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Carbon Trading – A Market Mechanism to Address Climate Change A Study of Sustainability Claims of Select CDM Projects in India

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Abstract

The concept of carbon trading came into existence as a result of awareness of the need for controlling the greenhouse gas emissions. Climate change due to greenhouse gas emissions increases the severity and frequency of storms, droughts, floods, forest fires, heat waves, extinction of species, spread of diseases etc. To address this world leaders entered into an international treaty, i.e., the Kyoto Protocol which is linked to the United Nations Framework Convention on Climate Change (UNFCCC), to place legally binding caps on greenhouse gas emissions by industry in developed countries. In December 1997, India became a signatory to the Kyoto Protocol and ratified the same in August 2002, to implement Clean Development Mechanism (CDM) projects in India.The CDM helps developed countries to achieve their climate change mitigation target and sustainable development for the developing countries.
In total, 7,814 CDM project activities were registered in around 108 countries and 1.527 billion CERs (i.e., 1.527 billion tons of carbon emission reduction) have been issued from 2574 CDM projects, by the end of January 2015. By the end of 2020, around 3.8 billion tons of carbon emission reduction may take place. India stands second in the world next to China and followed by Brazil, in the development of CDM projects. India's share in CDM project activities is around 20%, against that of China's 50%, and share in CERs is 13% against that of China's 60%. Because of the small scale CDM projects, India generates less number of CERs, in comparison with that of China which has large size CDM projects. Many Indian companies are registered with CDM Executive Board for carbon credits. To name a few – Wind turbine giant Suzlon Energy, solar power pioneer Tata BP Solar, Gujarat Fluoro Chemicals Ltd., Torrent Power Ltd., Jindal Steel Works Ltd., Bhoruka Power Corporation Ltd., Steel Authority of India Ltd., and many other power-generating companies are either switching to cleaner fuels or to renewable energy such as hydro, solar or wind. The present study focuses on referring the PDDs (Project Design Development which the CDM project developer has to submit to UNFCCC) of select CDM projects to know about their sustainability claims, and verification of achievement of these claims through the field surveys where the projects are situated. It is found from the field surveys that most of the PDDs give the rosy picture of sustainability claims (social, economic, technological and environmental well-being) which were not fully achieved by them.

Key Words: *Kyoto Protocol, CDM, Sustainable Development, PDDs.*

1. Introduction

The concept of carbon trading through climate exchanges came into existence as a result of awareness of the need for controlling the greenhouse gas emissions. Carbon markets play an important role in engaging States and Industry effectively in climate change mitigation. Climate change due to greenhouse gas emissions will increase the severity and frequency of storms, droughts, floods, forest fires, heat waves, extinction of species, spread of diseases etc.

The impact of these hazards is being already felt and hence world leaders entered into international conventions and treaties – like United Nations Framework Convention on Climate Change, the Kyoto Protocol treaty, etc., to place legally binding caps on greenhouse gas emissions by industry in developed countries.

Carbon is now traded like any other commodity in the "Carbon Market". Carbon trading is basically buying and selling of Carbon Credits. Carbon Credits are the emission reduction certificates/emission trading units assigned to the clean energy project (CDM) sponsors who reduce carbon dioxide emissions. One Carbon Credit is equivalent to one ton reduction of carbon dioxide or its corresponding greenhouse gas (GHG).

Carbon credits are issued by the United Nations Framework Convention on Climate Change (UNFCCC) under the Clean Development Mechanism (CDM) scheme of the Kyoto Protocol.

The worth of carbon markets has expanded to US$ 176 billion in 2012 from US$10 million in 2005 and estimates predict a potential of US$1 trillion by 2020.

IPCC's AR5 (Assessment Report 5) is the first to include an assessment of a "global carbon budget" for the planet. Carbon budget is a maximum amount of carbon dioxide the world can emit without inviting dangerous climate change. It is a budget for two degrees, with maximum of 1000 billion tons carbon emissions

IPCC report states that beyond 2 degree Celsius is the dangerous level of climate change. And to stay below 2 degrees, the total amount of carbon released through carbon dioxide emissions must be less than 800-880 billion tons, and of this, about 530 billion tons have already been emitted by 2011. Current carbon dioxide emissions is around 10 billion tons per year and the carbon left in the budget is set to be exhausted in about 3 decades.

Table 1: Greenhouse Gases addressed by the Kyoto Protocol and their Global Warming Potential

Sl. No.	Gas	Global warming potential	Atmospheric life (years)
1	CO_2-Carbon Dioxide	1	5-200
2	CH_4-Methane	21	12
3	N_2O-Nitrous Oxide	310	114
4	HFCs-Hydro fluorocarbons	140-11700	14-260
5	PFCs-Per fluorocarbons	560-9200	10000-50000+
6	SF_6-Sulpur hexafluoride	23900	3200

Source: UNDP - 2003

Of these, carbon dioxide (CO_2) is the most common because it is emitted by routine activities like burning fossil fuels for energy and transport.

Some GHG like hydro fluorocarbon, methane, and nitrous oxide, which are released as by-products of certain industrial process, adversely affect the ozone layer, leading to global warming.

2. Objectives

The main objective of this study is to assess the impact of CDM projects on the Sustainable Development of Host Country, i.e., developing country like India. The related objectives are:

- To study the role of UNFCCC and Kyoto Protocol in the mitigation of carbon emission through various mechanisms like emission trading, clean development mechanism projects and joint implementation.
- To know the international response to climate change
- To analyze the overview of clean development mechanism projects at global level
- To interpret the sustainability claims and their achievements by the select Indian CDM projects.

3. Research Methodology

It includes:

- Literature review
- Data collection and Analysis of PDDs (projects development design) of select CDM projects
- The field surveys where the select projects are situated.

The research methodology for the study comprised of literature review, PDD analysis of select CDM projects (using Stratified Random Sampling technique) and field surveys of such select CDM projects where they are situated to compare the sustainable claims given in PDDs with actual delivery of sustainable developments.

3.1 Literature Review

To address the severity of climate change due to greenhouse gas emissions, UNFCCC was formed in 1991 by world leaders. Many COPs (conference of parties) were organized by UNFCCC and at the third COP Kyoto Protocol was negotiated in 1997 at Kyoto, Japan. Kyoto Protocol has highlighted many internationally accepted principles like Common but Differentiated Principle, Polluter Pays Principle, Principle of Sustainable Development of developing countries by setting CDM projects to mitigate carbon emission at lower cost, and the Principle of intergenerational equity (UNFCCC news).

