieving the goals of inclusive and green growth in India. They contribute to inclusive growth by generating job opportunities, reducing poverty, and accelerating economic growth, while contributing to green growth through eco - innovation, eco - adoption, and eco - entrepreneurship [61]. MSMEs also play a critical role in closing the gender gap, ensuring effective women's participation in economic activities. As per the latest reports by the Udyam portal, in India, over 9.31 crore people, including 2.18 crore women, are engaged in about 1.28 crore registered MSMEs. Despite significant contributions, they still have a long way to go to realise their full potential. The Indian MSME sector is a notable greenhouse gas emission - causing sector, as it uses fossil fuels and natural resources, and is liable alone for the consumption of 25% of the total energy consumed by Indian industries. In today's world, the Indian MSME sector needs greener and sustainable practices, and technology - based reforms to enhance its transition into a low - carbon emitting sector to support and achieve the country's green and sustainable development goals [62]. For this, an urgent need for MSMEs to change their traditional business models to a more green model, which requires the policy of reduction, reuse, and recycling.

10.9 Digitization

A digital economy based on digital technologies such as the Internet of Things (IoT), Big Data, Artificial Intelligence (AI), Machine Learning, Robotics, and so on, particularly in the post - pandemic era, is the core driver of the urban Inclusive and green growth, which supports the transformation of society towards a better quality of life and well - being, as well as environmental protection by reducing deforestation. It also promotes the concept of circular economy. Digitization would bring new growth impetus to the Indian economy by benefiting the three essential elements of the food - water - energy nexus—by bringing sustainable food production, having access to clean and safe potable water, and accelerating the generation and consumption of green energy [63]. As well, the deployment of new - age digital technologies like AI, coupled with digital delivery of public services will help the country

leapfrog over its legacy deficiencies in physical and social infrastructure while improving the ease of living, and access to better livelihoods. The Union Budget 2023 also announces new departures for fortifying India's leadership in the digital space; the introduction of a 'National Data Governance Policy', DigiLockers for businesses and charitable trusts, the creation of specialised AI centres, as well as the setting up of 100 labs for 5G services [64].

11. Financing for IGG

IGG can be achieved through inclusive green finance, as it helps to mitigate and build resilience against the negative impacts of climate change. Green finance is a way to increase the level of financial flows (banking, micro - credit, insurance, and investment) from the public, private, and not - for - profit sectors to promote sustainable development priorities [3]. According to the World Bank (2012), many green policies impose economic costs in the short term, such as higher investment or operational costs, but over the longer term, they are designed to yield economic benefits and contribute to long - term sustainable growth [65]. India should therefore emphasize the delivery of finance in this accordance. Recently, green investment in different sectors has grown at a fast pace in the country, particularly investment in green buildings, clean energy, renewable energy, and production capacities [3], still, there is a long way to go because, by 2030, emerging economies will need around US \$2 trillion to fulfill their climate pledges. For this, reallocation of capital towards green investments, especially for emerging technologies like battery storage, offshore wind, and green hydrogen; for green manufacturing; and for the other economic sectors engaged in building more climate - resilient nations and sustainable communities should be prioritised. To cope with the demand for green finance, India must have to recognise the role of multilateral institutions like the World Bank, IMF, and WTO in raising SDG finance. Regarding green financing, we should adopt a six - prong pathway as: 1) an increase in domestic tax revenues; 2) an increase in sovereign (government) borrowing from international development finance institutions (DFIs); 3) an increase in sovereign borrowing from international private capital markets; 4) an increase in official development assistance (ODA); 5) an increase in funding from private foundations; 6) a debt restructuring for borrowers [66].

