An Assessment of Clean Development Mechanism Projects in the Energy Sector in India

Thesis
Submitted to the University of Calicut
In Partial Fulfilment of the Requirements for the
Award of the Degree of
Doctor of Philosophy in Commerce

By

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Under the Guidance of

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Declaration

I, T. Shemeera Kunhu, hereby declare that the thesis entitled "**An Assessment of Clean Development Mechanism Projects in the Energy Sector in India**" submitted to the University of Calicut in partial fulfilment of the requirements for the award of the Degree of Doctor of Philosophy in Commerce is a record of the bonafide research work done by me, under the supervision and guidance of Dr. B. Johnson, Professor & Dean (Rtd), Director, School of Business Studies, University of Calicut, and it has not formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title to any candidate in any University before.

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This is to certify that no corrections/changes/modifications are suggested by any of the adjudicators of the thesis entitled "**An Assessment of Clean Development Mechanism Projects in the Energy Sector in India**" prepared by **Ms T. Shemeera Kunhu** under my guidance and supervision.

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Both the examiners have not suggested any modifications of suggestions and therefore the original thesis is resubmitted as such. The soft copy attached is the same as that of the resubmitted copy.

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Dr. B. Johnson

(Supervising Teacher)

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T. Shemeera Kunhu

Abstract of the Ph.D Thesis in Commerce

An Assessment of Clean Development Mechanism Projects in the Energy Sector in India

Research Scholar: **T. Shemeera Kunhu** Research Guide: **Prof. B. Johnson**

India as a developing nation had shown its willingness to contribute towards carbon emission mitigation by signing the Kyoto Protocol in August 2002 itself. An extensive literature review showed that there was very little understanding of the various aspects of CDM projects, the process of earning carbon credits, carbon credit accounting, and the sustainable development outcomes of CDM projects. The study is based on the experiences of CDM projects in the Energy Industry as maximum CDM projects were registered in this sector. Primary data was collected and multi-stage purposive sampling was used to select the projects. EFA was done using the SPSS 22.0 package and as data is not normal, non-parametric statistical tools like Kruskal Wallis, Mann Whitney U test, and Kendal Theil Regression analysis were used for analysis purposes. Analysis shows that around 69% of all CDM projects are concentrated in the six states of Gujarat, Rajasthan, Maharashtra, Tamil Nadu, Andhra Pradesh, and Karnataka. The stakeholders exhibit a low level of awareness regarding the Kyoto Protocol, the CDM, and the rationale behind the implementation of such projects. The analysis makes it clear that government support is crucial to developing CDM projects to achieve sustainable goals. Private companies demonstrated greater ease in establishing Clean Development Mechanism (CDM) projects compared to public companies. The withdrawal of incentives and tax holidays for the CDM projects was a blow to the viability of the projects for many small companies who had entered into the energy business due to the Clean Development Mechanism. The Public Companies are lagging behind the Private Companies in confirming the accounting standard guidelines giswven by the ICAI. The lack of proper Accounting Standards is a major hurdle in following accounting and disclosure norms for all types of companies. CDM projects have been found to positively impact economic growth, social upliftment, and environmental protection in the localities where they are situated and do not have much effect on technology transfer. The study has implications for policy, operations, finance, technology, capacity-building, and international cooperation. These implications can drive improvements in the initiatives that the government is going to take in the future to become carbon neutral.

കൊമേഴ്സിലെ പിഎച്ച്ഡി തീസിസിന്റെ സംഗ്രഹം

ഇന്ത്യയിലെ ഊർജമേഖലയിലെ ക്ലീൻ ഡെവലപ്മെന്റ് മെക്കാനിസം പദ്ധതികളുടെ ഒരു വിലയിരുത്തൽ

റിസർച്ച് സ്കോളർ: **ടി.ഷെമീറ കുഞ്ഞ്** റിസർച്ച് ഗൈഡ്: **പ്രൊഫ.ബി.ജോൺസൺ**

വികസ്വര രാഷ്ട്രമെന്ന നിലയിൽ ഇന്ത്യ 2002 ഓഗസ്റ്റിൽ തന്നെ ക്യോട്ടോ ഉടമ്പടിയിൽ ഒപ്പുവെച്ചുകൊണ്ട് കാർബൺ പുറന്തള്ളൽ ലഘൂകരണത്തിന് സംഭാവന നൽകാനുള്ള സന്നദ്ധത പ്രകടിപ്പിച്ചിരുന്നു. സിഡിഎം പ്രോജക്ടുകളുടെ വിവിധ വശങ്ങൾ, കാർബൺ ക്രെഡിറ്റുകൾ നേടുന്ന പ്രക്രിയ, കാർബൺ ക്രെഡിറ്റ് അക്കൗണ്ടിംഗ്, സിഡിഎം പ്രോജക്ടുകളുടെ സുസ്ഥിര വികസന ഫലങ്ങൾ എന്നിവയെ സംബന്ധിച്ച് പൊതുവായി വളരെ ചുരുങ്ങിയ ധാരണ മാത്രമേയുള്ളൂ എന്ന് ഈ മേഖലയിലെ മുൻകാല പഠനങ്ങളുടെ വിശകലനത്തിൽ നിന്ന് മനസ്സിലാക്കാൻ സാധിച്ചു. എനർജി ഇൻഡസ്ട്രിയിലെ സിഡിഎം പ്രോജക്ടുകളുടെ അനുഭവങ്ങൾ അടിസ്ഥാനമാക്കിയാണ് പഠനം നടത്തിയത്, കാരണം ഈ മേഖലയിൽ പരമാവധി സിഡിഎം പ്രോജക്ടുകൾ രജിസ്റ്റർ ചെയ്തിട്ടുണ്ട്. പ്രൈമറി ഡാറ്റ ശേഖരിക്കുകയും പ്രോജക്ടുകൾ തിരഞ്ഞെടുക്കാൻ മൾട്ടി-സ്റ്റേജ് പർപ്പോസീവ് സാമ്പിൾ ഉപയോഗിക്കുകയും ചെയ്തു. SPSS 22.0 പാക്കേജ് ഉപയോഗിച്ചാണ് EFA നടത്തിയത്, ഡാറ്റ സാധാരണമല്ലാത്തതിനാൽ, Kruskal Wallis, Mann Whitney U test, Kendal Theil Regression analysis തുടങ്ങിയ പാരാമെട്രിക് ഇതര സ്റ്റാറ്റിസ്റ്റിക്കൽ ടൂളുകൾ വിശകലന ആവശ്യങ്ങൾക്കായി ഉപയോഗിച്ചു. ഗുജറാത്ത്, രാജസ്ഥാൻ, മഹാരാഷ്ട്ര, തമിഴ്നാട്, ആന്ധ്രാപ്രദേശ്, കർണാടക എന്നീ ആറ് സംസ്ഥാനങ്ങളിലാണ് 69% സിഡിഎം പദ്ധതികളും കേന്ദ്രീകരിച്ചിരിക്കുന്നതെന്ന് വിശകലനം കാണിക്കുന്നു.. ക്യോട്ടോ പ്രോട്ടോക്കോൾ, സിഡിഎം, തുടങ്ങിയ പ്രോജക്റ്റുകൾ നടപ്പിലാക്കുന്നതിന്റെ പിന്നിലെ യുക്തിയെ കുറിച്ചുള്ള അവബോധം ബന്ധപ്പെട്ടവർക്കു പരിമിതമാണെന്ന് വിശകലനത്തിൽ കണ്ടെത്തി . പൊതു കമ്പനികളെ അപേക്ഷിച്ച് സ്വകാര്യ കമ്പനികൾ കൂടുതൽ അനായാസമായി ക്ലീൻ ഡെവലപ്മെന്റ് മെക്കാനിസം (സിഡിഎം) പദ്ധതികൾ സ്ഥാപിക്കുന്നുണ്ടെന്നും കണ്ടെത്തി .സിഡിഎം പദ്ധതികൾക്കുള്ള ഇൻസെന്റീവുകളും ടാക്സ് ഹോളിഡേകളും പിൻവലിച്ചത് ക്ലീൻ ഡെവലപ്മെന്റ് മെക്കാനിസം കാരണം ഊർജ ബിസിനസ്സിലേക്ക് പ്രവേശിച്ച നിരവധി ചെറുകിട കമ്പനികളുടെ പ്രോജക്ടുകളുടെ നിലനിൽപ്പിന് തിരിച്ചടിയായി. ഐസിഎഐ നൽകുന്ന അക്കൗണ്ടിംഗ് സ്റ്റാൻഡേർഡ് മാർഗ്ഗനിർദ്ദേശങ്ങൾ സ്ഥിരീകരിക്കുന്നതിൽ പൊതു കമ്പനികൾ സ്വകാര്യ കമ്പനികളേക്കാൾ പിന്നിലാണ്. എല്ലാത്തരം കമ്പനികൾക്കും അക്കൌണ്ടിംഗ്, ആൻഡ് ഡിസ്ക്ലോഷർ മാനദണ്ഡങ്ങൾ പാലിക്കുന്നതിൽ ശരിയായ മാനദണ്ഡങ്ങളുടെ അഭാവം ഒരു പ്രധാന തടസ്സമാണ്. സിഡിഎം പ്രോജക്ടുകൾ അവ സ്ഥിതി ചെയ്യുന്ന പ്രദേശങ്ങളിലെ സാമ്പത്തിക

വളർച്ച, സാമൂഹിക ഉന്നമനം, പരിസ്ഥിതി സംരക്ഷണം എന്നിവയെ നല്ല രീതിയിൽ സ്വാധീനിക്കുന്നതായും സാങ്കേതിക കൈമാറ്റത്തിൽ കാര്യമായ സ്വാധീനം ചെലുത്തുന്നില്ലെന്നും കണ്ടെത്തി. നയങ്ങൾ, പ്രവർത്തനങ്ങൾ, ധനകാര്യം, സാങ്കേതികവിദ്യ, ശേഷി വർദ്ധിപ്പിക്കൽ, അന്തർദേശീയ സഹകരണം എന്നിവയിൽ ഈ പഠനത്തിന് സ്വാധീനമുണ്ട്. കാർബൺ ന്യൂട്രൽ ആകാൻ ഭാവിയിൽ ഗവൺമെന്റ് എടുക്കാൻ പോകുന്ന സംരംഭങ്ങളിൽ ഈ പഠനത്തിന്റെ കണ്ടെത്തലുകൾ നിർണായകമായ സ്വാധീനം ചെലുത്തും

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Abbreviations

AAUs	Assigned Amount Units
CCS	Carbon Capture and Storage
CCX	Chicago Climate Exchange
CDM EB	Clean Development Mechanism Executive Board
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CH_4	Methane
CO_2	Carbon dioxide
CO2e	Carbon dioxide Emissions
COP	Conference of Parties
COP	Conference of Parties
CUE	Carbon Usage Efficiency
DMRC	Delhi Metro Rail Corporation
DNA	Designated National Authority
DOE	Designated Operational Entity
ERUs	Emission Reduction Unit
ESC	Electronic Silo Certificate
ESTs	Environmentally Sound Technologies
EU ETS	EU Emission Trading Scheme
EU	European Union
EU	European Union
EUAs	EU Allowances
GHG	Green House Gases
HFCs	Hydrofluorocarbons
HUFs	Hindu Undivided Families
IASB	International Accounting Standards Board

ICAI	Institute of Chartered Accounts of India
IET	International Emission Trading
IIP	Index of Industrial Production
IPCC	The Intergovernmental Panel on Climate Change
JI	Joint Implementation
KP	Kyoto Protocol
LULUCF	Land-use, land-use change, and forestry
N_2O	Nitrous oxide
NCDMA	National Clean Development Mechanism Authority
PDD	Project Design Document
PFCs	Perfluorocarbons
PUE	Power Usage Efficiency
RMUs	Removal Units
SF_6	Sulphur Hexafluoride
Strate	South Africa's Central Securities Depository
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	US Environmental Protection Agency
VCS	Verified Carbon Standard
WUE	Water Usage Efficiency

Chapter 1

Introduction

“*The climate emergency is a race we are losing, but it is a race we can win.*”

– António Guterres, Secretary-General UN

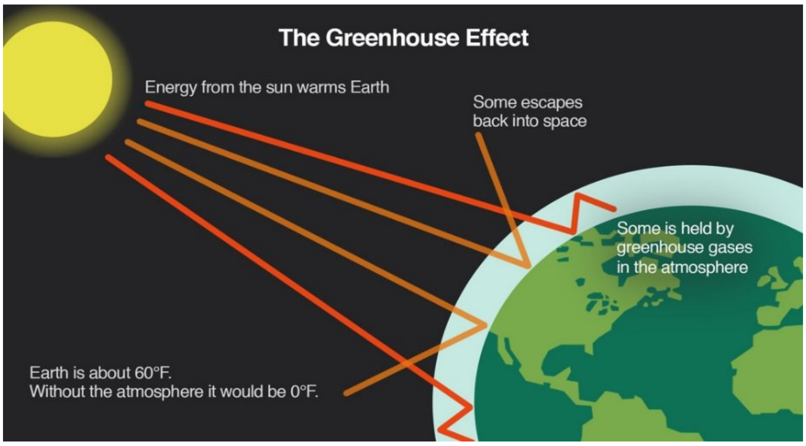
1.1 Introduction

Global warming stands as a formidable obstacle confronting humanity. The phenomenon of climate change extends its reach across the globe, harboring the capacity to inflict detrimental consequences upon our environment, communities, and economy unless immediate measures are taken to curtail greenhouse gas emissions and proactively address the forthcoming impacts. It is evident that adhering to business as usual is insufficient. As the immeasurable costs of climate change reach irreversible heights, the time has come for resolute collective action.