The clean development mechanism (CDM) is a market-based mechanism under the Kyoto Protocol whereby projects in developing countries can earn saleable credits equivalent to the amount of CO2 eq. they reduce or avoid. CDM has proved to be a useful mechanism for industry in developing country to implement climate change mitigation measures and renewable energy projects (CDM pipeline analysis).

UN's Intergovernmental Panel on Climate Change, in its report assessing impacts of climate change on human health, settlements and natural resources released in April 2014, carried a dire warning. "The worst is yet to come," it said, if no measures are taken to curb the ill-effects of global warming.

"Climate change is already becoming a determining factor in the national security policies of states", said a statement issued by the UN Framework Convention on Climate Change (UNFCCC) which has been working to arrive at a global climate deal by 2015 to fight the menace effectively through combined efforts of nations.

Shailendra Sharma (2012) states that Carbon credits are certificates issued to countries that reduce their GHG emission that causes global warming, through CDM projects. CDM is a relevant mechanism adopted in India for reduction in carbon emissions, investment and operating cost of CDM projects is recovered through sale of CERs. Selective advantages of CDM projects are –

1. Gaining annual CER revenue for the country.
2. Domestically it would help achieving:

- Reduction in poverty by creating employment
- Safe working conditions for the informal sector.
- Superior environmental quality (less odor, leach ate, disease vector).
- Enhanced public awareness on recycling
- Improvement in the quality of life of the city.
- Efficient resource utilization.
- Contribution to reduction of foreign expenditures (macro-economic indicators)
- Considerable amount of power to the city.

3. Globally achieving:

- Foreign Direct Investment
- Reduction of emissions of GHG's from dumping grounds which are responsible for global warming.

The FICCI Survey(2011), titled 'Impacts, Governance and Future of CDM - Indian Industry Perspective' found that amongst the investments made on energy efficiency and renewable energy projects as many as 48 percent of respondents have made investments in energy efficiency projects followed by wind projects (28 per cent). Indian Industry has given

big thumbs up to the continuation of CDM and market based mechanisms for climate change mitigation. As high as 96 per cent of respondents believe that CDM has contributed to sustainable development.

Over the past nine years, the CDM has been a success both in terms of its ability to reduce emissions (over 1.5 giga tons) and as a climate finance instrument having attracted at least USD 138 billion, probably significantly more. The CDM has proven its worth, now it must be put to full use - Hugh Sealy, Chair CDM Executive Board, 2014

The CDM is a mechanism with internationally agreed rules, embedded in the Kyoto Protocol's accounting system, which might offer advantages in ensuring integrity over a fragmented carbon market with multiple mechanisms. The CDM has been built over many years, learning by doing, and has been continually improved. We should not lose this instrument in a future climate agreement - Lambert Schneider Vice-Chair CDM Executive Board, 2014

Many scientific studies have been made to assess the sustainable development by CDM projects in the developing countries. One important objective of CDM is to contribute to the sustainable development of the host country. Article 12.2 of the Kyoto Protocol says, "The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3" (UNFCCC 1997).

Although there are no common guidelines for the sustainable development criterion and the Marrakech Accord clearly states that "it is the host party's prerogative to confirm whether a clean development mechanism project activity assists it in achieving sustainable development", the criteria for sustainable development may be broadly classified as (Pembina 2003):

- Social criteria: The project improves the quality of life, alleviates poverty, and improves equity.

- Economic criteria: The project provided financial returns to local entities, results in positive impact of payments, and transfers new technology.

- Environmental criteria: The project reduces greenhouse gas emissions and the use of fossil fuels, conserves local resources, reduces pressure on the local environments, provides health and other environmental benefits, and meets energy and environmental policies.

3.2 Data Collection and Analysis of PDDS (Projects Development Design) of Select CDM Projects and Field Survey

Research study began with literature review and selection of sample size of CDM projects. In Karnataka, there are 255 CDM projects approved by the National Clean

Development Mechanism Authority of India as of June 2012. As per the Karnataka Renewable Energy Limited's Website, 95 CDM projects have been registered by CDM Executive Board of UNFCCC as of 2012. The present study covers all the 95 registered CDM projects in Karnataka State.

The analyses of PDDs of all the 95 CDM projects were made to know about:

Field survey of only registered CDM projects was made and information about all the 255 approved CDM projects and their performance was collected from the officials of Karnataka Renewable Energy Development Limited (KREDL) Bangalore, Karnataka Power Corporation Limited (KPCL) Bangalore, Shakti Bhavan Bangalore, Bhoruka Power Corporation Bangalore, Global Energy Services Bangalore and CDM project's PDD developers, through the frequent visits.

Most of the select CDM projects are small in size and belong to renewable energy industry sector, particularly wind energy. Field surveys of the select CDM projects where they are situated have been made to compare the sustainable claims of CDM projects and the actual delivery of sustainable developments.

4. Limitations of the Study

- Analysis of PDDs of only 90 registered CDM projects in Karnataka is made and hence it cannot be generalized to all CDM projects.
- Most of the PDDs have same content about sustainable development as they might have been prepared by the same project developer.
- Every PDD highlights the positive contributions to Sustainable Development as the project developer is unlikely to write the negative about his project.
- PDDs explain only the potential benefits but not actual delivery of sustainable claims
- Complete reliance on respondents reply during field survey may not be possible

5. International Response to Climate Change

The following conferences/events/assessments were held to address the climate change:

1979 — The first World Climate Conference (WCC) takes place.

1988 — The Intergovernmental Panel on Climate Change is set up.

1990 — IPCC's first assessment report released. IPCC and second World Climate Conference call for a global treaty on climate change. United Nations General Assembly negotiations on a framework convention begin.

1991 — First meeting of the Intergovernmental Negotiating Committee (INC) takes place.

1992 — The INC adopts UNFCCC text. At the Earth Summit in Rio, the UNFCCC is opened for signature along with its sister Rio Conventions, UNCBD and UNCCD.

1994 — UNFCCC enters into force. An introduction to the United Nations Framework

Convention on Climate Change.

1995 — The first Conference of the Parties (COP 1) takes place in Berlin.

1996 — The UNFCCC Secretariat is set up to support action under the Convention

1997 — Kyoto Protocol formally adopted in December at COP3.

2001 — Release of IPCC's Third Assessment Report.

2005 — Entry into force of the Kyoto Protocol..

2007 — IPCC's Fourth Assessment Report released.

2009 — Copenhagen Accord drafted at COP15 in Copenhagen.

2010 — Cancun Agreements drafted and largely accepted by the COP, at COP16.

2011 — The Durban Platform for Enhanced Action drafted and accepted by the COP, at COP17.