In the Union Budget 2023 - 24, green growth has been adopted as one of the seven key priorities (termed as Saptarshi) to lead India in its 'AmritKaal'. The financial allocations under this Budget are as follows: 1) Rs 35, 000 crore for priority capital investment towards clean energy transition and Net Zero targets by 2070.2) Rs 19, 700 crore for the Green Hydrogen Mission to mobilise a green hydrogen production capacity of 5 metric million tonnes by 2030.3) Rs 10, 222 crore to strengthen the renewable energy sector.4) Rs 5, 331.5 crore for the solar power industry.5) Rs 20, 700 crore (central support - Rs 8, 300 crore) for inter - state transmission system for evacuation and grid integration of 13 GW renewable energy from Ladakh.6) Rs 3, 079.4 crore for the Ministry of Environment, Forest and Climate Change.7) Rs 756 crore for controlling pollution.8) Rs 459 crore to promote natural farming.9) Rs 2, 200 crore to

improve the availability of disease - free quality planting material for high - value horticultural crops.10) Rs 10, 000 crore for the establishment of 500 new 'waste to wealth' plants under the new GOBARdhan scheme [8], [67].11) Rs 6, 000 crore for PM Matsya Sampada Yojna in the fisheries sector to create inclusivity.

12. Government Initiatives to Promote Green Growth

The Indian government has initiated numerous policies and programmes for the promotion of IGG during the last few years. Some of them are:

12.1 LiFE

During the COP26, India proposed a vision for 'LiFE' (Lifestyle for Environment), which aims to inspire a trend towards sustainable living with a target of at least 80% of India's villages and urban local bodies to become environment - friendly by 2028. Instead of 'mindless and wasteful consumption', the concept advocates for an environment - friendly conscious lifestyle that emphasizes 'mindful and purposeful utilization' by motivating everyone to do every possible thing in their daily lives to safeguard the environment [68].

12.2 Green Credit Programme (GCP)

This programme was announced by the government of India in the 2023 - 24 Union Budget under the Environment (Protection) Act, to encourage behavioural change, leverage a competitive market - based approach and incentivize voluntary environmentally sustainable, and responsive actions of various stakeholders i. e. companies, individuals, and local bodies [8], [69].

12.3 PM KUSUM

The 'Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan' (PM - KUSUM) was launched in 2019 to ensure energy security for farmers in India. The main components of this scheme are setting up 10, 000 MW of Decentralized Grid Connected Renewable Energy Power Plants on barren land; installation of 17.50 Lakh stand - alone solar agriculture pumps; and solarisation of 10 Lakh Grid Connected Agriculture Pumps [69].

12.4. GOBARdhan Scheme

The 'Galvanizing Organic Bio - Agro Resources Dhan' (GOBAR - Dhan) scheme was launched in 2018 under the Swachh Bharat Mission (Gramin), which aims to transform 'Waste to Wealth'. It is considered an important component of India's biofuel strategy as the country has the potential to produce 10 thousand million cubic meters of biogas from Gobar (cow dung) [69]. Under this scheme, a total of 589 Biogas/CBG (Compressed Biogas) plants are functional and 251 are under construction.

12.5. PM PRANAM

'Prime Minister Programme for Restoration, Awareness, Nourishment, and Amelioration of Mother Earth' (PM PRANAM) was first announced in the Union Budget of 2023 - 24 by the government. The main objective of this scheme is to reduce or promote the balanced use of chemical fertilizers and encourage the use of alternative fertilizers as well. The government will promote and facilitate one crore farmers to adopt natural farming through this scheme [31], [69].

12.6. MISHTI

The scheme 'Mangrove Initiative for Shoreline Habitats & Tangible Incomes' (MISHTI) was announced by the Union government in the Union Budget 2023 - 24, which will involve planting mangroves along the coastline and on salt pan lands, wherever feasible, through convergence between MGNREGA, CAMPA (Compensatory Afforestation Management Fund and Planning Authority) Fund, and other sources. It envisages comprehensively exploring the possible area for the development of Mangroves covering approximately 540 sq. Kms. Spreading across 11 States and 4 Union Territories over five years (2023 - 28) starting from FY 2023 - 24.

12.7. Amrit Dharohar

'Amrit Darohar' is another new central government initiative that was announced in the Union Budget 2023 - 24 to protect wetlands. The scheme will be implemented over the next three years to encourage the best possible use of wetlands and enhance biodiversity, carbon stocks, eco - tourism opportunities, and revenue generation for local communities.

