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Climate Change Policies and Mitigation Measures (A Qualitative Case Analysis of GHG Reduction between India and South Africa)

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ABSTRACT

India being the second major contributor of GHG emission in Asia (third in the world) and South Africa being the most industrialized Nation in the African continent and the largest GHG emitter in the region, both these countries have been taken for a comparative analysis. This paper primarily focusses on the GHG emissions analysis and mitigation measures in India and South Africa in the essential sector of energy. Both these countries with a colonial past, face the twin challenges of meeting development aspirations of its population even while combating the looming threat of climate change. Lack of integrated action and financing challenges being the major issues plaguing the GHG mitigation measures/policy matrix in India, ensuring coordinated action across sectors/ministries and facilitating smooth flow of funds would be required. Neglect of climate change policies being the major concern in South Africa, bringing it to the centre stage of political and economic discourse is the need of the hour.

Keywords

climate change mitigation, GHG/carbon emission, renewable energy, coal/electricity sector, India, South Africa

Introduction

According to India's second Biennial Update Report (BUR II 2018) to the United Nations Framework Convention on Climate Change (UNFCC), the country stands as the third largest GHG emitter in the world with a total annual emission of 2607.5 million tonnes of CO2 equivalent in 2014 which accounts for seven percent of total world emissions. India currently consumes 6 percent of world's primary energy. However, with a large base of aspirational population and the policies geared towards employing them productively and the resultant high growth rate, there is an enormous demand on its energy resources. The country's per capita energy consumption grew by 56.4 percent from 2005-6 to 2016-17 even though India's per capita energy consumption still remains at 30 percent of world average. In 2014, the energy sector accounted for 73 percent of the total GHG emissions. Within the energy industry, the electricity production accounted for 42 percent of entire GHG emissions and the manufacturing and construction sectors accounted for 18.4 percent of emissions in the energy sector. India has been engaged in various international and domestic efforts to keep GHG emissions on check. Major initiatives include The National Action Plan on climate change (NAPCC), State Action Plan on Climate Change (SAPCC) and International Solar Alliance (ISA).

South Africa is one of the largest growing economies in African continent with an aggregate net GHG emissions of 426 214 gg CO2e in 2000 which increased to 513 83 Gg CO2e by 2015 (South Africa's third Biennial Update Report to UNFCC, 2019). From 2000 to 2015, the annual growth rate has been 1.43 percent whereby the energy sector has been the main contributor. As a pioneer in mining and mineral industry, South Africa's total energy consumption per unit of GDP is fifty percent higher than the world average. The energy sector was the largest contributor to South Africa's gross emissions in 2015, comprising 79.5 percent of total emissions. The energy sector emissions increased from 343 790 Gg CO2 e in 2000 to 429 907 Gg CO2e in 2015. The carbon tax bill, Greenhouse gas emissions reporting, climate change bill and pollution prevention plan regulations are the major policy measures undertaken by the country to reduce the GHG emissions. The key component of post-2020 South African mitigation efforts include Sectoral Emissions Targets (SET) which places quantitative limits on future GHG emissions(BUR III, 2019).

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Despite international negotiations and agreements set in motion to reduce GHG, the question of comparability of policy measures and actions across countries frequently arises as also the question of equity between developed and developing Nations. In this context, the purpose of this paper is to summarize, compare and evaluate the GHG reduction policy measures and mitigation efforts that are either implemented or under consideration for implementation in India and South Africa.