Gases that trap heat in the atmosphere are called Greenhouse gases. Greenhouse gases (GHGs) which are a natural part of the atmosphere are chiefly cloud droplets, water vapor carbon dioxide, methane, nitrous oxide, etc. These substances absorb the radiation from the sun and re-radiate it in all directions including back to the Earth. This helps in keeping the Earth’s temperature at an average of 14°C (57°F). In the absence of GHGs, the average temperature of Earth will drop to -17.778°C / 0^0 F. Thus, these gases keep the Earth’s climate warm enough to support life.

Figure 1.1

The Greenhouse Effect



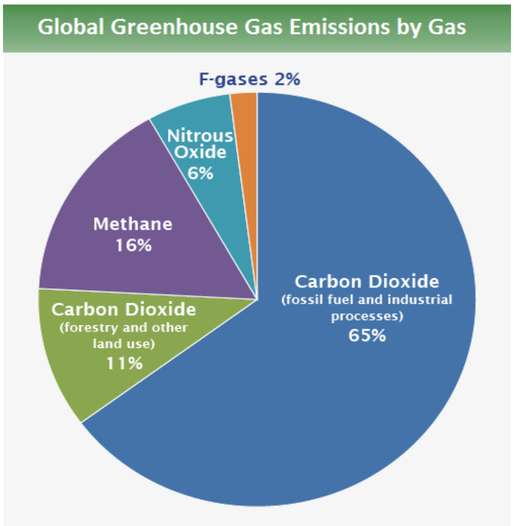
Source: (The Conscious Club, 2019)

Conversely, when the levels of naturally existing greenhouse gases rise due to various factors, it disrupts the equilibrium between absorbed and emitted infrared radiation, significantly impacting the Earth's climate.

At the global scale, the key greenhouse gases emitted by human activities are Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Fluorinated gases (F- gases which include Hydrofluorocarbons, Perfluorocarbons, Sulfur hexafluorides). The global greenhouse gas emissions are given below.

Figure 1.2

Global Greenhouse Gas Emissions by Gas

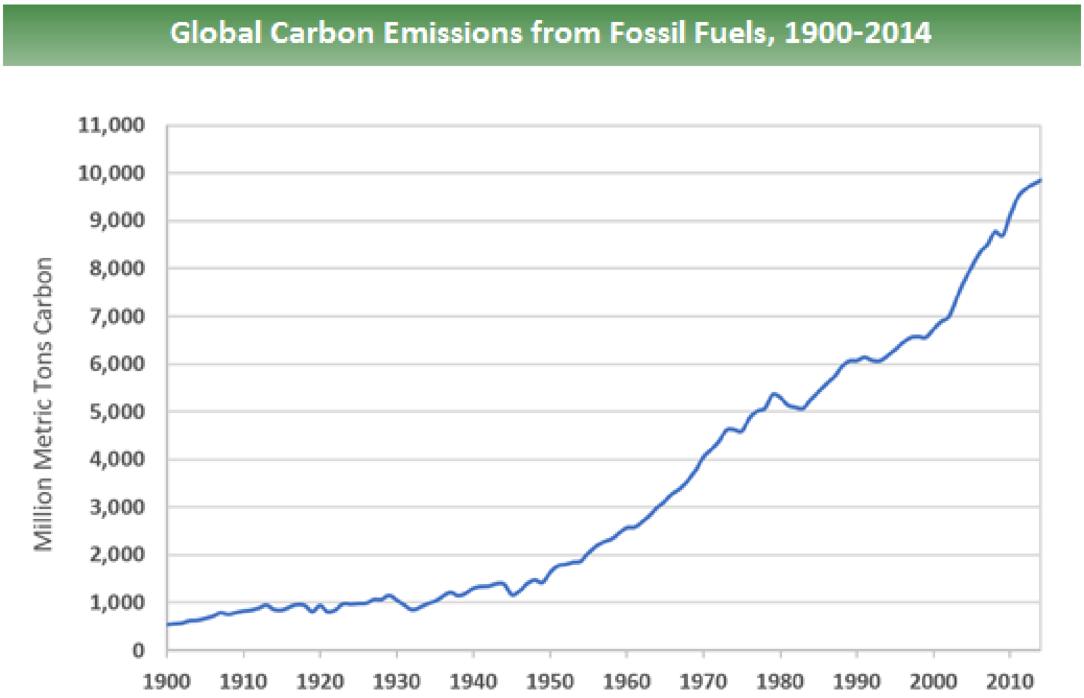


Source: (IPCC 2014)

Carbon emissions resulting from the burning of fossil fuels have experienced a substantial rise on a global scale since the year 1900. From 1970 onwards, there has been a noteworthy surge of approximately 90% in CO2 emissions, with fossil fuel combustion and industrial activities accounting for roughly 78% of the overall increase in greenhouse gas emissions between 1970 and 2011. The second most significant contributors have been agricultural practices, deforestation, and alterations in land use.

Figure: 1.3

Global Carbon Emissions from Fossil Fuels, 1900-2014



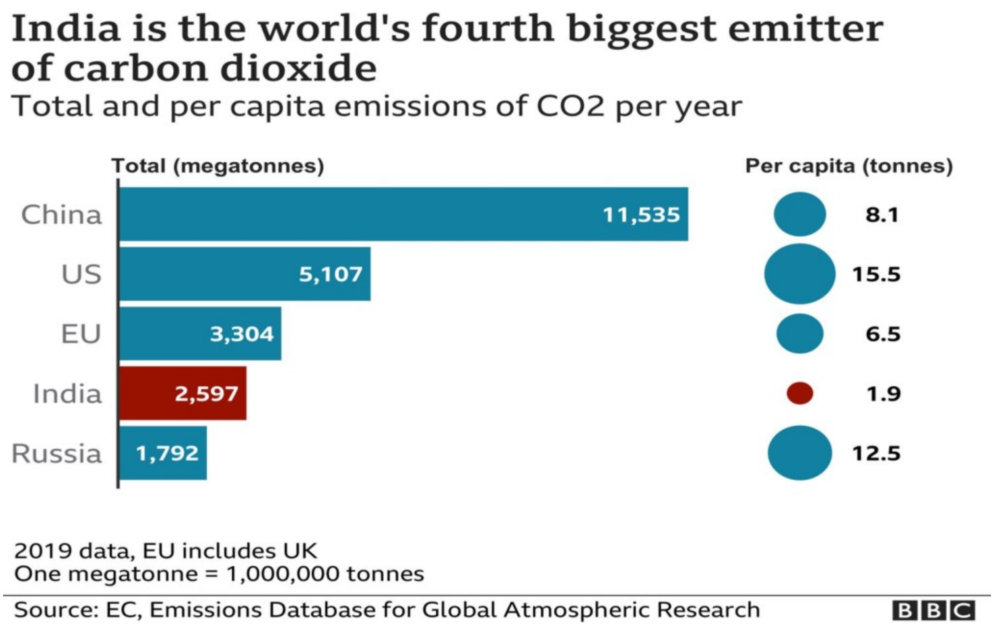
Source: Boden, T.A., Marland, G., and Andres, R.J. (2017). Global, Regional, and National Fossil-Fuel CO2Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001_V2017.

If this upward trend persists unchecked, the eventual consequence may involve a greater retention of heat in the atmosphere, leading to alterations in the climate cycle. The repercussions of climate change can already be observed through the proliferation of heat-related illnesses and diseases across the globe.

Governments worldwide realized the need to reduce carbon emissions and came together to look for some mechanisms that would help increase the absorption of greenhouse gases. This led to the signing of the Kyoto Protocol in 1997 held in Kyoto, Japan under the United Nations Framework Convention on Climate Change (UNFCCC). The Kyoto Protocol came into force in February 2005, which sets limits to the maximum amount of emission of greenhouse gases (GHGs) by countries. There are 197 signatories to the Kyoto Protocol and at present commits 44 developed countries (known as Annex I countries) to reduce their GHG emissions. This is a greenhouse gas-trading program, which is known as the "Cap and Trade system" and it imposed national caps on the emission of developed countries. On average, each country had to reduce emissions by 5.2% below their 1990 baseline over the 2008 to 2012 period, which is known as the first commitment period. Under this, the developed countries had emission reduction targets, which were to be achieved by 2012. This commitment period has been again extended and is known as the second commitment period, from 1 January 2013 to 31 December 2020 as per the Doha agreement (UNFCCC).

Figure 1.4

Total and Per Capita Emission of CO_2 Per Year of Some of the Leading Emitters



The above figure shows that India is the fourth largest emitter of carbon dioxide but the per capita emission is only 1.9 per person compared to 15.5 of the US. India ratified the Kyoto Protocol in August 2002 after 77 countries ratified it. India being a developing country, need not commit to a fixed target for reduction of emissions. Under one of the mechanisms of the Kyoto Protocol, known as the Clean Development Mechanism (CDM), developing and underdeveloped countries are given opportunities to earn revenue by setting up emission reduction projects with the help of any entity from a developed country. Such projects earn carbon credits for the reduction of emissions and they can be sold to entities in developed countries to meet their emission reduction targets.

1.2 Relevance of the Study

There was a time when Governments worldwide were in denial of global warming and the resulting climate change. But then after lot of discussions between the scientific communities and the Governments, they understood the effect of climate change on our environment, communities, and the economy. They realized that there was an urgent need to proactively take action to reduce emissions. The result was the implementation of the Kyoto Protocol in 1994 in Kyoto, Japan, under the guidance of the United Nations Framework Convention on Climate Change. India signed the Kyoto Protocol in 2002 and committed itself to help in reducing emissions.

The Indian government at the 26th session of the Conference of the Parties (COP26) to the UNFCCC in November 2021, promised to achieve the target of net zero emissions by 2070. (Ministry of Environment, Forest and Climate Change, 2022). Now it becomes imperative to know how the government has fared in helping the business entities in developing CDM projects under the Kyoto Protocol. A thorough understanding of how Indian Government helped the entrepreneurs and general public in adopting the Kyoto Protocol mechanism to its advantage will go a long way in achieving the net zero target of 2070. There is a need to evaluate the facilitating policies of the government for Kyoto Protocol. It will also benefit the country if it is known what barriers were faced by Indian Companies during the formation, implementation, operation of Clean Development Mechanism Projects and earning carbon credits known as Certified Emission Reduction Certificates (CERs)from it. This will allow the government to plug in the gaps in fiscal policy to enable the companies both public and private, to pitch-in for achieving the net zero target by 2070.

1.3 Scope of the Study

The present study is confined to companies in India that have registered their projects with the National Clean Development Mechanism Authority (NCDMA) and the UNFCCC. Projects in Energy Industries are considered for the study as they form the major portion (79%) of approved projects in India. Only those projects which have received Certified Emission Reduction Certificates (CERs) are included. The projects of only the top six states of Tamil Nadu, Maharashtra, Gujarath, Rajasthan, Karnataka and Andhra Pradesh are taken as majority (69%) of the energy projects are situated there.