2012 - The Doha Amendment to the Kyoto Protocol is adopted by the CMP at CMP8.

2013 - Key decisions adopted at COP19/CMP9 include decisions on further advancing the Durban Platform, the Green Climate Fund and Long-Term Finance, the Warsaw Framework for REDD Plus and the Warsaw International Mechanism for Loss and Damage.

2013 - IPCC's Fifth Assessment Report:

2014 - New York Summit

2015 - As the first commitment period (2008-2012) of the Kyoto Protocol is completed, to develop a new mechanism of carbon emission reduction, Climate Change negotiations took place at Geneva on February 8-14, 2015. A rough blue print of negotiating text was drafted for the global Paris Climate Summit, to be held in December 2015. The agreement is set to be reached in Paris at the end of 2015 and will come into effect in 2020.

5.1 What is UNFCCC?

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty that was formulated at the United Nations Conference on Environment and Development (UNCED) (informally known as the Earth Summit) in Rio de Janeiro, June, 1992.

The UNFCCC aims at stabilizing atmospheric concentration of greenhouse gases at a safe level that would prevent dangerous anthropogenic interference with climate system. To achieve the objective of stabilizing greenhouse gas concentration in the atmosphere at a safe level, all countries have a general commitment to address climate change, adapt to its effects and report their actions to implement the convention. It came into force on 21 March 1994, and has been ratified by 196 countries.

The UNFCCC divides countries into two groups: Annex I parties and Non-Annex I parties

Annex I parties are the industrialized countries who have historically contributed the most to climate change, and non- Annex I Parties, which include primarily the developing countries, like India. The principles of equity and "common but differentiated responsibilities" contained in the Convention required Annex I parties to take the lead in returning their greenhouse gas emissions to 1990 level by the year 2000.Another element stated by the UNFCCC is the polluter pays principle. This means that the party responsible for producing pollution is responsible for paying for the damage done to the natural environment.

The UNFCCC established the Conference of Parties (COP) as its supreme body with the responsibility to achieve the objective of the Convention. At the third COP held in December 1997 in Kyoto, Japan, an important milestone in the international climate change negotiations was achieved in the form of Kyoto Protocol.

5.2 What is Kyoto Protocol?

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005.

The major feature of the Kyoto Protocol is that it sets binding target for 37 industrialized countries and the European community (Annex I Countries) for reducing Greenhouse Gas emissions to an average 5.2 percent against 1990 levels over the five – year period 2008-2012.

Almost all industrialized nations and some countries with developing economies like China, Brazil and others, have ratified the Kyoto Protocol to reduce pollution levels.

The Kyoto Mechanisms: Under the Kyoto Protocol agreement, the Annex I countries must meet their targets primarily through national measures. However, the Kyoto Protocol offers them an additional three means of meeting their targets by acquiring the greenhouse gas reduction credits. They are:

- International Emission Trading – known as the "Carbon Market",
- Clean Development Mechanism (CDM) and
- Joint Implementation (JI).

Clean Development Mechanism (CDM)

The clean development mechanism (CDM) is a market-based mechanism under the Kyoto Protocol whereby projects in developing countries can earn saleable credits equivalent to the amount of CO2 they reduce or avoid.

Clean Development Mechanism (CDM), defined in Article 12 of the Kyoto Protocol, allows a country with an emission – reduction commitment under the Kyoto Protocol (Annex I Country) to implement an emission-reduction project in developing countries and in return

gain the emission reduction credits (CERs) to meet its Kyoto targets, e.g. a rural electrification project using solar panels or the installation of more energy-efficient boilers.

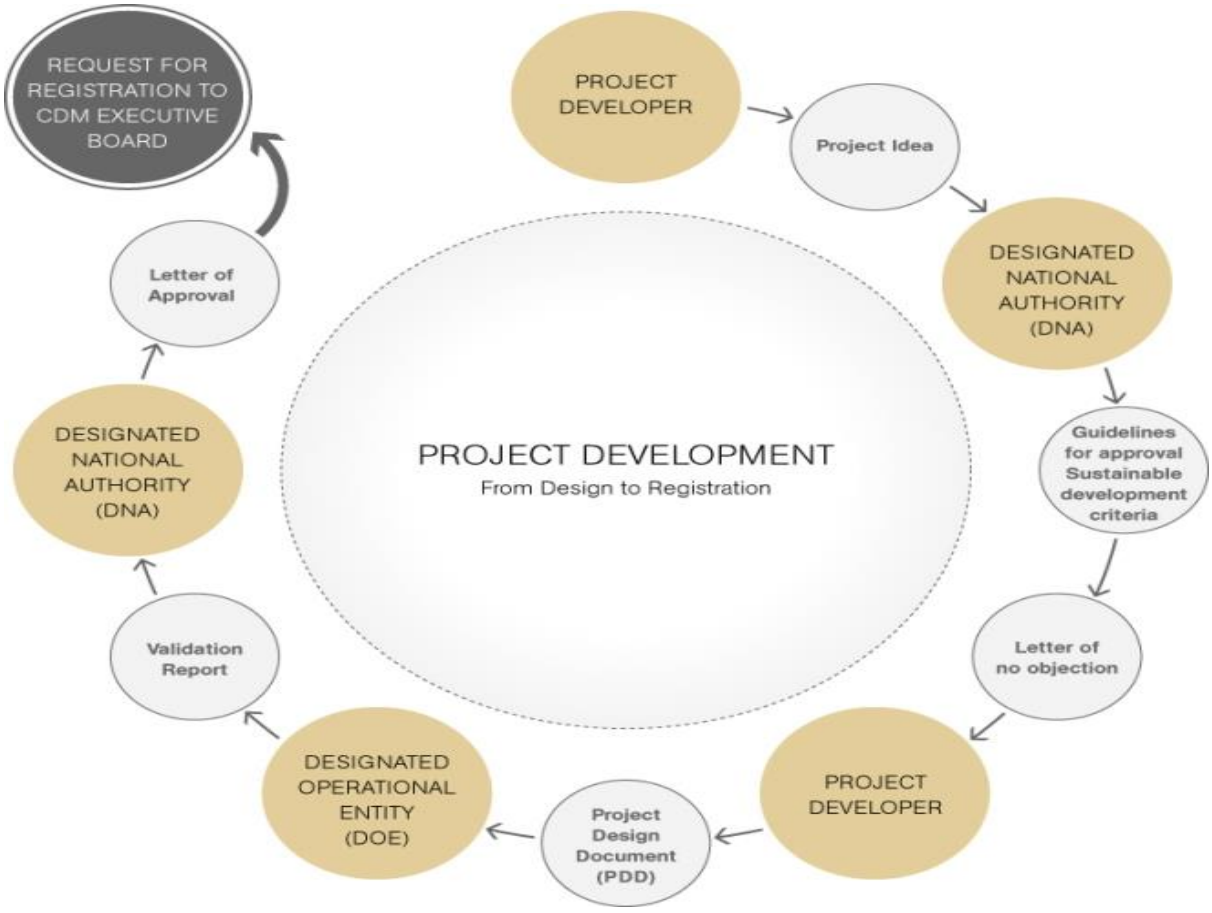
CDM is one of the flexibility mechanisms of Kyoto Protocol. This mechanism aims at helping industrialized countries to reach their emission reduction commitments in a cost-efficient manner by purchasing CERs from CDM sponsors in developing countries. China, India and Brazil are the main hosts of over 60 per cent CDM projects in the globe.