12.8. National Green Hydrogen Mission

The 'National Green Hydrogen Mission' (NGHM) was approved by the Union Cabinet in 2022, to support the transition of the economy to low carbon intensity and reduce fossil fuel imports. By 2030, this mission projected the outcomes of the development of green hydrogen production capacity of at least 5 MMT (Million Metric Tonne) per annum; over Rs.8, 00, 000 crore total investments; creation of over six lakh jobs; cumulative reduction in fossil fuel imports over Rs.1, 00, 000 crore; and abatement of nearly 50 MMT of annual greenhouse gas emissions.

12.9. Deep Ocean Mission (DOM)

In 2021, the Government of India launched the 'Deep Ocean Mission' (DOM) through the Ministry of Earth Sciences (MoES) intending to explore the deep ocean for resources and to develop technologies to harness these living and non - living resources. This mission aims to develop technologies for deep - sea mining; to develop underwater manned submersible vehicles and underwater robotics; to provide Ocean Climate Change Advisory Services; to conduct Deep Ocean Surveys and Exploration; to develop techniques to assess the changes in the ocean due to climate change; to identify technological innovations and conservation methods for sustainable utilization of marine bio - resources; to

develop offshore - based desalination techniques to get fresh water and techniques for extracting minerals from the ocean belt; and Advanced Marine Station for Ocean Biology [70].

12.10. Urban Swachh Bharat Mission 2.0

Under this scheme, the government intends to effectively manage waste from construction and demolition activities and bio - remediate all inherited landfills, focusing on integrated management of manure, sludge, and sewage treatment; the classification of waste sources; the reduction of disposable plastics; and reduction of air pollution [7].

12.11. India's Vehicle Scrapping Policy

The 'Vehicle Scrapping Policy', launched in 2021, is a government - funded program to replace old vehicles with modern & new vehicles on Indian roads. This policy is expected to reduce pollution, create job opportunities, and boost demand for new vehicles [71]. Under this new policy, commercial vehicles aged >15 years and passenger vehicles aged >20 years will have to be mandatorily scrapped if they do not pass the fitness and emission tests [69]. This will spur the transition to a more sustainable, low emission and alternative energy transportation system in India.

12.12. National Mission on Natural Farming (NMNF)

The government has formulated the 'National Mission on Natural Farming' (NMNF) from FY 2023 - 24 by up - scaling the Bharatiya Prakritik Krishi Paddhati (BPKP) to motivate farmers to adopt chemical - free farming and enhance the reach of natural farming across the country. NMNF will cover a 7.5 lakh ha area over the next 4 years, with a total budget outlay of Rs.1584 crore (GoI Share). This scheme will help 1 crore farmers through their transition towards natural farming by establishing 15, 000 Bhartiya Prakritik Kheti Bio - inputs Resources Centres (BRCs) [72].

12.13. Other Initiatives

- 'Jawaharlal Nehru National Solar Mission' (2010) to develop solar energy.
- 'National Offshore Wind Energy Policy' (2015) to develop offshore wind energy.
- 'Renewable Energy Certificates' (REC) scheme (2010) to provide financial incentives for the development of renewable energy.
- 'Green Rating for Integrated Habitat Assessment' (GRIHA) (2007) to encourage the development of green buildings.
- 'National Electric Mobility Mission Plan' (NEMMP) (2013) and 'National Electric Vehicle Policy' (2019) to promote electric vehicles.
- 'National Clean Air Programme' (NCAP) (2019) to improve air quality in 131 cities.
- 'Namami Gange Programme' (2014) to control water pollution and rejuvenate River Ganga and its tributaries.
- 'Pradhan Mantri Ujjwala Yojana' (PMUY) (2016) to replace unclean cooking fuels with clean household fuels.

- 'Nagar Van Yojana' (NVY) (2020) to promote urban forestry through tree plantation.
- 'Jal Jeevan Mission' (JJM) (2019) to provide safe and adequate tap drinking water.
- 'Atal Bhujal Yojana' (ABHY) (2019) for sustainable management of groundwater resources with community participation.
- 'Swachh Bharat Mission' (2014) to clean India and improve solid waste management.
- 'Catch the Rain' (2021) campaign to create Rain Water Harvesting Structures.