The experiences of project developers in the formation, implementation, generation of carbon credits, and achieving sustainable development outcomes are studied. The facilitating factors like stakeholders' awareness and government support which create a conducive atmosphere in the formation and implementation of the project is studied from the point of view of the project developers. Stakeholders of a CDM Project as per the Kyoto Protocol are the Project Developers, Local Communities, State Government, and the Central Government. Hence, the experience of the Project Developers when approaching the three stakeholders like Local Communities, State and Central Governments for various activities in implementing the CDM Project are studied. The outcomes expected of CDM Projects are Social Well-being, Economic Well-being, Environmental Well-being and Technological Well-being (Ministry of Environment, 2023). Hence, the Economic, Technological, Social and Environmental Benefits of CDM are assessed. Also, the accounting treatment for CERs, expenses related to the acquisition of assets for the CDM Project, and the disclosure norms for CERs under certification, CERs in hand, and revenue recognition are examined.

1.4 Statement of the Problem

Around 3053 projects have been undertaken and approved in India up to March 2022, out of which 2,380 projects are in the Energy Sector. But only 604 projects in the energy sector have received CERs as per the CDM Registry in the UNFCCC. There is a gap in the knowledge regarding the environment for setting up CDM projects in different parts of India and the factors facilitating the earning of carbon credits. A lot of expectations were there when India first ratified the Kyoto Protocol. Hence, there is a need to study the experiences of project participants in dealing with the paperwork, getting approval from various state and central agencies, local communities and also validation from international agencies for implementing the project. There is a gap in the literature regarding the understanding of the role of Stakeholders' Awareness and Government Support in the implementation of CDM projects. There is also a need to understand the issues faced by the CDM Project participants while planning and implementing the projects. After the implementation of projects whether there are any problems in running and maintaining the production of renewable energy as per the estimates, whether they were able to generate carbon credits from such activities, and whether it contributes to sustainable development outcomes like economic, technological, social, and environmental benefits. There is also a lot of confusion as to the treatment of expenses related to the generation of carbon credit and its disclosure. Therefore, the present study focuses on the following research problems-

1.5 Research questions

- What is the concept of carbon credit?
- What is the level of Stakeholders' Awareness on Clean Development Mechanism projects?
- What is the level of Government Support received by project developers for Clean Development Mechanism projects?
- What are the factors which affect the formation and implementation of Clean Development Mechanism projects?

- What are the facilitating factors in earning carbon credits in Clean Development Mechanism projects?
- What is the compliance level of accounting and disclosure of carbon credits adopted by Indian companies?
- What are the contributions of CDM projects in terms of economic, technological, social, and environmental benefits?

1.6 Objectives of the Study

The literature review reveals very little of the situation prevailing in India for the development of CDM projects and their accounting. Hence, the following specific objectives are set forth for the present study.

1. To measure the influence of Stakeholders' Awareness and Government Support in creating a conducive atmosphere in promoting CDM Projects.
2. To investigate the factors enabling the Indian Companies to form and implement Clean Development Mechanism projects.
3. To analyse the factors facilitating the Earning of Carbon Credits.
4. To examine the compliance of accounting and disclosure of Carbon Credits as per the guidance note issued by ICAI.
5. To evaluate the accomplishment of sustainable development outcomes of CDM Projects.

1.7 Hypotheses

Some of the basic hypotheses of the study based on the objectives are as follows: -

1. H_0: There is no significant difference in stakeholder awareness of CDM projects based on the Type of Company owning them.
2. H_0: There is no correlation between Stakeholders' Awareness and CDM Project Development

3. H_0: There is no correlation between Government Support and CDM Project Development
4. H_0: There is no significant difference in the CDM Project Development among the states.
5. H_0: There is no significant difference in the four dimensions of CDM Projects and the Type of Company Owning the Project.
6. H_0: There is no correlation between Stakeholders' Awareness and Earning Carbon Credits
7. H_0: There is no correlation between Government Support and Earning Carbon Credits
8. H_0: There is no correlation between CDM Project Development and Earning Carbon Credits
9. H_0: There is no significant difference in Earning Carbon Credits among different Types of Companies that own the projects.
10. H_0: There is no correlation between Earning Carbon Credits and Sustainable Development Outcomes.
11. H_0: There is no significant difference in Sustainable Development Outcomes with respect to the State in which the CDM Projects are situated.
12. H_0: There is no significant difference in Sustainable Development Outcomes based on the Type of Company that owns the CDM Projects.

1.8 Methodology

The present study is exploratory in nature as it is a pioneering study on the dimensions of clean development mechanism projects, factors facilitating the earning of carbon credits, sustainable development outcomes of CDM Projects and also the compliance of carbon credit accounting and disclosure in by Indian companies. As of March 2022, the National Clean Development Mechanism Authority had given its approval to 3053 projects in India. Since 79% of CDM projects are in the energy sector, samples for the study were chosen from that sector. Primary data was collected from top-level managers of various Indian companies who had the required experience in the formation and implementation of clean development mechanisms projects. The data relating to the accounting and disclosure of carbon credits was collected from finance managers of Indian companies.

Secondary data was taken from the published texts released by UNFCCC from time to time. It was used for understanding the method of approval of projects by UNFCCC, the methodologies used for measuring carbon credits, and the legal framework of the Kyoto Protocol and the Paris Agreement. In order to create a questionnaire to assess the social effects of such projects, the project development documents of a number of projects were examined to understand the goals and parameters of the projects. Articles in Journals, books, and the websites of relevant authorities also was referred to.

1.9 Tools for Analysis

As this is an exploratory study, Exploratory Factor Analysis was used to discover the factor structure of a measure and to examine its internal reliability. Suitable mathematical and statistical tools like mean, median, standard deviation, Mann Whitney U Test, Kruskal–Wallis H test, Spearman's Rank Correlation, and Kendell-Theil Regression were used for analysing the data.

1.10 Operational Definitions

Since the study is to understand the challenges in the formation and implementation of Clean Development Mechanism Projects, the accounting of transactions related to carbon credits, it is very important to know what is the meaning of greenhouse gases, carbon credit, and sustainable development outcomes like economic benefits, technological benefits, social benefits, environmental benefits.

1.10.1 Greenhouse Gases

Gases that trap heat in the atmosphere are called greenhouse gases. a gas that contributes to the greenhouse effect by absorbing infrared radiation (Oxford Dictionary). Carbon dioxide and chlorofluorocarbons are examples of greenhouse gases. Kyoto Protocol mainly targets six gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).

1.10.2 Carbon Credit

A carbon credit is a tradeable financial product that has been issued by UNFCCC indicating a decrease in emissions and can be purchased or sold. One tonne of carbon dioxide or its equivalent emission reduced equals one carbon credit certificate. The carbon credit certificates issued by UNFCCC to the Clean Development Mechanism projects in developing countries for emission reduction is known as Certified Emission Reductions (CERs).

1.10.3 Sustainable Development Outcomes

Sustainable Development Outcomes refer to the long-term positive results achieved through the implementation of CDM (Clean Development Mechanism) projects and include the Economic well-being, Technological well-being, Social well-being, and Environmental well-being (Ministry of Environment, 2023). The measurement of sustainable development outcomes in CDM projects is based on the benefits they generate. In this study, the sustainable development outcome is measured by analysing the crucial components that contribute to the benefits categorized as economic, technological, social, and environmental aspects of CDM projects.

1.10.4 Economic Benefits

In this study, the Economic benefits refer to the economic advantages associated with the sale of CERs, as well as the improved reputation through positive public perception a company can achieve through the implementation of clean technology and greenhouse gas reduction measures. The CDM projects that are officially recognized under the Kyoto Protocol offer multiple benefits, including the creation of job opportunities and enhanced possibilities for collaborating with foreign entities in developed nations, thereby facilitating the importation of cutting-edge clean technology. Ultimately, these factors contribute to an overall increase in business opportunities with these foreign counterparts.

1.10.5 Technological Benefits

Technology benefits encompass the advantages derived from the implementation of new technologies in various aspects such as renewable energy generation, efficient distribution of energy, efficient energy use, and effective reduction of emissions. The technology employed in CDM projects is often transferred from foreign participants, involving the importation of equipment and knowledge. The need for new technology drives companies to invest in research and development**.**

1.10.6 Social Benefits

Social benefits refer to the positive outcomes that arise from CDM projects in relation to the local population and community. These benefits include increased engagement between the company and the local population, improvement in educational resources, enhanced provision of basic amenities in the area, and the promotion of social upliftment, particularly for marginalized groups. This upliftment is achieved through initiatives such as empowering women, providing care for children and the elderly, conducting workshops, and offering training programs for skill development. Ultimately, these efforts have a positive impact on the overall quality of life within the local community.

1.10.7 Environmental Benefits

Environmental benefits comprise the positive changes and improvements in the natural surroundings resulting from CDM projects. These benefits include the reduction of greenhouse gas emissions, leading to improved air, soil, and water quality. Effective waste management measures are implemented to minimize environmental impact. Furthermore, the projects aim to protect and preserve environmental diversity. As a result of these efforts, the health of individuals living in proximity to the project area experiences positive enhancements.

1.11 Synoptic View of the Report

The research report is presented in seven chapters, each serving a specific purpose.

The first chapter, known as the Introduction, initiates the study by providing background information and discussing the events that led to India's participation in the Kyoto Protocol. It highlights the relevance and scope of the study, presents the statement of the problem, outlines the objectives, and acknowledges the study's limitations.

Moving on to the second chapter, an extensive literature review is conducted, covering various aspects such as the Kyoto Protocol, the Clean Development Mechanism (CDM), the process of earning carbon credits, carbon credit accounting, and the sustainable development outcomes of CDM projects.

The third chapter, titled "Clean Development Mechanism -An Overview," delves into the formation and implementation of CDM projects, exploring topics like the National Clean Development Mechanism Authority (NCDMA), the CDM Project Cycle, the United Nations Framework Convention on Climate Change (UNFCCC), the CDM Registry, rules regarding accounting and disclosure of CDM project transactions, carbon credits, carbon markets, registered CDM projects in India, sector-wise CDM projects in India, and the expected outcomes of CDM projects.

The fourth chapter, "Materials and Methods," covers the research approach, process, methodology, and database. It includes information on the type of data collected, the instrument used for data collection, the pilot study conducted, and the tools employed for data analysis, among other relevant aspects.

The fifth chapter, "Results and Discussion," presents the analysis and interpretation of the primary data collected, aligning with the stated objectives of the study.

Moving on to the sixth chapter, titled "Summary, Findings and Conclusions," a summary of the report is provided, followed by a concise discussion of the problem.

The chapter further encompasses the objectives, hypothesis, findings, and conclusion derived from the research.

Finally, the seventh chapter, "Recommendations" focuses on providing recommendations based on the study's outcomes and offering suggestions for further research.

Chapter 2

Review of Literature

2.1 Introduction

The data from several studies have identified the Kyoto Protocol as a historic international treaty that aimed to mitigate global warming by reducing greenhouse gas emissions. It established a framework for countries to set targets for reducing their emissions and created market-based mechanisms, such as the Clean Development Mechanism (CDM) and carbon credits, to incentivize emissions reduction projects in developing countries. The Protocol also aimed to promote sustainable development by encouraging the adoption of environmentally friendly technologies and practices.

In this review, the researcher explored the key concepts and debates surrounding these topics in chronological order, examining the existing research and identifying areas where further investigation is needed. After going through the available literature, it was found that they could be divided into five areas as under:

1. Kyoto Protocol
2. Clean Development Mechanism Projects
3. Earning Carbon Credits
4. Accounting and Disclosure of Carbon Credit Sustainable Outcomes of CDM Projects

The review will provide a comprehensive analysis of the existing literature and the researcher will gain a deeper understanding of the challenges and opportunities associated with these mechanisms, and identify the areas where further investigation is needed to promote effective and sustainable climate action.

2.2 Kyoto Protocol

The article "Climatic change: are we on the brink of a pronounced global warming?" published in the journal *Science* by **Broecker (1975)** was considered the first article which coined the word 'Global Warming'. The author hypothesized that the global ocean conveyor belt which was constantly moving the ocean water driven by temperature and salinity will be turned off if the temperature of the earth constantly increases. Due to global warming, the surface water of oceans will turn warm and decrease the density, thereby preventing the cold water from sinking, altering ocean currents, and effectively shutting off the conveyor belt. The article predicted that Europe would grow cooler just as it had during the ice age. These findings are still very relevant today.