5.3 What are CERs?

CERs are tradable, saleable certified emission reduction (CER) credits, each equivalent to one ton of CO2, earned by CDM projects. These credits can be used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol or, they can be cancelled for use in the voluntary market.

One Carbon Credit (CER) is equivalent to one ton reduction of carbon dioxide or its corresponding greenhouse gas (GHG). For example, a hydroelectric power plant avoids the emission of 30,000 tons of carbon dioxide equivalent per year, since it avoids burning coal in a coal-powered plant to produce the same quantity of electricity. The project sponsor is assigned 30,000 carbon credits each accounting for one ton of avoided carbon dioxide equivalent. The project sponsor can sell these carbon credits to help finance his project.

Graph Showing the CDM Project's Validation, Registration and Cers Issuance Process



5.4 Overview of CDM projects in the Global context

In total, 7,814 CDM project activities were registered in around 108 countries and 1.527 billion CERs (i.e., 1.527 billion tons of carbon emission reduction) have been issued from 2574 CDM projects, by the end of January 2015. By the end of 2020, around 3.8 billion tons of carbon emission reduction may take place.

Table 2: Distribution of Registered Projects and Cers Issuance by Host Party from 2008 To 2015

Year	Registered projects by host party	CERs in tons
2008	1284	235,887,967
2009	1899	350,000,000
2010	2453	448,858,231
2011	3542	754,750,101
2012	4884	1,024,292,336
2013	7366	1,400,387,921
2014	7772	1,505,359,771
2015	7862	1,545,952,932

Source: http://cdm.unfcc.int. December 2008, November 2009, October-2010, 2011, 2012, 2013 2014& 2015. (Compiled by the author)

There were 1284 registered CDM projects in 2008 and 7862 in 2015, the increase in number of CDMs is by 6578 projects, i.e., almost 5 times increase. This growth in the number of CDM projects is mainly because of contribution by China and India around 60 per cent of the total CDM projects in the globe.

CERs in 2008 were 235,887,967 and in 2015 were 1,545,952,932, the net increase was 1,310,064,965, almost 5.55 times increase in CERs during 7 years period, and China is main contributor, around 59 per cent.

Table 3: **Registered Project Activities by Host Party (in percentages)**

Year/Country	2008	2009	2010	2011	2012	2013	2014
China	26.48	35.02	40.73	45.99	50.96	50.59	49.67
India	29.44	24.64	22.18	20.84	19.13	19.6	20.23
Brazil	11.37	8.69	7.30	5.56	4.45	4.26	4.36
Others	32.71	31.65	29.79	27.61	25.46	25.55	25.74
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: http://cdm.unfcc.int. December 2008, November 2009, October-2010, 2011, 2012, 2013 &2014. (Compiled by the author)

China, India and Brazil are the three main developing countries, having more number of registered CDM projects. Chine leads with 50 per cent, followed by India 20 per cent and Brazil & others 50 per cent.

Table 4: **CERs Issued by Host Party (in percentages)**

Year/Country	2008	2009	2010	2011	2012	2013	2014
China	40.80	47.53	51.14	58.12	60.02	61.22	59.83
India	22.97	20.39	17.71	15.79	14.61	13.38	13.21
Brazil	12.03	10.19	9.61	7.69	7.24	6.42	6.49
Others	24.20	21.89	21.54	18.40	18.13	18.98	20.47
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: http://cdm.unfcc.int. December 2008, November 2009, October-2010, 2011, 2012, 2013 & 2014. (Compiled by the author)

As of 2014, CERs issued by host party were 1.5 billion (i.e., 1.5 billion tons of carbon emission reduction). China leads with around 60 per cent, followed by India 13 per cent and Brazil & others 27 per cent.

Table 5:Distribution of Registered Project Activities by Scope (in percentages)

Areas	2008	2009	2010	2011	2013	2014
Energy industries	58.00	60.35	63.37	67.37	74.53	73.06
Waste handling and disposal	18.94	17.61	17.49	14.10	10.92	12.24
Agriculture	5.61	5.29	4.36	3.55	2.44	2.96
Manufacturing industries	5.12	4.65	4.87	4.99	4.25	4.03
Fugitive emissions from fuels	7.40	5.68	4.87	4.07	2.59	2.64
Others	4.93	6.42	5.04	5.92	5.27	5.07
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: http://cdm.unfcc.int. December 2008, November 2009, October-2010, 2011, 2012, 2013 & 2014. (Compiled by the author)

Among the distribution of registered projects by scope, the share energy industries (renewable and non-renewable sources) is highest, more than 70%, followed by waste handling and disposal projects with 12 per cent share, and share of agriculture, manufacturing industries, fugitive emissions from fuels & others is very meager.

Table 6: Distribution of Registered Project Activities by Region

Region	2008	2009	2010	2011	2012	2013	2014
Asia & Pacific		74.04	77.95	81.87	84.38	84.25	84.02
Latin America & Caribbean		23.49	19.57	15.70	13.17	12.72	12.84
Africa		1.90	1.96	2.03	2.05	2.40	2.51
Other		0.58	0.53	0.40	0.41	0.62	0.63

Source: http://cdm.unfcc.int. December 2008, November 2009, October-2010, 2011, 2012, 2013 & 2014. (Compiled by the author)

Asia & Pacific Region has highest share with 84 per cent of registered project activities, and Africa has least share of 2.51in the registered project activities as of 2014.

5.5 Over view of CDM projects in Indian context

India is a Party to the United Nations Framework Convention on Climate Change (UNFCCC). In December 1997, India became a signatory to the Kyoto Protocol and ratified the same in August 2002, to fulfill the prerequisites for implementation of Clean Development Mechanism projects in India.