Review of Literature

As per the reviewed literature, it has been projected that per capita emissions would be rising by forty percent in India by 2030 and to decrease the emissions rate, stronger de-carbonization of energy sector is needed (Jonas Karstensen et.al 2020). In 2014 and 2015, the largest increase in global emissions have been recorded in India on account of rapid economic growth for more than a decade and further plans to add coal powered plants will jeopardise the global climate change efforts (Jonas Karstensen et.al 2020). As per India's Intended Nationally Determined Contribution (INDC) (MoECC 2015), the goals include decrease emission intensity of GDP by 33-35 percent by 2030 compared to the 2005 levels and to achieve 40 percent of installed electric power capacity from non-fossil fuel based energy sources. The literature recommends that India needs to gear up its mitigation efforts as its economy is likely to be negatively impacted in terms of GDP on account of global warming (Burke et al 2015). According to the Statistical Review of World energy 2020 (69th edition), the CO2 emissions (million tonnes of CO2) for the year 2019 in India include 2480.4. Even though the proportion of coal in fossil fuel emission has been declining since 1940, there is a steady increase post 2000. As India is expected to achieve high growth by 2040 and also become the most populous country in the world by 2025, India's share of GHG emissions is expected to rise from 7.5 percent to 14 percent in 2040 (IEA, 2015b). Under the above circumstances and the projected energy demand for the future vis a vie GHG emissions, energy efficiency policies are very important from the perspective of energy demand reduction and emission mitigation (Vaibhav Chaturvedi and Priyadarshini R Shukla, 2013). However, it is to be noted that even though energy efficiency improvements which are required to be an integral part of climate change policiesare an essential condition, they are not sufficient condition for achieving the mitigation targets for which climate policies are indispensable.

The energy sector in general and electricity sector in particluar being the major contributor towards GHG emissions in India, it is essential to review the literature on the subject. India's electricity sector shows that India is world's third largest producer and fourth largest consumer of electricity. The total installed capacity as on 31st March 2016 was 349.2 GW and total generation was 1351.97 TW hours. Moreover, there has been an increasing trend of coal based emissions from 2005-14. The National Electricity Policy in 2005 has provided the electricity sector with policy impetus to de-carbonize and it aims to provide reliable electricity supply across the country (Murali Ramakrishnan Ananthakumar and Yeshika Malik 2014). The authors have highlighted the drivers for emission reduction which includes fuel switch, technology adoptionand policy thrust.

As regards the initiatives for augmenting renewable energy in India, the announcement made by the prime minister of India in 2019 at United Nations Climate Action Summit in New York, fixing the target of 450 GW of non-fossil energy by 2030 needs a special mention here. Hence the same represents a substantial scale up from the current capacity of 74 GW at the end of 2018 and the implication of the revised target would be highly significant from the perspective of Climate change mitigation.

Coming to the scenario in South Africa, the GHG per capita emissions from coal powered industries witnessed a sharp increase on account of low energy prices. The power sector in South Africa is dominated by the State owned company Eskom which produces 95 percent of the country's electricity and a major chunk of the power comes from coal (Carmen Klausbruckner, Harold Annegarn et.al 2016). By 2010, South Africa's economy became one of the most carbon intensive economies in the world with an emission of 478.8 million tonnes of CO2 in 2019 (Statistical review

of World Energy 2020). The National Development Plan (NDP) of South Africa aiming for economic development of the country takes into consideration the need for electricity to ensure economic growth and GHG emissions mitigation is one of the challenges in this context.
The potential mitigation strategies for South Africa would include promotion of energy efficiency, use of coal technologies, switch to renewable power (solar and nuclear), waste incineration, use of bio-fuels and increased use of hydro-power. Enforcement of policy/mitigation measures is a major challenge for the success of mitigation strategies in South Africa. Other market interventions include carbon taxing which aims to internalise the external costs induced by climate related damages. The most comprehensive mitigation strategy in South Africa includes the Long Term Mitigation Scenario (LTMS) from 2005-08 based on which the Department of Environment Affairs (DEA) has projected the peak of emissions during 2020-2025 which would reach a plateau over a period of ten years and start declining from 2036.The Intended Nationally Determined Contributions (INDC) of South Africa seeks to bring in significant cuts in GHG emissions from 2020 which calls in for a gradual shift from carbon-emission approach to low emission development strategy. Thus, beyond the obligatory national commitments, South Africa needs to engage in wider regional cooperation to implement appropriate policy responses for promoting green energy. In this regard, South Africa is expected to take a lead in Southern African Development Community (SADC) framework by adopting neo-liberal and green theories (LereAmusan and Oluwole Olutola 2016).