In a summary of workshop presentations and working group discussions conducted by the Royal Swedish Academy of Sciences, **Lee et al. (1996)** presented the results of mitigation strategies in the three areas of energy, forestry, and methane. Data was collected from various Asian countries and the inconsistency and non-availability of data was a major hurdle for them. According to them, there is a need to increase the transfer of information on environmental issues to policymakers and the general public to increase awareness about the economic and health impacts of climate change. The article discussed the status of climate change programs in Asian Governments. The conclusion was that the design of mitigation options available in the region was in its initial stages. There was a lack of funding for increasing awareness and government institutions have to establish criteria for selecting mitigation projects.

In an article, **Shin et al. (1996)** opined that in developing economies, agricultural research would be increasingly concerned with the study of greenhouse gas emissions in farming and their prevention. In countries with predominant rice cultivation, rice research could play a crucial role in cultivating rice varieties that increases production and decrease emission. The study showed that intermittent irrigation and the use of decomposed rice straw before transplanting reduced methane by 36% and 49% respectively.

In their report**, The Chamber of Commerce and Industry of Western Australia (1999)** discussed the mechanisms developed under the Kyoto Agreement for emission reduction. It explored how governments and international organizations should respond to global warming. The paper also said that Australia should pursue emission reduction and sequestration measures keeping in mind the future obligations under Kyoto Protocol. However, at the same time, it argued that the effect of implementing the Kyoto Protocol would be to redistribute the emissions due to producing activity and not to reduce it. The rich countries would shift their dirty production activities to the poor countries and would wear the cap of respectability using schemes under Kyoto Protocol.

Babiker et al. (1999) in their report, prepared for the MIT Joint Program on the Science and Policy of Global Change discussed the obligations of Annex B nations who have committed to reducing greenhouse gases under the Kyoto Protocol. It was a comparative study of future possible emission reductions with and without the Kyoto Agreement. The paper does a detailed analysis of the effect of various measures like the removal of fuel tax distortions, abolishing subsidies for coal use, emission trading, and the combined effect of all policy measures on developing countries. It also suggested direct measures like tariff concessions, and direct compensations, to reduce the effects on developing countries. The report concluded that the OECD countries would be the most affected, as they are the largest energy exporters, and if a country is dependent on energy exports, Kyoto Protocol would hurt its economic welfare.

Deshun and Rogers (2000) reviewed the Kyoto Protocol in the fifth chapter of their book on the setting of baselines for the implementation the of Clean Development Mechanism and Joint Implementation under the Kyoto Protocol. The chapter analyzed the different concepts in determining the baselines and gave an overview of the practical experience in deciding the baseline the setting of baselines is one of the most difficult tasks in implementing either the clean development mechanism or joint implementation in projects. The chapter gave a comparison of the advantages and disadvantages of both the theoretical and practical aspects of the three different approaches. No one approach could be applied to all types of projects, hence, there was the approach for projects having highly site-specific conditions, a technology-based approach, and the top-down approach. Eventually, the approach that was accepted to calculate the baseline should also be acceptable to the investing parties.

Sutherland (2000) assessed the magnitude of adjustments required by the US markets to achieve the target set in the Kyoto Protocol. The study concluded that an unprecedented reduction in energy use by the US markets is required to achieve this. Such a scenario would lead to a decline in GDP of up to 4.9% per year. The suspension of the use of coal as a source of energy would lead to a 14% increase in energy prices per year. This would adversely affect the US economy and hence, the feasibility of such a large reduction in energy use was largely in doubt. Moreover, the technical improvements in natural gas plants had reduced energy prices, leading to more demand and more emissions. The availability of cheap electricity from natural gases would lead to the early retirement of nuclear power plants. All these would lead to less acceptance of fossil-free technologies and the market which would be relegated to small pockets. In effect, the conclusion was that the US will not be able to achieve the Kyoto Protocol targets without hurting its economy.

Duong (2000) opined that over the last decade, humanity had made significant progress in understanding global climate change. There was proof that in the next century, the global average temperature will increase by about 2^0 C in 2100. This was going to have a catastrophic effect on the climate dynamics. He warned that if not taken seriously, the negotiations under the framework of the Climate Convention which led to the Kyoto Protocol between industrialized nations will not be enough to ensure a stable long-term solution for the protection of the ozone layer.

Finus (2000) in the survey concerning the application of the Kyoto Protocol, used Game theory to analyze international environmental problems. The paper tried to understand under which conditions will an International Environmental Agreement be signed and ratified, what will be the reduction targets negotiated, and how many countries will sign the international environmental agreement. The paper discussed the complications in bringing cooperation among the countries and the measures to establish cooperation for the reduction of emissions. It comprehensively laid down the reason why there will be stability problems for International Environmental Agreements and why only moderate abatement targets will be agreed to by the countries. It suggested that threats should be sanctioned for non-compliance with the stability of International Environmental Agreements.

Reilly et al. (2001) declared that the Intergovernmental Panel on Climate Change (IPCC) has been charged with the important task of reporting to the governments on the state of scientific knowledge on climate change. To make informed choices, policymakers needed data that are risk-free and uncontentious. Otherwise, the policy discussions would become a farce with the parties using the analysis data to both support urgent action and to justify doing nothing while they wait for more concrete data. In order to avoid that, the authors suggested that the climate-change assessments should establish standards of scientific evidence no less rigorous in their uncertainty analysis than in their presentation of the underlying natural and social science. If the reports are to be taken seriously, guidance from experts should be taken, and the analysis should be grounded in a documented procedure that can be repeated and calibrated.

Carraro et al. (2001) analyzed in the white paper, the relationships between different equity rules and the incentives to sign and ratify a climate agreement. The authors were of the view that under the Kyoto Protocol, the burden of reducing emissions was not equally distributed among countries of the world and a stable global agreement would not be achieved. An analysis of the incentive structure of different types of climate agreements using the RICE model (Nordhaus and Yang, 1996) had been attempted. The RICE model is a single-sector optimal growth model that has been extended to incorporate the interactions between economic activities and climate. The conclusion was that almost all Annexure I countries lose by signing the agreement and more than one country among them will benefit by free-ride i.e. the net benefit from letting the other countries reduce emissions is larger than the net benefit from reducing domestic emissions.

Cooper (2001) criticized many aspects of the Kyoto Protocol in the article “The Kyoto Protocol: A Flawed Concept”. The article was pessimistic about the possibility of cooperation among all rich and poor countries for solving the problem of climate change. The national targets for the countries for emission level, which would be acceptable to all countries, were very difficult to arrive at in the absence of quantitative formula for the same. Hence, it would be difficult for Kyoto Protocol to succeed. The paper suggested imposing carbon taxes on emitters but since tax policy was a sensitive issue, it would be difficult to change it. Hence, the paper recommended that since climate change is a reality, all countries should position themselves for emergency actions for the rapid sequestration of greenhouse gases.

Fearnside (2001) studied the effect of mitigating global warming in Brazil's Amazonian forests. According to the author, Brazil had a major opportunity to reduce global warming by reducing deforestation. This task would be difficult to implement but not impossible. The Kyoto Protocol methods like Clean Development Mechanisms, and Emission Trading would be beneficial for the country as there is a lot of scope for protecting the standing forests and earning credits for the same. The social and environmental impacts on Brazil will be positive due to the heavy forest cover and trade ability of credits in the international market. The author also suggested that it will be in the national interest, to give more importance to the avoidance of deforestation than in reforestation.

Bohringer and Loschel (2002) tried to assess the cost of compliance with the Kyoto Protocol and to determine the policies that have to be drawn up for its implementation on the ground level. In their paper, they presented a generic computable general equilibrium (CGE) model for the analysis of the cost-effectiveness of various climate policy strategies to achieve Kyoto Protocol abatement targets. The simulation results showed that the developed countries with high growth like USA, Australia, Canada, and Japan will have to attain a much higher rate of emission reduction as the base year taken is 1990 in Kyoto Protocol whereas the implementation period is 2008-2012. This was the reason why the USA has withdrawn from the agreement and others were to follow if they were not given some relaxation in caps. They were asking for consideration of the spillover effects on the non-Annexure B countries, like low prices of fossil fuels due to a fall in demand for them on account of the push for green energy by the developed countries. This would increase the carbon tax on OECD countries, who will be motivated to improve technology leading to less pollution.

Bohringer (2003) discussed the ratification of the Kyoto Protocol which is binding on the developed countries with a commitment period of 2008-2012. This paper was a critical assessment of the problems and prospects of Protocol. It was the first international environmental agreement, which proposes a market-based mechanism for the abatement of greenhouse gases. This burden-sharing scheme had been accepted by all major parties except the US. This made Kyoto Protocol ineffective in environmental terms during the first commitment period. However, the paper concluded that though the agreement might not achieve the level of success that was intended, in the first phase, it is a good beginning in the sense that there had been a larger understanding of the need to contain pollution to control climate change. This would lead to further policy changes all over the world and the second commitment period will bring about valuable results through global cooperation.

Laroui et al. (2003/2004) discussed the implications of the 2001 Marrakech Conference of Parties agreement which had agreed on the modalities and guidelines of the flexibility mechanisms under the Kyoto Protocol. This paper concentrated on the benefits and obstacles of the European Union and Russia engaging in Joint Implementation (JI), which was one of the suggested flexible mechanisms of the Kyoto Protocol. The authors were of the view that the investing country can contribute towards meeting emission targets at a very low cost and for the host country, JI means more foreign investments and incentives for new business in clean energy. The major hitch in the implementation of JI was the fact that Russia had not ratified the Kyoto Protocol and there was no clear picture as to which organization will implement the Kyoto Protocol mechanisms. The author was optimistic and was wishing that this barrier would be overcome in the future.

Bohringer and Vogt (2004) in their paper, which was published in the European Journal of Political Economy ridiculed the Kyoto Protocol as they thought that after the withdrawal of the United States from the treaty, it had just become a symbolic one. When the US withdrew from the agreement, it required the approval of the remaining major parties like Russia, Canada, Australia, and Japan so that the required number of major polluters are party to it to make it effective. These countries used this constraint to their advantage and used their veto power to negotiate with the EU and get maximum concession on the issue of sink credits and emission trading. Hence, this resulted in the treaty being implemented at virtually no economic cost, and its effect on the environment was reduced to nil.

York (2005) tried to understand whether constraints of demographic variables, particularly population growth rates, affect participation in the Kyoto Protocol. The results of the analysis show that population growth and higher carbon targets are positively related. The reduction targets set by Kyoto Protocol are relatively very less. The research draws our attention to the importance of demographic factors for understanding human engagement with the environment and it bridges the gap in Kyoto Protocol. The result of the analysis showed that negative population growth can motivate countries to adopt policies to reduce their carbon emission and a country with high population growth may not implement the policies to reduce emissions even when there is wider political acceptance for policy changes in favor of emission reduction. This research concluded that the treaty does not question the global political economy but rather operates within it.

Swinton and Sarkar (2008) explained the incentive-based methods adopted by the Kyoto Protocol to curtail the emission of greenhouse gases. It laid down the opportunities and constraints faced by developing countries that are signatories to the agreement. It ensured market participation of all countries to get a piece of the opportunities. Hence, the article suggested that all developing countries should endorse Kyoto Protocol and participate in the new market for pollution control.

Agarwal (2008) examined in detail the international legal regime of climate change. It also analyzed the burden sharing of mitigation costs, economic costs, and the use of Kyoto Protocol mechanisms by Annex 1 developed countries to attain their commitments cost-effectively. It also gave details of the legal implications of the trade aspects of the Kyoto Protocol mechanism, legal issues raised by the developing countries, participation in the climate change regime, and the issues involved in the intergovernmental negotiation process for the post-Kyoto framework.

UNFCCC (2011) compiled a report from the annual reports submitted by Annex I countries under Kyoto Protocol, gives a summary of the Kyoto Protocol, and explained briefly, the path through which it can be implemented. It gave an idea about the mechanism to be used for adhering to Kyoto Protocol, the projected emissions for each country, and the targets to be achieved by each country in emission reduction.

Mendonca et al. (2012) explained how hydroelectric production contrary to our beliefs, contributed to global pollution in a chapter of their book. The study covered the scientific advances in the various aspects of hydroelectric reservoir ecology like production, consumption, and emission of greenhouse gases. The scientific data collected over the years from 1990 onwards in this regard have changed our views on hydroelectric reservoirs. It had been proved that two types of greenhouse gases vide carbon dioxide and methane were produced in high volumes in such reservoirs in the first 10 years of their life due to the decomposition of flooded organic soil and vegetation. After that, the emission from such dams is known to be equal to freshwater lakes. Thus, this study makes it clear that though hydroelectric reservoirs represent a renewable source of energy, but were not a carbon-free source of electricity. The report was silent on the role of reservoir sediment in the global carbon cycle and there was limited data on greenhouse gas emitted due to deactivating or removing dams at the end of its lifecycle.