'Green Skill Development Programme' (GSDP) (2017) to provide training and certification to youth in various 'green skills', particularly from rural and underprivileged communities.

12.14 National Action Plan on Climate Change and its 8 Missions

In India, the important milestones for mainstreaming climate in development processes at the national and state levels are the 'National Action Plan on Climate Change' (NAPCC) along with the 'State Action Plan on Climate Change' (SAPCC). NAPCC was launched formally on June 30, 2008, to combat climate change and establish sustainable development through its eight national missions, ranging from R&D to sustainable agriculture, with centerpiece programs to scale up solar power and energy efficiency [12]. These missions are:

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Eco - system
- National Mission for a Green India
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change

All the missions are governed by the Ministry of Environment, Forest and Climate Change (MoEFCC) except the 'National Mission on Sustaining the Himalayan Ecosystem' and the 'National Mission on Strategic Knowledge for Climate Change', which is governed by the Department of Science & Technology, Ministry of Science & Technology. The government is proposing to set up new missions on wind energy, waste - to - energy, health, and coastal areas, and remake the National Water Mission and National Mission on Sustainable Agriculture [29]. These National Missions have been reviewed in all meetings of the Executive Committee on Climate Change (ECCC). In 2021, ECCC mandated the Apex Committee for Implementation of the Paris Agreement (AIPA) to review the progress in the National Missions under NAPCC [73].

13. Proposed Strategies for Inclusive Green Growth (IGG) in India

IGG provides a clear framework for how countries can achieve economic growth and development while preventing

their environment and natural resources as well as making sure the participation and inclusion of the marginalised section. Changing current patterns of growth, consumer habits, technology, environment, and infrastructure are long-term projects that take time to change as we can't switch them immediately and we are bound to live with our past strategies and decisions regarding these for a long time. At the same time, environmental impacts are also cumulative and sometimes irreversible. Green growth strategies therefore, need to be designed carefully and flexible enough to take advantage of new technologies and unexpected opportunities, as well as be able to abandon one approach, if a better one becomes available [4]. Any Strategy regarding IGG identifies common principles and challenges but shows that there is no one-size-fits-all prescription for all countries. Each country needs to devise a strategy tailored to its own circumstances, local contexts, preferences, and resources, whether it is developed or developing [34]. In the specific context of developing countries and emerging-market economies like India, we can explore some IGG strategies as follows:

Capacity Building and Policy Related Strategies

- For incorporating the concept of green growth in decision-making processes, the government should adopt green budgeting for India, wherein all departments can prepare environmental budget statements highlighting key 'green' activities undertaken in their respective departments [29].
- Enhancing the financial, technical, and institutional capacities of government, as well as the voluntary sector, is essential for the implementation of climate-resilient green growth strategies, hence, it should be ensured [4].
- Adoption of policy mixes with appropriate regulatory, behavioural, information-based, and economic instruments for addressing sustainable production and consumption challenges in priority areas such as water use, energy use, chemicals use, and waste management could be helpful [9].
- A broad policy framework that mutually reinforces economic growth and the conservation of natural capital is needed, that includes core fiscal and regulatory settings such as environmentally-related taxes and competition policy which, if well designed and executed, maximise the efficient allocation of resources [4].
- Policies providing incentives to use natural resources efficiently and make pollution more expensive, including a mix of price-based instruments and non-market instruments such as regulations, technology support policies, and voluntary approaches need to be formulated [4].
- As markets are not always perfect in promoting green growth, India will need to develop a rich policy toolbox to manage interactions between different drivers of economic growth [74].
- Opening up new markets by stimulating demand for green goods, services, and technologies are equally important [69].
- Implementation of existing policies to address the health issues related to chemical and hazardous substances and indoor/outdoor air pollution should be ensured [9].

- Putting a price on pollution or the over-exploitation of scarce natural resources – through mechanisms such as taxes or tradable permit systems should be a central element of the policy mix [4].