Research Method

This study uses secondary data set to analyse GHG emissions and mitigation policies for India and South Africa. For the purpose of comparison, the methodological approach for this research uses quantitative and qualitative analysis for emissions data and mitigation policies respectively. The GHG emissions data for India for the years 2000, 2010 and 2014 is derived from the GHG inventory furnished in India's Second National Communication (2000), First Biennial Update Report (2015) and Second Biennial Update Report (2018) to UNFCCC. However, the limitation is that the data provided is limited to only three years aforementioned. The mitigation measures for India is also taken from the first and second Biennial Update Reports. The emissions data for South Africa for the years 2000 to 2015 is acquired from the Updated Biennial Report iii submitted by the South African Government to the UNFCCC in March 2019. Based on the literature review done, the following objectives can be elicited.

1. Summarize, compare and analyse GHG emissions of India and South Africa with special reference to energy sector for the years 2000, 2010 and 2014.
2. Summarize, compare and analyse mitigation policies of India and South Africa with special reference to energy sector.
3. Listing out the major lacuna in the GHG reduction policies and mitigation measures in India and South Africa.

GHG EMISSIONSININDIAAND SOUTH AFRICA: A COMPARISON

ECONOMIC BACKGROUND

To state the background of Indian and South African economies, in 2019, while the GDP current of India stood at 2,868, 929.42 US $, the GDP currentof South Africa was 351,431.65 US $ (The World Bank data). While India is world's fifth largest economy in terms of GDP, South Africa is assigned 32nd rank (worldometer). India's GDP growth rate (annual percentage) in 2019is 4.2 percent whereas the same in South Africa is 0.2 percent (World Bank data). InIndia and South Africa, the share of contribution of services and value added sector to GDP is the highest with 49.9 percent and 61.2 percent respectively (World Bank data). The contribution of industrial sector to the GDP in India is 25 percent while in South Africa, the same stands at 26 percent.

GHG EMISSIONS FOR INDIA AND SOUTH AFRICA FROM 2000 to 2014

Table 1: Gross and net GHG emissions for India in Gg CO2e.

Year	Gross total	Net total	Average annual change in

			net emissions (%)
2000	1523777.44	1301209.39	----
2010	2136841.24	1884309.46	4.4
2014	2607488	2306295	5.5

Note. Adapted from India's 2nd BUR report to the UNFCCC (pp. 42-43)

Table 2 : Gross and net GHG emissions for South Africa in Gg CO2e.

Year	Gross total	Net total	Annual change in net emissions (%)
2000	439238	426214	----
2010	538778	524297	2.77
2014	547509	518250	-1.75

Note. Adapted from South Africa's 2nd BUR (pp 49-54) and 1st BUR to the unfccc (pp 41)

In the year 2000, India emitted 15,23,777.44 Gg CO2e from energy, industrial process and waste management sectors. The net emissions with the inclusion of Land-use, land use change and forestry (LULUCF) were 1,31,209.39 Gg CO2 e in India. Whereas, in South Africa, the gross emissions stood at 439238 Gg CO2e. and the net emissions including the Forestry and Land use (FOLU) stood at 426 214 Gg CO2e. In India, during 2010, the gross total emissions were 236841.24 Gg CO2e and the net emissions including FOLU stood at 1,884,309.46 Gg CO2e. This amounted to 4.4 percent of average annual change in net emissions. Coming to South Africa, in 2010, the gross total emissions were 538778 Gg CO2e and the net emissions including FOLU were 524 297 Gg CO2 e. The annual change in net emissions for the same year is 2.77 percent. In 2014, in India, the gross total emissions were 2607488 Gg CO2e and the net emissions including LULUCF stood at 2306295 Gg CO2e. This accounts for 5.5 percent of average annual change in net emissions for the year 2014. Whereas, in South Africa, the gross total emissions for 2014 stood at 547509 Gg CO2e and the net emissions including FOLU were 518250 Gg CO2e. which stands for -1.75 percent of annual change in net emissions.