Hannah (2015) in a chapter of the book 'Climate Change Biology', talked about the formation/evolution of the International Climate Policy. In 1997, the Kyoto Protocol came into existence and the EU decided to create a carbon market to achieve the reduction in carbon emissions in a very efficient manner. The European Union Emission Trading System was a part of the Clean Development Mechanism and Joint Implementation under the Kyoto Protocol. The European Union Carbon market was the largest in the world. China and Australia had large national carbon markets and California had the world's largest subnational carbon market. States in the US started their own CO2 emission caps and carbon markets because of a lack of national-level action. In areas not covered by governmental carbon markets, some states as well as industries went in for voluntary reductions through carbon offsets. That is how 2% of global carbon markets are voluntary markets. The Verified Carbon Standard (VCS) helps companies to ensure that voluntary reductions meet strict standards and help conserve the environment

Many studies had been conducted to study the adverse effects of air pollution on the general health conditions of citizens around the world. **Steenhof (2015**) tried to understand, which characteristics of the air pollution mixture were associated with adverse health effects of short-term and long-term exposure to pollution. The study was conducted at eight sites in the Netherlands and the researcher concludes that there is no single exposure metric that is related to all cardiovascular and respiratory outcomes measured in the study, and hence suggests that a multi-component approach that combines the gaseous pollutants and several particle matter characteristics should be adopted for air quality legislations.

Yun (2016) discussed China's response after the Paris Climate Change Conference. She said there was a significant change in the attitude of the Chinese government towards climate change. China recognized the urgency of addressing the issues of climate change. This led the government to implement the Paris Agreement and be an example for other developing countries of the world. China actively contributed to the success of the Paris Climate Change Conference by providing a proposal of a successful model, which could help coordinate the efforts of all governments to bring about a common development goal of implementing the Paris Agreement.

De-Xin (2016) in a study gave the detail of the Chinese government's action plan for coping with climate change by promoting wind energy. The paper listed the challenges and opportunities in the use of Wind Energy for sustainable development. The paper concluded that China should opt for more green energy, especially wind energy. It should increase its installed wind power capacity to 1000 GW to become the leading wind power generating country and cooperate with other countries to achieve the common goal of protecting the environment.

Barrett and Dannenberg (2016) were of the view that though it was a good initiative by the Paris Agreement to assess and review the nationally determined pledges and contributions of countries, it would not lead to achieving the global goal of reducing pollution in the environment. They had given their opinion based on a lab experiment using a game in which players choose a group target, declare their pledges, then make voluntary contributions to supply a public good. They found that review affects the target and pledges but not the actual contributions. Hence they were of the view that the pledge and review mechanism should be retained but combined with other measures for achieving the target.

In the 21st yearly session of the Conference of Parties to the United Nations Convention on Climate Change Conference, the Paris Agreement was signed by 195 countries of this world to fight climate change. **Caytas (2018)** was of the view that the Paris Agreement was a step backward as it stresses more on building awareness and setting aspirational goals as opposed to more enforceable and effective sanctions. The author felt that developing countries can be persuaded to reduce their pollution levels, only after they achieve industrialization by using cheap energy sources. Once the counties can feed their growing population and could provide them with employment, they could focus more accurately on environmental protection, clean water, and the elimination of toxic greenhouse gases. The two tools that could be used to reduce greenhouse gas emissions are Tax and Technology. Both tools could be used simultaneously after a proper political and regulatory framework favoring innovation and environmentally conscious tax policy is introduced. Thus, the paper concluded that smarter solutions could be achieved by exercising environmental and ecological priorities through fiscal means.

Hsu et al. (2017) stressed the need for a Polycentric approach to global mitigation efforts. Climate action would be a success only if there were the integration of non-state, sub-national, and national policies on climate protection. The paper discussed the interdependency of different levels of government, peer cities, and regions for efficient use of resources in the fight against climate change. The paper developed an ideal type of structure that could be applied to different climate protection projects after creating an analytical framework to identify and categorized the horizontal and vertical linkages in subnational climate policies. Using this understanding, it identified the vertical and horizontal forces which support the functions of information sharing, capacity building, and regulative/rule set. This framework was applied to nine different cases of subnational climate action in Brazil, Canada, China, India, Germany, and the USA, to understand how they interact vertically and horizontally to implement the climate action programs.

Walton (2018) in the article warned about the fallout of the rollback of federal actions to address climate change after President Trump's withdrawal from the Paris Agreement. The author listed the pros and cons of divergent strategies followed by different states in the United States of America for converting their economy from a predominantly fossil fuel energy-consuming giant to one that runs almost exclusively on clean, carbon-free energy. It is argued that though using electricity markets to push for rapid de-carbonization is the best way to expedite the process of achieving carbon neutrality, it would be very risky as the electricity corporates are quasi-public entities.

Blanc et al. (2019) developed a methodological framework to quantify carbon credits from carbon-oriented forest management and evaluate the economic sustainability of the same. They had studied two forest areas that were owned by public forest owners since 1953 and had been continuously designing and applying decadal Forest Management Plans. The authors thought that human-induced climate change cannot be avoided in the future and hence they suggested implementing sustainable forest management which mitigates this phenomenon. For this, they suggested stringent regulation and interest on the part of the government.

Nguyen (2019) in the article "The Relationship between Economic Growth, Energy Consumption, and Carbon Dioxide Emissions: Evidence from Central Asia" explored the relationship between economic growth, energy consumption, and greenhouse gas emission in five Central Asian countries, Kazakhstan, Kyrgyzstan, Turkmenistan, Uzbekistan, Tajikistan between 1998 and 2017. These countries heavily depended on fossil fuels like coal, oil, and gas exploration and export for their growth. According to the author, since the countries depended heavily on fossil fuels, they can reduce their carbon footprint only by increasing the use of renewable sources of energy for their domestic consumption.

Tetteh et al. (2021) in the journal article "Emerging carbon abatement technologies to mitigate energy-carbon footprint- a review" stressed the importance and need for innovative technologies and energy environmental resolutions for developing green and sustainable energy economies to reduce carbon footprints while transforming the global economy. The authors thought that there was limited discussion on both renewable socio-technological transition perspectives and emerging carbon abatement technologies. The systematic review of academic studies also revealed that there are limited options available to reduce energy-related CO2 emissions.

Shandilya et al. (2022) in their study, revealed that knowledge and capacity building, technology transfer, and social benefits were the most significant CDM benefits, respectively. It was because knowledge and capacity building tended to spread the awareness of Clean Development Mechanism benefits among policymakers and stakeholders. Stakeholders' awareness leads to efficient policy-making and encourages effective technology transfer in a way to achieve sustainable economic growth in the host country.

2.3 Clean Development Mechanism Projects

Klasson and Davison (2001) were two contractors of the US Government who in their paper, outlines a set of tools for carbon management analysis. It could be used for assessing the merits of carbon sequestering methods. They had given a standard set of criteria that can be applied to a wide variety of technologies for comparative purposes to assess the better technology among them. The methodology could be used to address long-term merit before engaging in a sequestration process.

Flower and Sanjayan (2007) presented the results of their research on environmentally sustainable designs for housing. The paper quantified the CO_2 emissions associated with each process involved in the manufacture of concrete. The production of Portland cement, which was widely used in the construction industry was found to be highly polluting, and at the same time the production of fly ash and ground granulated blast furnace slag which is a substitute was less polluting. The authors thought that right at the design stage, the buildings should be able to make energy efficient in such a way that they can generate renewable energy on-site, consume no non-renewable energy, and minimizes the mains water consumption. The tenants could also make carbon literate to reduce the overall CO_2 emission from the building.

Yulkin (2007) expounded on the possibilities for Joint Implementation Projects in the Russian Metallurgical Sector, which is second only to the power generation industry in terms of the volume of greenhouse gases that it emits. The paper discussed the possible reduction in pollution by replacing the existing obsolete production processes with modern technology. It is estimated that between 2008 and 2012, the carbon emission in metallurgical production will decrease from 3.786 to 3.243 tons of CO_2e per ton of steel leading to an emission reduction of 39.1 million tons of CO_2e.

In the case study by **Chee et al (2010)** related to a petroleum Refinery in Malaysia, the article explored the possibility of the refinery participating in the Clean Development Mechanism. The study concluded that there is a large emission gap, which could be closed by technological transfer from Annex I country. Hence, the company could participate in the emissions market for monetary benefits from transferring their 'credits' to developed countries.

Vucinic et al. (2010) gave a detailed plan of the Republic of Croatia for the mitigation of greenhouse gases through Waste Management. The Waste Management Strategy and Waste Management Plan of the country defined the criteria for sustainable waste management. It envisaged avoiding and minimizing waste, recycling, and recovery of waste as well as landfill gas. The article gave a detailed list of measures that could be taken to control emissions in the disposal of Municipal Solid Wastes. Mechanical Biological Treatment with bioreactor landfill was recommended for the reduction of gas emissions from landfills compared to raw waste. The projected emission reductions on the adoption of various measures showed a significant reduction of up to 19% by 2020.

Indira and Srividya (2012) reviewed the measures to reduce the emission of greenhouse gases from livestock rearing which was incidentally more than driving cars. Many approaches had been discussed here for reducing emissions in livestock. These included improving feeding practices, increasing productivity through breeding, and reducing livestock. Scientific development of feed formulation, improved animal genetics and changes in forage production has to be promoted to reduce emissions.

Lucanin et al. (2012) had given a good overview of the cloud computing business, and mitigation of CO_2e emissions, and the paper acts as a general guideline for running a data center to make it Kyoto compliant. Though there were many measures for controlling energy efficiency at data centers like Power Usage Efficiency (PUE), Carbon Usage Efficiency (CUE), and Water Usage Efficiency(WUE), it was only considered best practice and was not measured or controlled. The paper suggested that agencies like the US Environmental Protection Agency (EPA) could encourage the ICT to measure energy efficiency and reward the best data centers with an award. Another idea was to transfer the CO_2e emission responsibilities from the producer to the buyer of energy. This would result in three types of costs to the data center energy cost, CO_2e cost, and service cost. To maximize profit, the data center would have to reduce the emission cost and decrease energy consumption. They also proposed a wastage-penalty model that can be used as a basis for implementing Kyoto Protocol-compliant scheduling and pricing models.

Dixon et al. (2013) praised the decision to adopt modalities and procedures for carbon dioxide capture and geological storage as CDM in the meeting of UNFCCC in Durban, South Africa. This paper aimed to analyze the Durban CCS decision and its impact on future project proposals. The in-depth review and analysis in the paper led to the conclusion that the Durban CCS decision established a practical international standard for managing CCS projects and will lead to a high level of environmental protection. As per this decision, CCS projects would earn CERs under CDM and the lowest-cost projects will be rewarded fast. The paper also mentioned that as the price of CERs was declining and there was uncertainty regarding the second phase of the commitment period under the Kyoto Protocol, the CCS projects will need additional financial support to upgrade to a commercially viable project. Moreover, the EU's decision to only trade in CERs generated by least-developed nations was expected to be a setback to the uptake of CCS projects in developing countries. The only hope was that many new carbon markets are emerging and it might push up the CDM projects in developing countries. The International Legal Framework and the market mechanism for CCS projects had been put in place for all carbon markets to follow.

Rajput and Chopra (2014) discussed the basic concepts related to carbon credit as a tool for saving the environment and studied the business opportunities in emission markets in India's context. The paper referred to some of the largest CDM projects in terms of emission reductions in India. The project was designed to capture and destroy a gas known as HFC-23, which was a waste product during the production of HCFC-22, which was used in refrigerators, air conditioners, and the production of certain plastics. As HFC-23 is 11,700 times more harmful than CO2, such projects can earn more CERs. India's second-largest CDM project is the power plant by Torrent Power Limited in Gujarat, which uses natural gas instead of coal to produce electricity thus earning CERs for reduced emissions. JSW Energy is another major beneficiary of the CER system as it generated energy using waste gas produced by JSW steel. The researchers have expressed their doubt on whether a real reduction in emissions takes place when the emissions are controlled by regulations alone. Moreover, the establishment of CDM projects needed a workforce, which has in-depth knowledge of various green technologies. At the same time, we cannot undermine the level of international cooperation that has come about in carbon mitigation due to the Kyoto Protocol

Under **The Indo-German Environment Partnership Program (2014)** a report was prepared for India, to understand the social, environmental, economic, and technological achievements under CDM and to prepare a plan for the future. A significant example of registered CDM projects had been analyzed to understand the shortcomings in the registrations, issuance, and transaction process. The report confirms that a large number of investments had been made in CDM projects in India and 2% of the CER revenues is spent towards local community initiatives. Biomass CDM projects were the most efficient in creating jobs and renewable energy projects perform better than energy efficiency projects.