Sustainable Natural Resource Management

- The focus of green growth strategies should be on ensuring that natural assets can deliver their full economic potential on a sustainable basis [69].
- Encouragement of an inclusive sharing economy to improve the efficiency and sustainability of resource use would be effective [9].
- Enhancing productivity by creating incentives for greater efficiency in the use of natural resources, reducing waste and energy consumption, unlocking opportunities for innovation and value creation, and allocating resources to the highest value use needs to be ensured [34].
- Efficient use of water can be enhanced in irrigated agriculture by increasing the output per unit of water, reducing the loss of water to unusable sinks, reducing water degradation, and reallocating water to higher-priority uses [29].
- Integrated water resource management needs to be explored for water conservation using rainwater harvesting and groundwater recharge as well as the rejuvenation of lakes and ponds in the river basin catchment [29].

Energy Based Strategies

- First of all, we must ensure that the basic and growing energy needs of the common man are met through clean but affordable sources.
- Elimination of fossil fuel subsidies is necessary to reduce its harmful effects.
- To boost infrastructural development in the direction of green energy, Public-Private-Partnership (PPP), procurement, and appropriate construction models are required.
- Recognising solar energy as a major solution for green energy, India needs to strengthen and upgrade its solar R&D and manufacturing capabilities to achieve low-cost manufacturing and therefore lower capital costs in the solar sector.
- For this, a strong collaboration between private R&D, engineering institutes, and the solar panel manufacturing industry should be encouraged and incentivised [75].
- A strong network of storage batteries is also required to ensure full utilisation of captured solar energy and this can be achieved through cost reduction in this area [75].
- In India, with significant renewable energy potential, the grid does not have sufficient spare capacity to be able to evacuate the increasing quantum of RE electricity. This issue needs to be addressed urgently by upgrading and expanding grid capacity.
- Higher deployment of advanced technologies, such as the Thyristor Controlled Series Compensation, High Surge Impedance Loading lines, High-Temperature High Capacity Conductors, Multi-Circuit Towers, and Mono Pole Towers are also required to enhance the power transfer capability of existing and new transmission lines in India.

- There should be also serious moves to attract sizeable long - term funding at low interest for solar generation plants, storage battery networks, hydrogen electrolyzers, EV charging infrastructure, and grid up - gradation in the field of green energy [75].
- At the same time, the cost of electrolyzers needs to reduce to achieve the goal of green hydrogen cost parity with natural gas [75].
- There is a need for effective public - private partnerships to drive demand and supply of green hydrogen.
- Towards green growth, there is also a need for increased penetration of cleaner fuels like LPG and PNG, and improved biomass - based chullahs (for rural areas) with higher efficiencies and lower emissions.
- India can also explore carbon pricing as an instrument for reducing emissions and promoting green energy solutions.

Agriculture Based Strategies

- In the agriculture sector, technical options for improving energy efficiency in irrigation such as solar pumping systems could facilitate a reduction in diesel consumption in irrigation and therefore save a scarce non - renewable fossil fuel.
- Irrigation facilities must be enhanced, including drip irrigation and rainwater harvesting, to ensure water usage more efficiently and effectively, and reduce water wastage [49].
- Other options include the use of advanced water accounting systems and technologies to assess the amount of water available, including soil moisture sensors and satellite evapotranspiration measurements may be considered. Such measures can facilitate techniques such as alternate wetting and drying of rice paddies, which saves water and reduces methane emissions at the same time.
- Switching to less - thirsty and less - emitting crops to reduce the total water consumption and overall emission of methane may also provide a better option. For example, rice farmers could switch to crops that require less water such as maize or legumes because rice is a major source of agri - food emissions.
- Improving soil health with the help of increasing amounts of organic carbon in the soil, which provides more nutrients without requiring as much chemical fertilizer, is hugely important as these chemical fertilizers are a major source of emissions.
- It also helps the soil to retain water and allows plants to access water more readily, increasing resilience to drought.
- Farmers can restore carbon that has been lost by not tilling the soil and by using cover crops, particularly with large roots, in the rotation cycle rather than leaving fields fallow.
- Increase investment in agricultural research and development (R&D) to develop climate - resilient and high - yield crop varieties is also required [49].
- Provide subsidies and financial incentives to farmers for green technologies.
- Reduction of food wastage throughout the supply chain, from production to distribution and consumption to

conserve resources and reduce greenhouse gas emissions is needed on a priority basis [49].