From the above data, we find that in India, there is a steady increase in GHG emissions from 2000 to 2014. During the first decade of this century, we find an average annual increase of 4.4 percent in net emissions and after 2010, there is a further increase in the rate of change of emissions with an average annual increase of 5.5 percent from 2010 to 2014. Whereas in South Africa, even though there was a steady increase of 2.77 percent per annum in net emissions from 2000 to 2010, there is a decrease in net emissions from 2010 to 2014 to an extent of -1.75 percent.

ENERGY SECTORCONTRIBUTIONTO GHG in INDIA AND SOUTH AFRICAFROM 2000 to 2014

Table 3 : Energy sector contribution to the GHG emissions in India and South Africa in Gg CO2e. and %

Year	India (in Gg CO2e.)	(in %)	South Africa (in Gg CO2e.)	(in %)
2000	1027015.54	67	343790	78.2
2010	1510120.76	70.7	436922	81
2014	1871709	73	436458	79.7

Note. Adapted from India's 2nd BUR to the unfccc (pp. 43) and South Africa's 2nd BUR (pp. 49-54) and 1ST BUR to the unfccc (pp. 46, 61)

During the year 2000, the energy sector in India contributed 1027015.54 Gg CO2 e which accounted for 67 percent of the total GHG emissions excluding LULUCF. Whereas, in South Africa, the energy sector contributed 34379 Gg CO2e. of the total gross emissions which accounts for 78.2 percent of total emissions. In 2010, the energy sector in India emitted 1,510,120.76 Gg CO2e which accounts for 70.7 percent of the total GHG emissions excluding LULUCF. In South Africa, for the year 2010, the contribution of energy sector stood at 436972 Gg CO2e of the gross emissions which accounts for 81 percent of the emissions. In 2014, the energy sector contributed 1871709 Gg CO2e. which accounts for 73 percent of GHG emissions excluding LULUCF. In comparison, in South Africa, for the year 2014, the energy sector contributions were 436458 Gg CO2e of gross total emissions which accounts for 79.7 percent of total emissions.

Examining the data, we find that energy sector's contribution to the GHG emissions in both the countries is substantial. In India, it was 67 percent

in the year 2000 which increased by 3.7 percent in the next ten years. The rate of increase of the energy sector's contribution has become rapid during the period 2010 to 2014. In 2014, 73 percent of GHG emissions has been contributed by the energy sector. In South Africa, the story is almost similar with 78.2 percent contribution coming from energy sector in the year 2000. In 2010, it has further increased to 81 percent and during the next four years, a marginal decrease is noticed in the contribution of energy sector with the percentage being pegged at 79.7 percent.

In both the countries, the contribution of energy sector to the GHG emissions were substantially high. In India, while the energy sector contributed to 73 percent of total GHG emissions in 2014, in South Africa, the contribution of energy sector was around 79.7 %. In India, within the energy industries, 94.96% of emissions were from electricity production, 4.39% from refinery and 0.66% from manufacturing of solid fuels. Thus, the electricity production has contributed substantially to the overall GHG emissions across the sectors.

Table 4: GHG emissions in relation to GDP in billion (dollars) in India and South Africa

Country	2000	2010	2014
India	468.40	1680	2040
South Africa	136.36	375.35	350.91

Note. Adapted from The World Bank economy data

India witnessed an exponentialgrowth in GDP from 2000to 2014. This explains the increased GHG emissions during the same time period. However, in the case of South Africa, the GDP fell from 375.35 billion US $ in 2010 to 350.91 billion US $ in 2014. This explains the fall in GHG emissions between 2010 and 2014. India's exponential increase in GHG emissions can be attributed to sustained economic growthand the consequent increase in demand for electricity across the sectors over the period taken for the present study. Despite high growth in energy intensive sectors, the growth in energy consumption and environmental emissions with respect to GDP are low. However, due to an increased level of electricity, the electricity consumption has grown at a rate higher than the GDP. India's energy intensity has decreased over the last decade. This decline may be attributed to the fact that GDP is growing faster than the demand for energy in the country.