The Government of India constituted the **National Clean Development Mechanism Authority** in 2003, for the purpose of protecting and improving the quality of environment in terms of Kyoto Protocol. The National Authority evaluates and approves CDM projects as per the guidelines of Designated Operational Entity authorized by CDM Executive Board of UNFCCC. Trading in carbon credits takes place in five stock exchanges –

- The Chicago Climate Exchange (CCX)
- The European Climate Exchange (ECX)
- Nord Pool
- Power Next
- European Energy Exchange

Multi Commodity Exchange of India Ltd. the country's leading commodity exchange, entered into a strategic alliance with Chicago Climate Exchange in September 2005 to initiate carbon trading in India. The tie-up would provide immense scope and opportunity for domestic suppliers to realize better prices for their carbon credits.

Table 7: India's Share in Registered CDM Projects

Year	Total CDM projects	CDM projects of India	Percentage to Total
2008	1284	378	29.44
2009	1899	468	24.64
2010	2453	544	22.18
2011	3542	738	20.84
2012	4810	920	19.13
2013	7366	1444	19.60
2014	7772	1027	13.21

Source: http://cdm.unfcc.int. December 2008, November 2009, October-2010, 2011 & 2012 (Compiled by the author)

An analysis of the projects from 2008 to 2014 shows that 7772 projects in the globe have been registered by CDM EB of UNFCCC. India has witnessed a steady rise in the numbe of CDM projects over that period, i.e., from 378 registered projects in 2008 to 1572 in 2014, with 20 per cent share in the global CDM projects.

Table 8: India's Share in Cers Issuance by Host Party

Year	Total CERs	CERs of India	Percentage to Total
2008	235,887,967	54,182,398	22.97
2009	350,000,000	71,365,000	20.39
2010	448,858,231	79,492,792	17.71
2011	754,750,101	119,175,041	15.79
2012	1,024,292,336	149,641,369	14.61
2013	1,400,387,921	182,245,421	13.38
2014	1,505,359,771	195,893,801	13.21

Source: http://cdm.unfcc.int. December 2008, November 2009, October-2010, 2011 & 2012(Compiled by the author)

An analysis of the CERs issuance by India from 2008 to 2014 shows that there is a rise in the CERs from 54,182,398 to 198,858,026, around 4 times increase in CER issuance. While CER issuance in the globe has seen around 6 times increase i.e., from 235,887,967 in 2008 to 1,505,359,771 in 2014. Contribution of China with large scale CDM projects, towards total CERs issue is around 60 per cent and that of India's is only 13 per cent because of the small scale CDM projects in India.

Table 9: Distribution of Indian Registered Project Activities by Scope

Name of Sector	**No. of Projects**	**CERsupto 2012**
Afforestation and Reforestation	27	10,860,666
Agriculture	3	74,393

Chemical Industries	18	11,793,853
Energy Demand	224	27,109,485
Energy Distribution	9	657,149
Energy industries(Renewable/Non-renewable sources)	2293	487,457,143
Fugitive emissions from fuel(Solid, Oil and gas)	4	165,438
Fugitive emissions from production & consumption of halocarbons and Sulphur	6	82,095,771
Manufacturing Industries	243	64,405,361
Metal Production	5	5,425,126
Mining/Mineral Production	4	19,053,935
Solvent use	1	103,579
Transport	13	1,238,906
Waste handling and disposal	70	12,498,337
Total (No. of Projects)	**2920**	**722,939,143**

Source: www.cdmindia.gov.in

Analysis of the Sector-wise distribution of NCDMA approved CDM projects (2012) shows that Energy Industries (Renewable and Non-Renewable Sources) have the highest number of CDM projects-2293, with highest number of CER issuance-487,457,143. Around 79 per cent of the NCDM approved CDM projects belongs to Energy Industries.

CDM projects of Fugitive emissions from production and consumption of halocarbons and Sulphur are only 6 in number but generates second highest number of CERs-82,095,771.

There are only 691 large scale projects with 467,179,033 CERs up to 2012. The small scale projects are 2229 with 255,741,071 CERs up to 2012.

Table 10: Registered CDM Projects in Different States of India

Name of State	No. of Projects	CERs up to 2012
Multi State	99	1,380,897
Andhra Pradesh	217	86,823,972
Arunachal Pradesh	1	156,393
Assam	15	852,579
Bhutan	1	529,914
Bihar	9	750,896
Chandigarh	1	0
Chattisgarh	105	27,368,203
Delhi	17	3,823,996
Goa	4	1,186,500
Gujarat	369	127,021,481
Haryana	37	4,512,243
Himachal Pradesh	100	17,273,314
J&K	4	9,686,384
Jammu & Kashmir	2	128,326
Jharkhand	32	24,046,731
Karnataka	255	69,702,116
Kerala	19	642,032

Madhya Pradesh	71	8,787,799
Maharashtra	384	61,620,089
Meghalaya	4	1,598,429
Multi State	97	25,330,436
Orissa	81	22,794,520
Pondicherry	1	139,332
Puducherry	2	14,674
Punjab	74	12,157,425
Rajasthan	236	63,178,620
Sikkim	10	9,973,169
Tamil Nadu	371	51,950,734
Tripura	1	4,427,526
Utarranchal	36	19,454,380
Uttar Pradesh	172	37,799,292
Uttarakhand	14	1,030,493
West Bengal	80	26,799,892
Total	**2921**	**722,942,789**

Source: www.cdmindia.gov.in

An analysis the State-wise distribution of NCDMA approved CDM projects, shows that Maharashtra (384), Gujarat (369) and Tamil Nadu (371) are the States with more 300 projects. Karnataka (255) stands fourth among these States. This is because of the special provisions and incentives for the CDM projects in these states.

CDMs in Karnataka

Table 11: Sector-Wise Distribution of CDM Projects in Karnataka -Total 255

Sl. No.	Sector-wise distribution	Small	Large	Total
1.	Mini hydel projects	19	09	28
2.	Bio mass projects	18	01	19
3.	Waste heat recovery	13	09	22
4.	Bagasse cogeneration	08	09	17
5.	Hydro power projects	13	05	18
6.	Wind power projects	70	31	101
7.	Methene/Bio-gas/Bio fuel	15	-	15
8.	Efficiency improvement	15	02	17
9.	Solar	08	-	08
10.	Others	08	02	10
	Total	187	68	255

Source: www.cdmindia.gov.in 2012 compiled by the author.

Analysis of CDM projects in Karnataka shows that there 187 small and 68 large CDM projects in Karnataka during 2012, which are approved by NCDMA (National Clean Development Mechanism Authority of India). There are in total 255 NCDMA approved projects in Karnataka and out of which 95 projects are registered by CDM EB of UNFCCC during 2012. Wind power projects lead the list of sector wise distribution of projects both in of small as well as large scale projects.