Nylander (2015) felt that the CDM had not been as successful as the architects of KP had envisaged it to be. Lax commitments from some Eastern European parties to the Kyoto Protocol led to very tepid trading between countries in carbon credits. As a result, there was very less demand for carbon credits and there is a possibility that some CDM projects would have to stop operating. Several countries had prepared voluntary domestic schemes, but the efforts to create demand were lagging behind the creation of additional supply.

Sharma and Satpal (2015) opined in their study, that controlled energy expenditure led to the saving of greenhouse gases in the atmosphere. Society had to be educated and informed about how we can make this earth a livable place and conserve it for future generations. The researcher thought that an academic institution should always encourage the public to accept new energy-efficient technologies by implementing the same in the institution. This work was a case study of an academic institution where the 1-star air-conditioners were theoretically replaced with 5-star air-conditioners and it was found that 161 tCO_2/year can be saved from being emitted to the atmosphere by consuming less electrical energy. It was also understood that revenue to the extent of four lakh rupees per annum could be generated by selling the carbon credits earned through Clean Development Mechanism

Manoukian et al. (2015) studied the nontechnical barriers to the commercialization of second-generation renewable energy technologies. The authors prepared a framework for the renewable energy technology commercialization process. The study was conducted in a case study form concentrating on 4 real cases of projects using renewable energy sources like wind, solar power, solar water heating/cooling, and biogas were chosen. The method of collecting primary data was interviews of project participants like project champions, representatives of site owners, local government leaders, financing entities, end users, and other people directly involved in the project. Secondary data was which validate the claims of the interviewee etc.

The findings of the study suggested that partnership synergy if achieved, produces a unique internal and external resource combination, which in turn results in successful technology commercialization.

Aldy (2016) in the study 'Mobilizing Political Action on Behalf of Future Generations' analyzes durable, successful public policies in US history like the 1935 Social Security Act, the 1956 Interstate Highway Act, and the 1970 Clean Air Act Amendments.

Shah (2016) addressed technologies adopted by organizations and baselines, factors, and risk levels associated with different registered CDM projects of energy sector organizations in Gujarat. The report covered the CDM projects registered under NCDMA in Phase I (until 2012) in Gujarat State, it was found that solar, and wind technologies are the major energy sectors, which have gone for the generation of carbon credits. The factors that had to be satisfied by CDM projects were that they needed to be eco-friendly, create employment, and should be feasible. It was found that CDM projects were influenced by variables; capital cost over-run risk, operational risk, and supply risk. The majority of the organizations had a tie-up with foreign parties and hence did not go for carbon trading. Those who go for carbon trading prefer forward contracts because of carbon price fluctuations.

Grassi et al. (2018) discussed the challenge of credible accounting of the sink in managed forests in the context of the Paris Agreement. Their study aimed to have a credible approach to an accounting of forest mitigation that can be compared to the accounting of emissions in other sectors. The article also assessed the EU-level impact of policies on forests. They had given a conceptual framework for accounting mitigation from forest management, which was comparable to other GHG sectors.

United Nations Framework Convention on Climate Change (2022) in the booklet titled "CDM Methodology" had given a comprehensive list of methodologies that can be adopted by a CDM project for determining its baseline, monitoring, quantifying, and estimating its emissions when the project is built. Estimating the emission was important to compare it to the baseline emissions to calculate the carbon credits eligible for the project. The booklet standardized the methodologies according to the diverse sectors, techno-economic situations, and geographical regions.

2.4 Earning Carbon Credits

Barry et al. (2001) said that forests have many important functions in Irish life and economy. The function of forests as a great storehouse of carbon was the idea, which was of interest to Ireland under the Kyoto Protocol. The Kyoto Protocol's rule that Afforestation + Reforestation – Deforestation = Net Change, is used to understand the positive or negative effect on the atmospheric carbon stock and will result in a carbon credit or debit in the country's final declaration of net emissions. The report concluded that growers should undertake planting decisions taking into account carbon sequestration and other environmental impacts. The growers should maintain a good record of all activities engaged to reap the full benefits of carbon credits.

Abramson et al. (2006) examined the evolution of the carbon-trading concept from its origins in air pollution programs of the government in the 1970s to its central role as a carbon reduction strategy in the 1998 Kyoto Protocol. According to their study, the spread of regional greenhouse gas initiatives from California to New York focused on reducing power plant emissions has helped increase the business community's interest in carbon trading. In addition, the Chicago Climate Exchange (CCX) played an important role in developing the carbon trading market in the United States of America. After comparing the carbon trading networks in many countries, the authors made several recommendations for improving their efficiency for global integration. They suggested keeping carbon-trading frameworks as simple as possible to reduce the number of loopholes, making contract specifications identical between various trading markets, avoiding implementation of personal carbon contracts due to their complexity, developing rigorous monitoring, and reporting standards to ensure fairness between different markets.

In the article, "Accumulation by Decarbonization and the Governance of Carbon Offsets" the authors **Bumpus and Liverman (2008)** discussed the management of international carbon offsets and analyze the origin and governance of offsets. The article made a comparison between the regulations for carbon offsets under the structures of the Kyoto Protocol's Clean Development Mechanism and unregulated Voluntary carbon offsets. They criticized both systems for sloppy definitions of additionality and development benefits. They thought that there existed unequal exchange and dispossession of rights in selling cheap credits to the North obtained from projects in the South. There was also a lack of transparency and participatory governance.

According to the **World Bank (2010)** report, it has taken many initiatives in carbon financing all over the world. Its carbon finance operations are an advantage in new public and private investments into projects, which contribute to climate mitigation in developing countries and economies in transition. As part of its carbon finance initiatives, it has also established several technical assistance facilities for capacity building and project preparation. It has helped the private sector easily choose environment-friendly technologies to reduce emissions the report lists its projects in 14 countries, which help in climate-friendly environmentally, and socially responsible projects.

Kerste et al. (2010) were of the view that a single global price for carbon was not there because there is no market for carbon globally and thus no political consensus. Financial data showed that carbon prices were highly volatile. The traded commodity was artificially 'created' and numerous methods to reduce the emissions made it highly arbitrary to determine the price. At the same time, new financial markets had been set for trading in AAUs, EUAs, CERs, ERUs, and RMUs. In these financial markets, there were contractual and financial instruments, agents working as intermediaries, and the whole sector was working towards seizing the opportunity in trading carbon. However, the success of carbon trading could only be measured by the amount of reduction in emissions or the number of emission rights traded. The low level of trade in Kyoto's AAU pointed to a lack of success. Out of CDM & JI, which are project-based Kyoto mechanisms, CDM had been deemed a success but trading activity in JI is low. The actual effectiveness of EU ETS is also doubtful due to various reasons. If the carbon market is to be sustained then according to the authors, more research is needed on the methodology for the calculation of threshold prices of carbon and the selection of projects for a reduction in emissions will depend on it.

Hansson (2010) analyzed the impact of the Emission Trading Scheme adopted by the European Union to solve the problem related to the emission of carbon dioxide. Based on the reports of the European Environment Agency, the author felt that though a small emission reduction would take place, the target of 8% relative to the base year 1990 will be difficult to achieve. Though the policy of EU ETS was not a solution to the problem of climate change, it can be used with a mix of other policy changes targeting individual polluters and creating awareness of clean energy.

MERCY CORPS (2010) in its report provided a simple outline of the terminologies involved and helps in deciding whether carbon revenue is an appropriate source of funding for a particular project. It gave a systematic report on selecting the projects by categorizing each based on renewable energy, energy efficiency, reforestation, afforestation, and Reducing Deforestation and Forest Degradation. According to the amount of reduction or capture of emission, it is decided whether it should be entered into compliance or voluntary market. According to the report, the actual process for determining the feasibility and the further implementation of the project will be influenced by the "Standard" and "Methodology". The methodology used will depend on the technology adopted and the standard being followed.

According to **Maclaren and Ford (2010)**, Kyoto Protocol rules were followed in trading carbon credits from afforestation and reforestation. Human-induced sinks could compensate for human-induced emissions, but looking at the ever-increasing usage of fossil fuels, there was a need for an ongoing expansion in the forest area or carbon density. The global area, which could be converted into forest, is limited and hence, this could not continue in perpetuity. Forest sinks are a popular topic in the current decade because they are seen as a relatively low-cost first step to reducing net greenhouse gas emissions. However, before enthusiastically adopting the trading in carbon sinks, numerous technical difficulties had to be overcome including the acceptance of a standard method of carbon accounting. The concept of multiplying the "ton-years" by the time the carbon was out of atmospheric circulation is flawed.

It threatened to undermine the “stocks” based accounting approach that was built into Article 3.3 of the Kyoto Protocol. According to the researcher, afforestation was merely the reverse of deforestation and is a one-off movement of carbon from the atmosphere to the earth’s surface. Hence, the landowner who undertakes to increase the long-term carbon density of a piece of land could be given a one-off payment of Carbon credits. No further transactions would be required unless the landowner makes land use/cover decisions, which will change the long-term carbon density again. An efficient audit system should be implemented to verify the continued existence of the stated land cover.

Paul (2010 & 2011) gave an overview of carbon credit and carbon trading in India. As carbon credit and trading emerged as a sustainable solution to the problem of climate change, the researcher explored the prospects of the same in India. Carbon trading had emerged as the fastest-growing financial market in the world economy. India had a large potential for reducing domestic carbon emissions by adopting the CDM technique as designed by the Kyoto Protocol. In 2007, India had a carbon trade of US $64 billion and was in second position in the CDM project by capturing a 6% market share. The per capita emission of greenhouse gas is 1.2 tons per year in the country and so if India had to realize its full potential of economic growth through carbon trading, proper policies had to be formulated and implemented which was absent in the present scenario.

Gupta (2011) explored India’s role in carbon trading and the production of carbon credits. The paper listed various CDM projects in India and their success in earning carbon credits. The researcher believed that it is not a penalty awarded to erring companies, but the rewards and recognition given to green firms make this system so popular and exclusive. It encouraged companies with limited emissions also to devise strategies to reduce emissions so that they can earn carbon credits. This system hence depollutes the environment increasingly.

Broderick (2011) in the thesis “Business as Usual? Instituting Markets for Carbon Credits”, concluded that climate change has necessitated substantial alterations to patterns of worldwide economic activities, right from a reduction in demand for energy-consuming activities to switches in technology, and sequestration of carbon dioxide through forestry. Under the guidance of the United Nations Framework Convention on Climate Change emission trading, systems have been introduced to correct the past mistakes of humankind through the new definition of property rights. It investigated the development, constitution, and consequences of the generation of credits as financial instruments awarded to organizations for reductions in emissions from 'business as usual'. Those parties who released emissions into the atmosphere consumed credits. There is a need to study the various agents involved in these exchanges and have to identify the economic and non-economic relationships that constitute these institutions. The commodification of atmospheric pollution has created problems socially and economically.

Takeuchi (2012) in the doctoral dissertation "Carbon Credits: Origin, Effectiveness, and Future Environmental and Energy Systems Studies" critically examined the effectiveness and environmental credibility of credits through studies of additionality and the CDM, which has largely dominated the carbon credit market. In-depth case studies of methodologies applicable and applied to large-scale electricity generation from CDM projects are included. The main objectives of the thesis were to find what is effective carbon credit and to understand whether Certified Emission Reductions (CERs) earned through the CDM represent additional emission reductions. The dissertation traced the concept of additionality under CDM, tried to understand its broader meaning, and examined its relationship to effectiveness. The findings showed that the environmental integrity of CDM can be improved by revisiting the theory of emissions reductions underlying the creation of credits.