- ‘Agro - forestry’, a combination of agriculture with forestry through the planting of trees and forests on agricultural lands or the bank offields should be encouraged as it can enhance soil fertility, conserve water, and provide additional income streams for farmers through timber and non - timber forest products [49].

Transportation Related Strategies

- Greening of the transport sector in India would seek a holistic strategy that involves planned interventions to make a decisive shift to green transport and for this, interventions and massive investments are required in the coming decades.
- Up - gradation in terms of fuel quality and fuel efficiency can promote cleaner fuel by reducing sulfur content and can lead to a significant reduction in emissions.
- Electric vehicles (EVs) as a green growth intervention yield multiple co - benefits, including energy security, job creation through local manufacturing, and reduced local air pollution.
- However, to accelerate the uptake of this green technology, it is recommended that the ‘FAME’ scheme, in the direction of EVs be further augmented with substantial additional funding and provisions made for granting 100% capital subsidy to state governments that are keen to adopt these EVs in public transportation.
- In the vehicular sector, more stringent steps should be taken to mitigate carbon emissions and one of them is that old vehicles should be gradually phased out with proper scrapping mechanism in place.
- We can lower transportation’s carbon footprint by changing our way of travel by opting for public transport and car - sharing/carpooling - as well as changing our system of transporting goods under a global supply chain.

Construction Based Strategies

- There is a need to ensure that all new construction of commercial buildings are ECBC (Energy Conservation Building Code) compliant, which aims to reduce energy consumption in buildings, in which greening of rooftops and public spaces in all urban areas should be mandatory to prevent urban heat island effect.
- In the construction sector, alternate building materials that perform equally or better than conventional ones should be encouraged to bring in environmental sustainability.
- Apart from basic structure, recycled and renewable materials can be used for interiors also. Some of the recycled materials are reclaimed wood, barn wood, recycled plastics, and glass, whether renewable materials are bamboo, cork, adobe bricks, and stone, which can be used [76].
- To make a building more energy efficient, solar panels should be installed as much as possible on the rooftop to curtail the electricity consumption.
- Construction of a building should be based on a green formula where walls and roof are designed in such a way that they minimise the impact of heat and cold, lowering the dependency on air conditioning systems for cooling or heating and thus, reducing the emission.

- Installation of smart thermostats also provides a smart option for air conditioning of the building. We can set the programming of the thermostat to heat certain areas of the building that are used most often, conserving energy in the places that are not used [76].
- Under green buildings, heating, ventilation, and air - conditioning (HVAC) systems can run on renewable energy, like solar and wind power, making them more efficient and less costly to operate [76].
- In the construction of a building, we can improve our energy efficiency with CFLs and LEDs rather than traditional bulbs, as it will help to reduce electricity bills and lower energy usage.
- Green building practices are aimed at energy efficiency, and for this, we should make provisions that maximize the amount of natural lighting through large glass windows, glass walls, or a transparent/glass patch on the roof.
- Additionally, we make sure that the building is well - ventilated with a natural flow of wind through open windows and a proper ventilation system. It will save the energy, used by air purifier and exhaust system.
- At the same time, proper measures should be adopted to control the pollutants in the water bodies.
- The most effective way to reduce water pollution is the treatment of water before reintroducing it into the waterways, hence government should develop a proper water treatment mechanism.
- Chemical fertilizers can be replaced by organic farming and efficient use of animal waste as fertilizer to reduce contamination of water.
- Water hyacinth (an aquatic weed and an invasive plant) can be used to purify marine water by removing harmful compounds and heavy metals.