95 registered CDM projects are selected from Karnataka state for assessing their sustainable claims.

6. Sustainable Development Claims

6.1 Definition of Sustainable Development

There is still no universally accepted definition of sustainable development or agreed basis for determining whether a specific action, such as a proposed CDM project, would contribute to sustainable development.

Owing to the absence of an accepted international definition of sustainable development, the responsibility for determining whether a CDM project contributes to sustainable development as defined by the host country currently resides with its designated national authority (DNA).

Therefore the DNA of the host country states in its letter of approval of the CDM project that, the proposed CDM project will contribute to the country's sustainable development. A Designated Operational Entity (DOE) must ensure confirmation by the DNA of the host country that the project activity assists in achieving sustainable development in the host country.

6.2 Illustrative List of Sustainable Development Activities

6.2.1 Social Well-Being

1. Health- Organizing medical camps to promote awareness, free consultations and distribution of free medicine, Mobile Dispensary for the surrounding villages, renovation of existing hospital/dispensaries, etc.

2. Education- Supporting schools/anganwadis, providing notebooks, school uniforms and scholarships, Computer literacy program, improving school infrastructure (buildings, flooring, toilets, boundary walls) and provision of equipment's like computers.

3. Women empowerment- Training through SHGs on tailoring, soap and detergent making and other income generation activities like making plates from leaves, etc.

4. Community/women empowerment - Formation of SHGs, engaging panchayats (village governing council), awareness programs on women's rights and her entitlements (e.g. property, land, etc.) promotion of sports etc.

6.2.2 Environmental Well-Being

1. Land reclamation and plantation of trees.

2. Fly ash generated as waste product being used to produce fl y ash bricks.

3. Rain water harvesting and recycling and reuse of wastewater.

4. Development of check dams and water recharging structures for effective utilization of groundwater resources.

5. Conservation of top soil

6.2.3 Economic Well-Being

1. Training to local communities on agriculture practices, animal husbandry, etc.

2. Training to women through self-help groups on soap and detergent preparation, tailoring classes and other income generation activities

3. Relief activities during floods and landslides.

4. Micro credit and asset building through small interventions relating to facilitation of NREGA for employment and as investment into Natural Resources Management.

5. Community infrastructure- Building infrastructure like bore well, check dams, roads, sanitation, public toilets, etc.

6. Livelihoods- Engaging the local communities for plantation in the plant's vicinity, imparting vocational training (driving, computers, etc.)

(Source: CDM Pipeline analysis)

7. Findings

7.1 CDM Projects in Globe

- CDM is a truly global mechanism.
- It helps to generate and support green growth programs globally.
- CDM a flexible market mechanism contributed to the development of a global carbon market, allowing developed countries to achieve their emission reduction target.
- CDM has removed 4 tons of CO2 per second since 2004
- CDM holds 36 per cent share in Kyoto Protocol Mechanisms
- CDM projects are 3-4 times larger in terms of power generation capacity (except solar thermal projects)
- CDM projects are 15% (solar photovoltaic) to 50% (geothermal and solar thermal power) less capital intensive.
- CDM projects lead to more efficient use of capital invested.
- CDM facilitates the transfer of technology and knowledge to developing countries.
- CDM has effectively designed a set of indicators for reporting on sustainable development in host countries. Sustainable development of host country is one of the important objectives of CDM.
- As per literature review, it was agreed by many experts that CDM has a positive impact on the various facets of sustainable development in host countries.
- Literature review state that the CDM is the only climate change mechanism that offers an innovative solution to the challenge of how to incorporate sustainable development considerations into emission mitigation activities.
- CDM has seen an impressive growth from 2006 to 2012 followed by a sharp decline. The main causes of this decline are not due to the mechanism itself, but due to the restrictions by some buyers on the quantity, type and origin of CERs, economic recession and the level of ambition of Parties to the Convention that are also Parties to the Kyoto Protocol

with commitments inscribed in Annex B to the Kyoto Protocol in addressing climate change.

- The reluctance of industrialized countries to accept binding emission targets will dry up demand for carbon credits and reduce their prices further
- Low demand for carbon credits in the wake of economic slowdown has led to a slump in carbon prices. At the same, there is an excess of supply with businesses in countries like India holding on to a large number of carbon credits.
- Due to crisis in CER prices more than 50 per cent of project developers in China and India plan to decrease investments in CDM projects. It may result in slow down of CER issuance post 2015.
- There are uncertainties to find out markets for the projects registered post 2012.
- By the end of 2020, approximately 70 per cent of projects will have reached the end of their crediting periods and around half of these will be eligible to renew their crediting periods.
- India and China, the two countries that have benefited most from the CDM, now facing pressure from EU, which has decided not to entertain CDM projects registered by these countries after January 1, 2013 for carbon credits.
- The EU has said it only consider projects registered by the least developed countries.
- In total, 7,814 CDM project activities were registered in around 108 countries, by Jan 2015. 1.527 billion CERs (i.e., 1.527 billion tons of carbon emission reduction) have been issued from 2574 CDM projects, by the end of January 2015. There were only 235,887,967 CERs issued in 2008
- As of March 2015, there 7826 CDM project activities, out of which 7622 were registered CDM projects. 2582 CDM projects have issued 1,545,952,932 CERs, that means around 1.54 billion tons of carbon emission was reduced. 33 per cent of the registered CDM projects have CERs issuance to their credit.
- Potential issue of CERs by 2020 will be 3.965 billion.
- There were 1284 registered CDM projects in 2008 and 7862 in 2015, the increase in number of CDMs is by 6578 projects, i.e., almost 5 times increase in number of projects. This growth in the number of CDM projects is mainly because of contribution by China and India around 60 per cent of the total CDM projects in the globe.
- CERs in 2008 were 235,887,967 and in 2015 were 1,545,952,932, the net increase was 1,310,064,965, almost 5.55 times increase in CERs during 7 years period, and China is main contributor, around 59 per cent.
- China, India and Brazil are the three main developing countries, having more number of registered CDM projects. Chine leads with 50 per cent, followed by India 20 per cent and

Brazil & others 50 per cent. Around 70 per cent of the CDM projects are located in India and China alone.

- Around 74 per cent of the CERs are issued to CDM projects in China and India.
- Among the distribution of registered projects by scope, the share of energy industries (renewable and non-renewable sources) is highest, more than 70%, followed by waste handling and disposal projects with 12 per cent share, and share of agriculture, manufacturing industries, fugitive emissions from fuels & others is very meagre.
- Asia & Pacific Region has highest share with 84 per cent of registered project activities, and Africa has least share of 2.51in the registered project activities as of 2014.