With the analysis of the data, we find that the scenario in South Africa is entirely different. The country is a major suppliers of minerals, base metals and coal and consequently, consumption of energy per unit of GDP is higher than the world's average by fifty percent with energy intensive industry contributing to high levels of energy consumption rate, followed by manufacturing industry, which is more into primary extraction with little or no value addition.

MITIGATION ACTIONS FOR GHG EMISSIONS REDUCTIONIN INDIA

Following are the major mitigation measures adopted by India for reducing GHG emissions :

1. The National Action Plan on Climate Change (NAPCC), a majorcomponent of mitigation action initiated by Government of India, consists of the following eight missions with a focus on various sectors/areas for reduction of GHG emissions(India's IInd BUR to UNFCCC, 2018, p.10).The said eight missions areJawaharlal Nehru National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission for a Green India, National Mission on Sustainable Habitat, National Water Mission, National Mission on Sustainable Agriculture, National Mission on Sustaining Himalayan Ecosystem and National Mission on Strategic Knowledge for Climate Change (India's IInd BUR to UNFCCC, 2018, p.99-101). The challenges in the implementation of NAPCC includes bureaucratic bottlenecks like ineffective monitoring system and limited budgetary support (VijetaRattani et. al 2018).
2. In accordance with NAPCC, State Governments have come out with the State Action Plan on Climate change (SAPCC) for their respective States(India's IInd BUR to UNFCCC, 2018, p.102). UnderSAPCC, various programmes have been implemented separately targeting different sectors like Agriculture, Forest and Biodiversity, Energy, Urban Development,Water Resources and Transportation which are prioritised by the

States/Union Territories(India's IInd BUR to UNFCCC, 2018, p.102). SAPCC formulated by the States have been found to be vague which is a primary challenge in its effective implementation (VijetaRattani et. al 2018).

3. With regard to mitigation measures in energy sector, India's Nationally Determined Contribution (NDC) includes a formidabletargetof 40% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030(India's IInd BUR to UNFCCC, 2018, p.11). Being a tropical country with abundant sunshine throughout the year, India has tremendous potential in the solar energy sector. Between the years 2014 to 2018, the Solar installed capacity in India has gone up by 9 times from 2.63 Gigawatt (GW) to 23.28 GW(India's IInd BUR to UNFCCC, 2018, p.11). In this context, it is relevant to mention that the international Solar alliance (ISA) launched in 2015 aims to harness this untapped potential of solar energy for universal energy access at affordable rates(India's IInd BUR to UNFCCC, 2018, p.11).

MITIGATION ACTIONS FOR GHG EMISSIONS REDUCTIONIN SOUTH AFRICA

South Africa has a lofty goal of achieving a low-carbon, environment friendly and climate resilient society and economy in long term. The country's approach is twin pronged in terms of both GHG emissions for sustainable development and poverty reduction for sustainable society. Nevertheless, in terms of actual mitigation measures, we find that emissions reduction (93 percent) have primarily happened in the energy sector during the period from 2000 to 2015 (South Africa's 3rd BUR to UNFCCC, 2019). The country has achieved the said reduction with contributions from various policies and programme, the details of which are as under.