Manufacturing and Clean - Technology - Based Strategies

- Using sustainable raw materials, such as recycled materials can make the manufacturing process more green and sustainable [55].
- Along with this, the implementation of environmentally friendly manufacturing processes is essential to ensure the transition to green technology [55].
- In addition to technological change, a policy instrument like a carbon tax has been viewed as a tool to create an environment for green manufacturing.
- A collaborative approach between the green technology provider companies and diesel generator manufacturers can provide a way to cater to the demands of the Indian manufacturing industry towards green and clean technology as diesel generators are extensively used in factories across India [55].
- The adoption of EVs and hybrid vehicles for logistics and transportation can significantly reduce emissions throughout the manufacturing supply chain [55].
- We should also take initiatives to mitigate carbon emissions through an alternative means of transportation over trucks or lorries by replacing them with railways and marine vessels for the transportation of goods in the manufacturing sector.

Pollution Mitigation Strategies

- To mitigate air pollution and improve air quality, the installation of air pollution control equipment (APCE) should be made mandatory for all industries [55].
- Industries can also put air purifiers to cleanse the air by filtering out various particles such as dust, smog, or smoke [55].
- The best strategy for the government to reduce air pollution is to implement broader policies to tackle the climate challenges such as control of deforestation and wildfires, as both – air pollution and climate change, are inter - connected.

Waste Management

- Waste management must be looked at holistically and preference must be given to the reduction of waste at the source rather than investing in the management and disposal of it at a later stage [29].
- Economic incentives and disincentives serve to motivate consumers and businesses to reduce waste generation and dispose of waste responsibly, thereby contributing to increased demand for greening the waste sector [29].
- Where waste is produced, it should be regarded as a resource, an investment, and an employment opportunity [9].
- To ensure proper disposal of waste, governments need to come up with innovative techniques.
- The disposal of plastic requires innovation and new technologies, for instance, using plastic waste to make roads or building blocks, that can be further used in the place of ordinary bricks.
- Non - plastic waste materials can be used as fertilizers/compost or as fuel materials in plants under controlled conditions.
- Moving towards a circular economy with its four pillars i. e. Recover, Recycle, Reuse, and Remanufacture would be also helpful.

Investment and Finance Mobilisation Strategies

- Financing is critical to the implementation of climate - resilient green growth interventions and for this, in addition to public finance, the private sector, banking institutions, and development agencies should also come forward.
- Contributing to fiscal consolidation by mobilizing revenues through green taxes and the elimination of environmentally harmful subsidies is also advisable [34].
- Perennial flow of finance, especially the bank finance, must be insured for developing the market for commercially available green technologies.
- Reallocation of capital toward green investments is also suggested.
- Boosting investor's confidence through greater predictability in how governments deal with major environmental issues is equally important [34].
- Investment in eco - innovation and cleaner manufacturing practices should be on an urgent basis.
- Investment and support for the development and commercialisation of green technologies also be needed.
- Investment in education and social interactions to change the mindsets of people towards green practices and behaviour is needed [9].

Green Urbanisation Strategies

- Cities need to prepare plans for scaling up forest cover, as the current growth is too slow to meet climate change goals [73].
- They also need to prepare energy consumption plans in transportation and buildings that can be shifted towards renewable energy [73].
- Raising awareness of sustainable lifestyles among people and incorporating the concept of environmental sustainability in daily life and social practice is also important [9].
- All cities must identify the hazards posed to life from different sources of pollution and make proper plans to resolve them [73].

Green Innovation Strategies

- New technologies may find it hard to compete with existing technologies as these techniques dominate the Indian market. In this scenario, strengthening the markets will give a boost to green innovation [4].
- Along this, trade barriers can also create a hurdle to the innovation and development of green technologies, hence, reducing these barriers and providing effective protection and enforcement of intellectual property rights (IPRs) are crucial to encourage the innovation of green technologies in the country as well as the international technology transfer [4].
- Broad - based policies to strengthen innovation should be designed to combat the innovation incapability in India.
- To mitigate the financial constraints towards green innovation - co - investment funds, public - private partnerships, a mixture of tariffs and taxes, and foreign aid/investment should be suggested [4].