7.2 Indian CDM Projects

- India played a key role in facilitating the development of CDM projects through a proactive National CDM Authority (NCDMA).
- Various donor agencies were instrumental in promoting CDM in India through carbon fund purchase programs, capacity building and training.
- The presence of major CDM auditors, (Designated Operational Entity (DOEs) accredited by UNFCC) in India also facilitated early development of CDM projects.
- In respect of total number of CDM projects in India, Maharashtra leads with 384, Gujrat with 369 and Karnataka with 255 projects, the top three states with more number of CDM projects.
- The base of India's climate policy framework is its 2008 National Action Plan on Climate Change (NAPCC)
- NAPCC specifies eight national missions for 2017 that center on improving: energy efficiency, solar technology, sustainable habitats, water, Himalayan ecosystems, "green India", agriculture, and strategic knowledge.
- Indian CDM pipeline has 2355 projects as of June 2012 approved by NCDMA. Renewable energy has the highest number of projects (980), energy efficiency (655) and renewable biomass (473), fuel switch (106), industrial process (84), municipal solid waste (42) and forestry (15).
- Under Renewable Energy category (980), more number of projects (668) are from wind sector, followed by Hydro power projects (221).
- As of June 2012, there were a total of 844 CDM projects registered with the CDM EB of UNFCCC. The highest number of registered projects are from renewable energy (379) and renewable biomass categories (209), closely followed by energy efficiency category (182).
- 1604 Indian companies (representing 55 sectors) account for 2355 projects in the Indian CDM project portfolio (as of June 2012)

- Out of the total 1604 companies, 83 are public sector entities which account for 210 projects (9% of total projects). The expected CERs from these 210 projects are 98.32 million upto 2012.

7.3 CDM Projects in Karnataka

- Karnataka is one among the top three States with large number of CDM projects. NCDMA approved projects are 255 and among these registered projects are 80 in Karnataka.
- Approved 28 Mini Hydel and 18 Hydro Power projects, both together accounts for 18.04 per cent of the total. This indicates that among the approved projects, mini hydel and hydro power projects stand next to wind power projects.
- Registered Mini Hydel and Hydro Power projects are 14 in number and both together accounts for 35 per cent of the total. This indicates that hydel and hydro power projects are highest in number in Karnataka among other CDM project activities.
- The registered wind power projects are 27 in number with 33.75 per cent share to the total.
- Approved 71 small scale and 30 large scale wind power projects. Wind power projects are highest in number among all and accounts for 39.61 per cent of the total.
- Registered Bagasse projects are 10, Waste Heat Recovery projects are 7 and Biomass projects are 7, in number and sharing 12.5 per cent and 8.75 per cent respectively.
- Approved Bagasse projects are 17 (06.67%), Waste Heat Recovery projects are 22 (8.63%) and Biomass projects are 34 (13.33) in the CDM pipeline. They all together accounts for 28.63 per cent of the total.
- Approved Cement & Efficiency improvement projects are 17 and accounts for 6.67 per cent of total.
- Approved Solar and all other projects are 8 and10 respectively and accounts for 7.06 per cent of total.
- Approved Small scale projects are 187 and accounts for 73.33 per cent of total and Large scale projects are 68 and accounts for 26.67 per cent of total.
- Wind, hydel, hydro and Generation of electricity through combustion of waste gases from blast furnace and corex units have contributed highest number of CERs to the total CERs issued as of 2012.
- Carbon Credits issuance by all the 255 approved project activities was 69,702,116 (CERs) as of 2012, that means 69702116 tons of carbon emission reduction has taken place because of these CDM projects.
- Bundled Wind Power Project in Chitradurga by Enercon (India) Ltd., Kabini Hydro Electric Power Project, SKPCL, India, Kemphole Mini Hydel Scheme (KMHS), by

International Power Corporation Ltd. India, Chunchi Doddi Grid-connected SHP are the main CDM projects in Karnataka

- Bhoruka Power Corporation, Enrcon, KPCL, DLF, VRL Logistics, Bharat Petroleum Corporation, Jindal Steel Works, Tata, Shree Renuka Sugars, International Power Corporation Limited, India, SKPCL India, etc., are the main CDM developers in Karnataka.
- As there is no internationally accepted definition of Sustainable Development, DNAs of the host country state the concept of sustainable development to include at least three well-beings: the social, the economic and the environmental.
- 99 per cent of the PDDs state the potential benefits of CDM projects towards sustainable development of host country.
- 90 per cent of PDDs mentioned economic benefits, 80% mentioned social benefits and 70% mentioned environmental benefits, and around 10 percent mentioned about technological benefits.
- As per Field survey of the actual delivery of the SD benefits, 10 per cent of the projects differ from the sustainable claims that were given in their PDDs
- Employment generation was one of the most widely reported impacts in PDDs but as per field survey, most of the local people viewed that only during construction of projects there were better employment opportunities.
- 90 per cent of the small scale CDM projects performed well towards sustainable development of the locality where they are situated.
- 90 per cent of CDM Projects in Karnataka are unilateral.
- Most of the power generating project developers have a worry about tariff policy of Karnataka Power Transmission Corporation Limited and tax policy of central government regarding tax liability on CER revenue.
- Project developers viewed that CER revenue should be exempted from payment of tax and this measure will encourage many to develop CDM projects and thereby protect environment from pollution
- All of the CDM project developers worried about CER price crisis and not ready to sell their CERs.
- All project developers viewed that the cost of validation is more and time consuming.
- All projects generating green power in Karnataka are connected to southern grid for transmission of power
- All project developers have positive faith in the second phase of Kyoto Protocol to be implemented from 2020, based on climate meet in December 2015.