1. The Carbon Offset Regulations, developed jointly by National Treasury, Department of Mineral Resources and the department of Environment, Forestry and Fishery, outlines the eligibility criteria for offset projects and lays down the procedure for claiming the offset allowance (National Treasury, Republic of South Africa, 2019, p.1-2). For the purpose of reducing emissions and with an aim to incentivize actionstowards the same, the said regulationsseeks to provide an offset mechanism for developing carbon offset projects to enable a reduction of carbon tax liability. By investing in such specificprojects, businesses can generate carbon offsets.
2. As stated in National Climate Change Response Policy, NDP and NDC commitments under Paris Agreement, Carbon Tax is an inherent part of South African Government's Mitigation policy measures. This tax is introduced with a view to provide a level playing field for new generation energy efficient and green technology using businesses vis-a-vie those using conventional carbon intensive energy resources. The Carbon tax is being introduced by the South African Government in a phased manner, the first phase running until December 2022 at a lower rate and thereafter till 2030 at a higher rate(Gathright, 2019). The said carbon taxation is a potent tool to drive the businesses towards clean and green technologies.
3. Carbon budget is an approach of direct intervention and regulation which forces organizations to cap their cumulative GHG emission target leading to desired environmental outcome. South African Government, in the first phase from 2016 to 2020 made it voluntary on the part of companies and no complains mechanism was put in place(Cloete, Cohen, Child &Ramkolowan, 2017). In the subsequent phases, compliance mechanism with in-built disincentive would be put in place by the Government, albeit striking a balance with reference to increase in electricity prices fuelling poverty in the short term.
4. Regulatory standards mandate thatinstitutionsemitting greater than 0.1 Mt of CO2 equivalentsare classified as 'significant emitters'and are requiredto put forthPollution Prevention Plans (PPPs) as per the National Environmental Management: Air Quality Act, 2004(South Africa's 3rd BUR to UNFCCC, 2019).

5. Focussing on the energy sector, South African Government has put in place Integrated Resource Plan 2018 which sets targets for increasing the renewable energy sources. Further, Post 2015 National Energy Efficiency Strategy has been formulated for agriculture, industry and public transport by the Government with ambitious targets to be attained by the end of the current decade (South Africa's 3rd BUR to UNFCCC, 2019). Last, but not the least, Government has augmented data collection efforts in energy sector and to ensure that policies in the area of energy efficiency are backed by end-use information, Efficiency Targets Monitoring System has been set up.

Comparison Of Mitigation Policies Of India And South Africa

India, the second most populous country with sustained economic growth in the past and ambitious development plans and limited financial resources have been successful to some extent in containing the GHG emissions in implementing the mitigation measures. However, we find that there is a lack of integrated action from the part of the Government and bureaucratic bottlenecks in implementation. A point to be cited in this regard is that following the hurried announcement of NAPCC in 2008, the ministries concerned took more than six years to approve the missions and the new schemes announced were not in sync with NAPCC policy. As regards South Africa, we find that with relatively much lower GDP and economic growth, their past efforts in GHG emission reduction cannot be termed successful as compared to that of India. In fact, climate change has never been a part of the mainstream political discourse which has resulted in neglect of concrete efforts in the climate change policy arena. In the energy sector, while India has been successful substantially in the area of promotion of renewable energy especially solar, South Africa lacks in political will and efforts.

Conclusion

India and South Africa, as emerging economies, face the herculean challenge of striking a balance betweentheir development needs and climate change mitigation actions.Examiningthe Indian developmental scenario, it is projected that the absolute GHG emissions would continue to rise in the coming three decades i.e. till 2050s on account of increase in energy demand (TERI, 2015). In the context of exponential rise in GDP and the consequent rise in GHG emissions, this study suggests that India ought to increase the share of renewable energy resources in general and solar power in particular. Moreover, to achieve the targeted reduction in GHG emissions, ensuring integrated Government action across sectors/ministries and facilitating smooth flow of funds towards mitigation actions is the need of the hour. It is proposed that clear demarcation of responsibilities across ministries and fixation of accountability in terms of targets and funding and incentivizing performing states in the area of mitigation measures would help in bettering the situation. With regard to South Africa, despite relatively lower GHG emissions in comparison to India, the energy intensive mining sector contributessignificantly towards GHG emissions in the country. According to the UNFCCC report on Low Emissions Development Strategy (LEDS), structural changes are required in numerous areas in South African efforts for GHG mitigationwhich includes enhancing institutional capacities and arrangements, creating right financial environment by aligning fiscal strategy with sustainable growth, providing broad access to funds and promoting sustainable development through education and culture (LEDS, 2020). In this light, this study suggests that prioritization of climate change issues need to be brought about in the national political and economic discourse so that it percolates to the policy level.

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