Inclusive Growth Strategies

- Anticipate the losses that may accompany the transition from an economy based on non - renewables to more diversified and renewable resources through reskilling, intensified training, promotion of job placement in renewable jobs, and social safety nets [9].
- Though the concepts like a carbon tax or others, disincentivise the use of fossil fuels on one side and the other, also generate revenue, which may be further redistributed back to the households, especially the lower income ones, to add inclusivity with greening the economy.
- Along with this, the fiscal policy reforms that shift tax burdens away from the poor to reduce inequality are equally important [9].
- Investment in more labour - intensive sources of growth such as agriculture, horticulture, floriculture, aquaculture, creative and cottage industry, and so on to ensure Inclusive and green growth is advisable [9].

Concept of 'LIQUID 3'

A concept of 'Liquid Tree', called 'LIQUID 3', is a completely new biotechnological solution given by the 'Institute for Multidisciplinary Research' of the University of Belgrade for air purification and reduction of CO₂ emissions in urban areas, where its concentrations are highest. It is estimated that cities are the source of as much as 75% of total CO₂ emissions in the world, of which the

largest percentage comes from traffic and cooling and heating systems in buildings. LIQUID 3 may provide an efficient and innovative solution for reducing greenhouse gas emissions and improving air quality in Indian cities as this system can be used to fill the gap of green areas in those urban pockets, where there is no space for planting trees. The advantage of microalgae in LIQUID 3 is that they are 10 to 50 times more efficient than trees and replace two 10 - year - old trees or 200 square meters of lawn [77].

14. India's G20 Presidency and IGG

In 2012, G20 introduced inclusive green growth as a cross - cutting priority on the G20 development agenda and subsequent G20 presidencies took forward it along with several commitments made by all the members to achieve it. India got a year - long G20 presidency on 01 December 2022, which provides it a significant opportunity to set the goals and priorities towards inclusive green growth, especially focusing on food security and climate sustainability. Currently, the world after COVID - 19 is off - tracking in accomplishing SDG goals of alleviating poverty, hunger, and malnutrition, and as a G20 president, India is committed to promoting sustainable agriculture as a part of IGG to achieve the SDG of food and nutrition security. Moreover, the G20 has a strong economic interest in limiting global warming to 1.5°C. Today India is fast emerging as a global clean energy powerhouse and as G20 president, it has multiple opportunities to share its clean energy expertise and products with the member countries. Furthermore, India is also scaling up its footprints in emerging technologies such as green hydrogen, battery storage, and low - carbon steel. Thus, as G20 president, India aims to strengthen global support for developing countries' priorities around inclusive, equitable, green, and sustainable growth [78]. Under India's G20 presidency, the 'New Delhi Declaration' was adopted on September 09, 2023, by the leaders of G20 countries during the Leader's Summit in New Delhi. One key agreement under this declaration was the 'Green Development Pact' to accelerate the steps needed to tackle the challenges of environment and climate change, recognising that the prosperity and well - being of both current and future generations are intrinsically tied to the choices and actions we make today. In brief, India's presidency of the G20 is expected to have a long - lasting, positive impact across the globe in terms of sustainability, environmental conservation and green growth.

15. Conclusion

Inclusive and green growth is an auspicious approach to achieving the required growth rate for an emerging economy just like India. It requires addressing the needs and concerns of all sections of society; promoting equal access to economic opportunities and resources; and transitioning towards a low - carbon and resource - efficient economy. Building a green economy that is not only sustainable but also equitable, requires carefully designed policies that encourage sustainable agriculture and rural development, investing in renewable energy and efficiency, promoting green industrialization and circular economy, creating green jobs, and improving access to health, and education. At the same time, policies and measures such as green

protectionism and aid conditionality that could adversely impact poor and marginalized people must be avoided if the benefits of an inclusive green economy are to be realized [12]. It also underlines the urgency for the industrial sector, corporates, and their value chain stakeholders to adopt responsible and cleaner business practices [8]. The Indian economy is expected to grow at 6.7% in the current year (2023 - 24), and the 'Inclusive Green Growth' strategy presents new opportunities for long - term value creation, contributing towards a prosperous future for India.

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