Birla et al. (2012) said that Carbon Trading is the "Greenest" pasture for business trading for the small and large-scale private and governmental sectors in India with opportunities for everyone. In this study, the researchers reviewed and put forward the technologies and market standards that can be set so that the concept of carbon trading can have its roots in India too. Even though India is the largest beneficiary of carbon trading and carbon credits are traded on MCX, there is no proper policy for the trading of carbons in the market. In addition, the researchers suggest that a special statute be created for bringing in changes in the Contracts Act to govern the issues related to carbon credits.

Modi and Bhojak (2013) opinioned that carbon markets have played an important role in channeling finance and investment to projects that reduce greenhouse gas emissions in developing countries since 2005 when Kyoto Protocol came into existence. Many businesses are generating financial assets (carbon credits) through these projects and trading in them in the international markets. The sale of these credits contributes to meeting the incremental costs associated with greening investments. Hence, carbon finance is expected to remain a key instrument for catalyzing finance for low emissions development.

Promethium Carbon (2014) prepared a report for the British High Commission in Pretoria presenting the findings of the research project on the potential structuring of a carbon offset trading program in South Africa. The report's main objective was to investigate the possibility of implementing a carbon offset trading scheme in South Africa. The findings suggest that it will be possible provided maximum usage of existing infrastructure is done to ensure both the environmental and economic integrity of the system is maintained. The environmental Integrity of the system can be ensured by the utilization of existing offset standards like the CDM, VCS, or Gold Standard. Economic integrity can be assured by using the JSE as a trading platform and combining it with either a local registry such as Strate or ESC or an international registry such as Markit or APX. The research suggests a set of 'National Appropriateness Tagging Rules' to check the appropriateness of the projects traded in South Africa. These rules should specify the eligibility criteria for projects that can be traded within the system. After a high-level analysis of the potential market supply and demand, it was found that there is sufficient potential volume at a marginal cost of R1220 per ton of CO_2e to create a viable market. Hence, the overall conclusion was that there is sufficient demand and supply and the infrastructure to create a carbon offset trading scheme in South Africa.

Garg and Arya (2015) explored the growing financial market in India. Since India signed and ratified the Kyoto Protocol in 2002, the big and small companies in the country have exploited and embraced the concept of carbon credits. According to the findings of the study, the carbon credit market is the fastest-growing financial market in India. This study mainly focused on the business scenario of India. It also explained the carbon credit trading market mechanism and notes the accounting treatment of carbon trading of Indian Companies.

Kumari et al. (2013) tried to study the effect of carbon credits on the stock market. For this, they have done an empirical analysis between carbon credit and other indices like Greenex, Carbonex, Powerex, IIP, Msci, Gold, Exports, and Imports with the help of mean, median, skewness, kurtosis, correlation, and regression. They found that the factors like Msic, Greenex, Carbonex, Powerex, Gold, Imports, and Population have a direct impact on carbon credit. The factors influencing Greenex are population and Powerex. The factors influencing the Index of Industrial Production are Imports, Exports, and Greenex and the factors influencing Gold are Imports, Exports, Msci, and Greenex.

Rodrigues (2017) covered the fundamental ideas and the significance of carbon credit. The paper examined the business opportunities in carbon credits in the Indian context (Haslam, Butlin, Andersson, Malamatenios, & Lehman, 2014) and also identified and designed strategies to harness carbon credit.

Aliyu (2019) examined the corporate governance variables like the size of the board, board independence, board meeting, and risk management committee composition and their influence on Certified Emission Reductions in Nigeria. The finding of the study was that companies with more independent board members and more frequency of board meetings are likely to have a positive influence on CER. The number of board members and risk management committee composition does not have a significant influence on CER.

2.5 Compliance and Disclosure of Carbon Credits

UNFCCC (2008) in its report gave a detailed reference tool for stakeholders and Annex I countries to understand and navigate through the rules, systems, and procedures that underpin the Kyoto Protocol's accounting and compliance system. It guided the countries by a set of rules and regulations for accounting and compliance in the first Phase of the Protocol. It specified the rules regarding disclosure of information, which proved that the countries are meeting their commitments, rules for accounting of assigned amounts, and trading of Kyoto units.

Patnzik et al. (2016) in an article studied the importance of Carbon Credit Accounting and surveyed finance students and professionals in the emerging field of carbon credit accounting. They concluded that the awareness level was very low among even the educated masses and suggested that more social media should be used to make people aware of credits for reducing carbon emissions.

Ramesh (2012) gave a short preview of the Guidance Note issued by ICAI and observes that it does not address the accounting issues involved in JI and IET. Certified Emission Reduction is recognized as an asset only when the communication of credit of CER is received by the generating entity. CER should be valued at a lower cost and net realizable value. When CERs are taken as inventory, it is accounted for according to AS 2. CERs should be shown in the inventory separately from raw materials, work-in-progress, and finished goods. AS 9 Revenue Recognition, should be applied to the sale of CERs. Full disclosure of the number of CERs held, the number of CERs under certification, depreciation and maintenance cost of emission reduction equipment, expensed during the year should be made.

Agarwal and Prabhash (2013) discussed the different methods adopted by various CDM projects to account for CERs due to the lack of any mandatory guidance from ICAI. Different accounting standards were used when CER is taken as an intangible asset (AS26), contingent asset (AS29), an inventory (AS2), or as other income (AS9) to record the same. The advantages and disadvantages of the different methods were also discussed.

Shrivastava et al. (2015) collected annual reports of 30 Indian Companies for the year 2012. The reporting standards of CER have been compared according to the Guidance Note on Accounting for Self-Generated Certified Emission Reduction (CERs) issued by ICAI, 2012. The findings of the study showed that no Indian Company disclosed depreciation, maintenance, and operating costs of equipment used for CER reduction. The accuracy of the analysis is dependent upon the accuracy of the data in the annual report. This study focused on guidance notes on accounting for self-generated certified emission reduction. However, the lack of specific guidance furthers the scope for judgment and results in varying treatments.

Sedimbi (2017) tried to understand the concept of carbon credit accounting, its treatment in the books of accounts, and the effectiveness of carbon credit accounting with the help of a case study. This study focused on how Delhi Metro Rail Corporation (DMRC) has generated carbon credits by removing more than 91 thousand vehicles from the roads of Delhi daily. DMRC's second CDM project has been developed, based on the shift in the preference of the public from cars/buses and other means of road transport to the metro trains. Further, in Phase III, lifts and escalators designed with regenerative braking systems will be used, for claiming carbon credits. Although India is the largest beneficiary of carbon trading, there is still no policy for the trading of carbon in the domestic market. Hence, for the proper functioning and development of carbon markets and carbon trading practices, separate financial accounting standards must be established.

The objective of the research article by **Desai (2015)** was to analyze the carbon credit accounting practices of Indian companies and to compare the carbon dioxide emissions of developing countries. The data for the period 1990-2013 was found to show that CO2 emissions have increased all over the developing economies except in South Africa. India is at the top in emission levels followed by Brazil, Mexico, Iran, Saudi Arabia, and South Africa. In South Africa, it had shown a stable position indicating a positive effect of the efforts taken by the government and industry. The Indian companies had recorded the earnings from selling carbon credits as 'Other Income' in the absence of proper accounting standards issued by the Institute of Chartered Accounts of India (ICAI) and the International Accounting Standards Board (IASB).

Kamath et al. (2015) analyzed whether practicing accountants and educators are aware of Carbon Accounting and the key dynamics involved in reporting the same. The article also critically evaluated the problems faced by practitioners due to the absence of proper carbon accounting regulations and the concerns in the implementation of the guidelines issued by ICAI. They revealed that though CDM projects are registered in India, there was a lot of ambiguity in terms of accounting, taxation, legal and other issues

Carbon credit-related accounting policies of three companies, which come under the mandatory and voluntary markets in Australia, were studied by **Mookdee and Bellamy (2017).** They explored the methods of asset recognition and classification, measurement of emission, impairment testing, revenue, and expense recognition, accounting and disclosure policies and practices. The sample taken was of three companies, one each from mandatory, voluntary, and hybrid markets. The method of accounting adopted by each firm was based on factors like rules, regulations, and general accounting standards. The impairment testing of carbon credits by the hybrid company was based on information received on the prices from the government. Professional accountants and chartered accountants need to address the issues relating to the quality of accounting and promote standardization of accounting practices for carbon emission trading worldwide.

Soni and Bhanawat (2018) focused on the accounting and taxation issues of certified emission reduction generated through clean development mechanisms and voluntary emission trading schemes. Primary data was collected from 148 respondents and they found that there is a significant difference between recognition of CERs in the book of accounts, valuations of CERs held for inventory, different methods of recognition of revenue from the sale of CERs in the books of accounts and different heads of direct and indirect taxes when it is imposed on the sale of CERs.

Kumar and Firoz (2019) analyzed the carbon credit disclosure practices of 131 Indian Companies. Content analysis was done to understand when the companies have recognized the receipt of CERs, how the emission is measured and CERs calculated how it is presented and disclosed within the financial statements. Their study concluded that there is no uniformity in accounting for CERs among Indian companies. The study used only secondary data and hence the disclosure practices have not been validated by the accountants or auditors of the firms.

2.6 Sustainable Outcomes of CDM Projects

Golombek and Hoel (2005), explained the technological fallout of the implementation of the Kyoto Protocol. They argued that all such environmental agreements should suggest measures to technologically incentivize Research and Development along with other measures for decreasing emissions. The analysis of the present form of the mechanism under the Kyoto Protocol showed that the level of emission reduction will be much lower than expected. The main reason for such an outcome was the non-inclusion of research and development activities as one of the mechanisms under the Kyoto Protocol. If proper incentives were given to countries for research and development under the agreement, it will increase the investment in new technologies and the latest technologies can be shared with developing (Agarwal, 2008) countries, which, in turn, will lead to a higher reduction of emissions.

Tuyen and Michaelowa (2006) gave a detailed account of how Vietnam was helping electricity supply companies and energy-efficiency improvement projects. It calculated baseline emission factors of Vietnam Electricity Companies as per the procedure recommended by CDM Executive Board. Vietnam has a competitive advantage over other countries as all necessary parameters for large and small projects related to the electricity grid had been calculated by Vietnam. The Vietnam government and project developers had the tough task of collecting data and recording it as in the future, CERs would be issued only if documented data can be verified.

Rezende et al. (2007) examined the possible economic transactions from reforestation activity. Among these, carbon credit trading has the potential to generate sustained income and at the same time, companies can compensate for the pollution generated by them. Companies are forced to adopt sustainable development models by international organizations. This study analyses the sustainable income from reforestation in Brazil and concludes that there are significant opportunities to earn a return ranging from 5.22 % to 49.41% a year.

Cirman et al. (2009) gave a wide overview of greenhouse gas emissions and the drivers behind the emission. It looked into the implementation of Kyoto Protocol mechanisms in developed countries and developing countries like India, China, etc. It also analyzed the responses and attitudes towards Kyoto Protocol from the development perspectives of countries. The paper concluded that the loss in GDP because of commitment to the Kyoto Protocol is very low and varied among the countries. Moreover, the negative effect on GDP will be reduced if Kyoto Protocol is implemented globally. The activities undertaken to protect the environment were also creating new opportunities for many countries in the form of getting the latest technology in production, creating employment, new business relations, etc.

Dhingra et al. (2010) surveyed the level of awareness regarding carbon credits in Indian Small and Medium Sized Enterprises located in *Uttar Pradesh State Industrial Development Corporation*, Parsekhera Industrial area in Bareilly. A sample of 8 industries was selected and it was found that most of the industrialists were aware of the carbon emissions and they are actively involved in reducing their carbon emissions. Most companies were engaged in planting trees, water harvesting, etc. to maintain the ecosystem.

Sarkar and Dash (2011) opined that the Kyoto Protocol had only limited success in restricting emissions among the developed nations (G-8 Nations) through the "Cap and Trading System". The option for trading in Certified Emission Reduction certificates (CERs) had generated huge interest and motivation among the Annexure I and Non-Annexture I countries to generate and trade in CERs. Clean Development Mechanism has been widely used by Non-Annexure I countries like India, China, Mexico, Brazil, etc to earn credits by participating in the emission mitigation process at the same time it was found that there was very little consensus on the accounting and reporting standards to be followed in national and international markets. In the context of India, energy consumption has increased over the years with the rising standards of living. Though India is a major player in trading carbon credits in the international markets, it had only limited effects on carbon mitigation in India.