8. Suggestions

- As EU has restricted the CDM projects from developing countries post 31 December 2012, it hampers the growth of CDM projects in developing countries, hence CDM Executive Board should insist on removal of EU's restriction.
- The average time period required for registering a large scale project is approximately 2 years. The reasons for delays in registration of CDM projects are :
  - Lack of acceptable guidelines for setting benchmark on additionality, sustainable development, etc.
  - Lack of institutional capacity both at national and state levels.
  - Frequent revisions to CDM EB guidelines for CDM implementation and
  - Lengthy validation process by DOEs. Hence these guidelines need to be modified and reframed to speed up the registration process of CDM project activities.
- The increase in number of DOEs is not in proportion to the increase in CDM project activities in India, hence it is needed to increase the number of DOEs to reduce the time required for validation process.
- There should be streamlining of the guidelines to reduce the time and cost involved in the implementation of the CDM project activities.
- All renewable energy projects should be auto registered irrespective of region or additionallity guidelines as these projects are globally accepted for mitigating GHGs.
- The Government should provide a Floor Price of CERs to the Project developer, which will be helping quantifying the revenues from Carbon Credit while making the investment decisions.
- Clarity is needed on 2nd commitment period of Kyoto Protocol.
- Requires more transparency on CDM validation, registration, monitoring and CER issuance processes.
- Stakeholder consultation should be enhanced to receive timely and meaningful input to the proposed CDM project.
- Enhancing understanding of the CDM, its need to reduce emission levels and its potential benefits for sustainable development of host country.
- CDM mechanism should be extended to new sectors and under-represented regions, to enhance its implementation there by further reduction in carbon emission.
- PoAs within a region and among regions should be enhanced to have cost reduction and effective implementation of the activities
- More number of companies should buy CERs to contribute to climate change action and display their corporate social responsibility.

9. Conclusion

India, by ratifying the Kyoto Protocol, supported its participation in the international carbon market. The growing enthusiasm from all sectors, to curb pollution levels and to avail sustainable development benefits of CDM activities, has made India a viable destination for foreign investments and latest clean technology transfers.

The present study has found that there are many Sustainable Development benefits of CDM projects in the form of employment generation, generation of green energy, mitigation of carbon emission thereby protecting health of the people, development of rural areas through setting up of CDM projects, and helping the developed countries to achieve their carbon emission reduction targets.

Despite considerable progress in Clean Development Mechanism of Kyoto Protocol as an efficient and effective tool to address climate change, the mechanism faces serious challenges like decline in demand for CERs, crisis in CER prices, reduced number of parities participating in the Kyoto Protocol post 2012, reluctance of developed countries to buy CERs, EUETS ban on projects from developing countries, etc.

To address these challenges, Parties are working to develop a new means on strength of the CDM, to collaborate on emission reduction efforts, like new market mechanism, bilateral efforts etc.

It is proved that the CDM can incentivize emission reductions at scale and contribute significantly to enhanced sustainable development and technology transfer to the host countries.CDM Executive Board has viewed that CDM mechanism is not only fit for the present, but also an invaluable tool fit for the future.

Through various effective guidelines, the Board is attempting to ensure that best use of the CDM is made by all, that emission reductions continue to happen through it and that the mechanism is sustained in the long term.

References

A study by Gujarat Forum on CDM, India, "Glimpses from Ground: Analysis of selected CDM Projects in India", January 11, 2013.

Abigail Jones Nigel Purvis Cecilia Springer, "TRADING UP THE CASE FOR AN INTERNATIONAL CARBON MARKET RESERVE TO REDUCE VOLATILITY AT THE LIMITS IN 2020 AND BEYOND", *Global Economy and Development* working paper 63, Dec 2013.

Andrew Steer, "King coal's climate challenge", LIVEMINT, November 23, 2013.

Dr. Bhawana Bhardwaj, "Future of carbon trading: A business that works for global environment", *International Journal of Science, Environment and Technology*, Vol. 2, No.1, 2013, pg. 115-121.

Fiona Harvey, "The Kyoto Protocol is not quite dead", Environment, guardian.co.uk, November 26, 2013.

Hari Pulikkat, "Climate Change and India, who's looking at the climate?", *The Economic Times*, October 8, 2013.

Ian Partridge and Shama Gamkhar (2009), "The role of the clean development mechanism in a post Kyoto climate agreement: Effective participation by China and India", Paper presented at workshop, Washington DC, June 18-20, 2009

iGES – Institute for Global Environmental Strategies, "Market Mechanisms country fact sheet: India", 2012.

IPCC Fact Sheet: What is the IPCC? www.ipcc.ch/pdf/tor/TOR_Bureau.pdf

Karnataka Renewable Energy Development Limited, Bangalore, "Clean Development Mechanism", www.kredl.com

Melanie Fitzpatrick, "The Global Carbon Budget and why the Warsaw Climate Talks matter", The Equation, November 14, 2013.

Mukul Sanwal, "We should now prepare a Carbon Budget", *The Economic Times*, October 4, 2013.

Nithin Sethi, "Cabinet clears climate negotiations strategy", The Hindu, November 8, 2013.

Paula Castro, Axel Michaelowa, "Empirical Analysis of performance of CDM projects", Climate Strategies Report, 2007.

Paula Castro, Gudrun Benecke, "Empirical analysis of performance of CDM projects: case study India", Discussion paper CDM – 7, Climate Strategies, February 2008.

Peter Sopher (EDF Co-author) & Anthony Mansell (IETA co-author), "The World's Carbon Markets: A case study Guide to Emissions Trading (India), Environmental Defense Fund (EDF) and International Emission Trading Association (IETA), 2011.

Punam Singh, "Measurement of Sustainable Development in CDM projects in India", Dept of Humanities and Social Sciences, IIT Bombay, October 2010

Roz Pidcock, "Carbon briefing: Making sense of the IPCC's new carbon budget", Carbon Brief, October 23, 2013.

S. Gopalkrishna Warrier, "Global warming is here to stay," The Hindu Business Line, October 5, 2013.

Shailendra Sharma, "Carbon Credits – A growing opportunity with boon to environment", EPC&I, Anniversary Issue August 2012.

Steven Lee Myers & Nicholas Kulish, "Growing glamour about inequities of climate crisis" LIVEMINT, November 18, 2013.

Sunitha Narain, "Climate science in the real world," Business Standard, October 28, 2013.

TERI, The Energy and Resources Institute of India, "Assessing the impact of Clean Development Mechanism Project on sustainable development and technology transfer", prepared for UNFCCC, 2012.

The FICCI Survey (2011), "Impacts, Governance and Future of CDM – Indian Industry Perspective", India Vision, Oct 25, 2012.

UNFCCC Press Release on "Climate Change Conference in Warsaw keeps governments on a track towards 2015 climate agreement, www.unfccc.int

Urmi A Goswami, "Warsaw climate meet to focus on emissions," ET Bureau, November 11, 2013.

Urmi A Goswami, "Funding for tackling climate change to top UN agenda at Warsaw," ET Bureau, November 6, 2013.

UNEP, "The emission gap report 2013, a UNRP synthesis report", ISBN – 978-92-807-3353-2

UNFCCC-CDM Executive Board's Reports from 2008 to 2015.

Vishwa Mohan, "Climate Change may lead India to War: UN report", April 2014.