Nath and Das (2012) evaluated the role of village bamboo management in North East India in global climate change mitigation. In North East India, village bamboo was extensively used for household and handicraft preparation. They heavily depended on bamboo for the construction of their houses and the repair of existing houses. About 40 different fishing and agriculture-related products were made using bamboo. Therefore, the utilization of village bamboo provides the opportunity for increasing bamboo cultivation through which carbon sequestration is possible and at the same time, the social, ecological, and economic well-being of the region is achieved.

Revellino (2019) did an empirical analysis focussing on a simulated calculative device developed by Autostrade, a motorway management firm, to reduce CO2 emissions. The researcher found that the technological innovation of *Telepass* makes the use of vehicles a responsible and accountable action. Technological innovation helps in engaging the public in environmental concerns.

Ottonelli et al. (2023) opinioned that CDM projects should not only reduce carbon emission through the projects but also must include intended contributions to sustainable development in their scope. Though there was high solar irradiation in Latin American countries, only 25 solar photovoltaic projects were registered in the region. They found that there was a gap in project contribution to sustainable development. One of the features of the projects was the technological transfer of knowledge and equipment but it does not imply the development of the local solar technology industry; nor does it lead to community engagement, equal gender opportunities, improvement in water quality, and conservation of biodiversity.

Mele et al. (2021) supported the idea of countries meeting their greenhouse gas mitigation commitments and environmental objectives through multiple instruments. They cited examples of cooperation like the Clean Development Mechanism under the Kyoto Protocol, the Paris Agreement (Article 6), and also another form of cooperation established under the framework of Official Development Assistance (ODA). Their analysis showed that the Kyoto Protocol renewable energy projects were cost-effective and led to strong policy actions for environmental sustainability. The paper also advised policymakers to learn from the success of the Kyoto Protocol and apply multi-criteria decision-making approaches while implementing the Paris Agreement.

Nussbaumer (2009) in the article titled “On the contribution of labelled Certified Emission Reductions to sustainable development: A multi-criteria evaluation of CDM projects” praises the success of clean development mechanism for contributing to the global carbon market, and for being a flexible mechanism for achieving carbon emission reduction targets. The CDM projects are unevenly distributed among underdeveloped countries. In response to these concerns, Gold Standards and Community Development Carbon Fund have been launched. Gold Standard CERs are given to those CDM projects which are considered best practices and Community Development Carbon Fund is for working among the underprivileged. The study finds that such labelled CDM projects outperform ordinary CDM projects in achieving their sustainability goals.

2.7 Research Gap

The literature review has provided a comprehensive analysis of the Kyoto Protocol but very less on the success or failure of CDM projects, facilities for earning carbon credits, carbon credit accounting and disclosure, and their impact on sustainable development outcomes. While the Clean Development Mechanism has been successful in incentivizing emissions reduction projects with India becoming the second country next only to China, to earn carbon credits, there are still several gaps in our understanding of the CDM Projects.

The success of CDM projects depends on the participation of various stakeholders, including project developers, investors, host countries/states, and local communities. However, there is a research gap in the literature on the awareness of these stakeholders regarding the CDM projects and the government support available to them. One area of research that could be explored is the level of awareness among stakeholders, particularly local communities and project developers, about the CDM projects and their benefits. This research could investigate the extent to which the awareness or lack of it is affecting the formation and implementation of CDM projects.

Another area of research that could be explored is the role of government support in facilitating the development and implementation of CDM projects. This research could investigate the extent to which governments in developing countries are providing support to CDM projects, including financial support, technical assistance, and policy frameworks. It could also examine the impact of government support on the success of CDM projects and the factors that may be hindering governments from providing adequate support.

CDM projects play a crucial role in mitigating climate change by reducing greenhouse gas emissions. One way these projects are incentivized is by earning carbon credits and selling them in the international markets through Kyoto Protocol-based mechanisms. However, there is a research gap in identifying the hurdles that CDM projects face in earning carbon credits despite being fully commissioned. Very little literature is available on the challenges faced in navigating the complex process of earning carbon credits. The process involves several steps, including project design, validation, verification, and issuance, and can be time-consuming and costly. Research could investigate the barriers that renewable energy projects face at each step and identify ways to streamline the process and reduce costs. Additionally, the research could also explore the challenges that CDM energy projects face in selling their carbon credits in the carbon market due to its volatility and complex nature.

One aspect of the CDM that has received relatively little attention in research is the economic benefits of CDM projects for the company, host countries, and local communities. This research could investigate the extent to which CDM projects contribute to the income of the company, and the economic growth and development of the country, including job creation, income generation, and poverty reduction. It could also explore the distributional effects of these economic benefits, including the extent to which different segments of the population, such as women and marginalized groups, benefit from CDM projects. The findings of such research could inform policy decisions aimed at maximizing the economic benefits of CDM projects while minimizing any negative impacts.

One area of research that could be explored is the technology transfer that occurs through CDM projects. This research could investigate the extent to which CDM projects contribute to the transfer of environmentally sound technologies (ESTs) to developing countries and the generation of intangible assets through R&D. Another area of research that could be explored is the social benefits that CDM projects generate. This research could investigate the extent to which CDM projects engage the local population, contributes to uplifting the weaker sections through their empowerment, improves the basic amenities in the area, skill development, quality of life, and improve basic educational resources.

Additionally, the research could investigate the environmental benefits that CDM projects generate beyond greenhouse gas emissions reductions. One of the aims of the Kyoto Protocol is for CDM projects to contribute to biodiversity conservation, land restoration, and ecosystem services.

Overall, the research gap in economic benefits, technology transfer, social benefits, and environmental benefits in CDM projects presents an opportunity for the researcher to investigate the factors that contribute to the success or failure of CDM projects in achieving sustainable development.

Hence, the Research Gap can be summarized as follows:

1. The role of Stakeholders' Awareness and Government Support in the formation and implementation of CDM projects.
2. The prospects and challenges faced by Indian Companies in the formation and implementation of CDM projects in India.
3. The factors facilitating and issues faced in earning carbon credits.
4. The extent of compliance of Indian Companies to the methods of accounting and disclosure of Carbon Credits according to the guidelines set by ICAI.
5. Evaluate the achievement of Sustainable Development outcomes of CDM projects in India.

2.8 Chapter Summary

This chapter is a detailed review of the scientific articles on climate change leading to the adoption of the Kyoto Protocol in 1997 and coming into force in 2005. The Kyoto Protocol aims to mitigate the effects of climate change by reducing greenhouse gas emissions and promoting sustainable development. Therefore, further research in this area is done in the next chapter on Clean Development Mechanism which can help to strengthen the understanding of theoretical underpinnings and help to investigate the factors that contribute to the success or failure of CDM projects in achieving sustainable development.

Chapter 3

Clean Development Mechanism - An Overview

3.1 Introduction

The literature review of the previous chapter has led the researcher into addressing the following questions on theoretical aspects of Clean Development Mechanism, like, how the Kyoto Protocol was formed, what are the mechanisms under Kyoto Protocol for reducing emissions, what is the concept of carbon credits, how carbon credits are earned, how and who permits the formation of CDM projects in India, What are the steps in a CDM Project Cycle, how are they governed at the UNFCCC, what methodologies are used for measuring emission reduction, what are the baselines for calculating emission reductions, how are the CDM Projects registered, Is there a register to keep track of the carbon credits issued and sold, how are the carbon credits traded and where, how the carbon credits generated and sold should be accounted in the books of Indian companies, how many CDM projects have been registered by Indian companies and in which sector, what are the outcomes expected from setting up a CDM project, literature related to the benefits received from CDM projects. The answers to all these questions and more can be found in the following paragraphs.

3.2 Background of Kyoto Protocol

The review of literature in Chapter 2 revealed that scientists had been warning of the impending effects of Climate Change for a long time. The term "global warming" appears for the first time in print on August 8, 1975, with the publication of Wallace Smith Broecker's paper "Climatic Change: Are We on the Brink of a Pronounced Global Warming?" in the journal *Science*. (https://www.history.com/this-day-in-history/global-warming-appears-first-time-paper-science). The World Meteorological Society and the United Nations Environment Programme (UNEP) established '***The Intergovernmental Panel on Climate Change***' (IPCC) in 1988. It is the United Nations body for assessing the science related to climate change. It prepares comprehensive Assessment Reports about the state of scientific, technical, and socio-economic knowledge on climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place (https://www.ipcc.ch/). This report guides the countries in the world on how much climate change is going to affect each of them and hence motivates them to take steps to reduce emissions. After several rounds of negotiations among member countries, the ***United Nations Framework Convention on Climate Change*** (UNFCCC) came into force on 21st March 1994 which has the aim to improve the climate system of the planet through the proactive participation of all member countries toward the reduction of emissions. The first step taken by the convention was to recognize that there was a problem with how humans were treating the environment. This realization by the member countries was a big step in the face of scientific uncertainty at that time. The Convention had set itself a lofty goal of stabilizing greenhouse gas concentrations at a level that would prevent dangerous anthropogenic (human) interference with the climate system. It also envisaged that such a level should be achieved in a time-bound manner giving sufficient time to allow the ecosystem to adapt itself naturally to climate change. The aim was to ensure that food production was not threatened and to enable economic development to proceed sustainably. It puts the onus on developed countries to lead the way as they are the source of most of the greenhouse gas emissions and hence, were expected to cut the emissions from their industries. The industrialized countries agreed to share finance and technology with the less developed countries and the ***Kyoto Protocol*** was born.

3.3 Kyoto Protocol

The Kyoto Protocol came into force on 16th February 2005 after a complex ratification process and this led to the strengthening of the *United Nations Framework Convention on Climate Change* (UNFCCC). It got the authority to set limits to the maximum amount of emission of greenhouse gases (GHGs) by setting individual targets for each country. It asks the countries to mitigate carbon emissions and to report periodically. It recognizes that developed countries are largely responsible for the present situation of ozone depletion. Hence, it follows the principle of "common but differentiated responsibility and respective capabilities", and hence it binds only 37 industrialized countries, economies in transition, and the European Union, and holds them to individual targets mentioned in annexure-B in the first phase of the protocol. The Kyoto Protocol which is the only legally binding treaty to reduce carbon emissions has two commitment periods. The first commitment period is five years between 2008 to 2012 during which the developed countries had to reduce by 5% emission compared to the 1990 base level. On December 8th, 2012, the Doha Amendment was passed to adopt a second commitment period starting from 2013 till December 2020. However, the composition of parties and the rules relating to the operation of mechanisms changed in the second commitment period.

Table 3.1

Countries included in Annex B to the Kyoto Protocol for the First Commitment Period and Their Emissions Targets

Country	Target (1990** - 2008/2012)
EU-15*, Bulgaria, Czech Republic, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia, Switzerland	-8%
US***	-7%
Canada,**** Hungary, Japan, Poland	-6%
Croatia	-5%
New Zealand, Russian Federation, Ukraine	0
Norway	1%
Australia	8%
Iceland	10%

Source: https://unfccc.int/

Though the developed countries were given a target of 5% to be reduced from 1990 levels in the first phase, based on the European Union and member countries (15 at that time) went beyond the target of 5% and committed themselves to an 8% emission reduction. The United States did not ratify the Kyoto Protocol and Canada withdrew from the agreement on 15 December 2012 (https://unfccc.int/).

3.4. Kyoto Mechanisms

An important element of the Kyoto Protocol was the establishment of three flexible mechanisms. The member countries had to reduce the emissions in their countries through national measures and at the same time were given additional means to meet their targets by way of three market-based mechanisms. These mechanisms provide cost-effective methods to reduce emissions and at the same time promote investment in new technologies in developing economies (https://unfccc.int/process/the-kyoto-protocol/mechanisms). The three Kyoto Mechanisms are as follows:

1. Joint Implementation (JI)

The Kyoto Protocol has given common but differentiated responsibilities to the developed and developing countries. Under it, the developed countries (annex I countries) are allotted a fixed amount of Assigned Amount Units (AAUs) by the UNFCCC. This represents the maximum amount of greenhouse gases that they can emit into the atmosphere. These AAUs will be in turn distributed to the industrial units in the country who want to emit carbon into the atmosphere.

Apart from this, a developed country can also set up projects that reduce carbon emission in another developed country to earn carbon credits from UNFCCC. Under this mechanism known as the Joint Implementation, a developed country with relatively high costs of domestic greenhouse reduction would set up a project in another developed country and earn Emission Reduction Units (ERUs) from the UNFCCC. The emission reduction or removal project equivalent to 1 ton of CO2 each will be certified and can be set off against the countries own emissions.

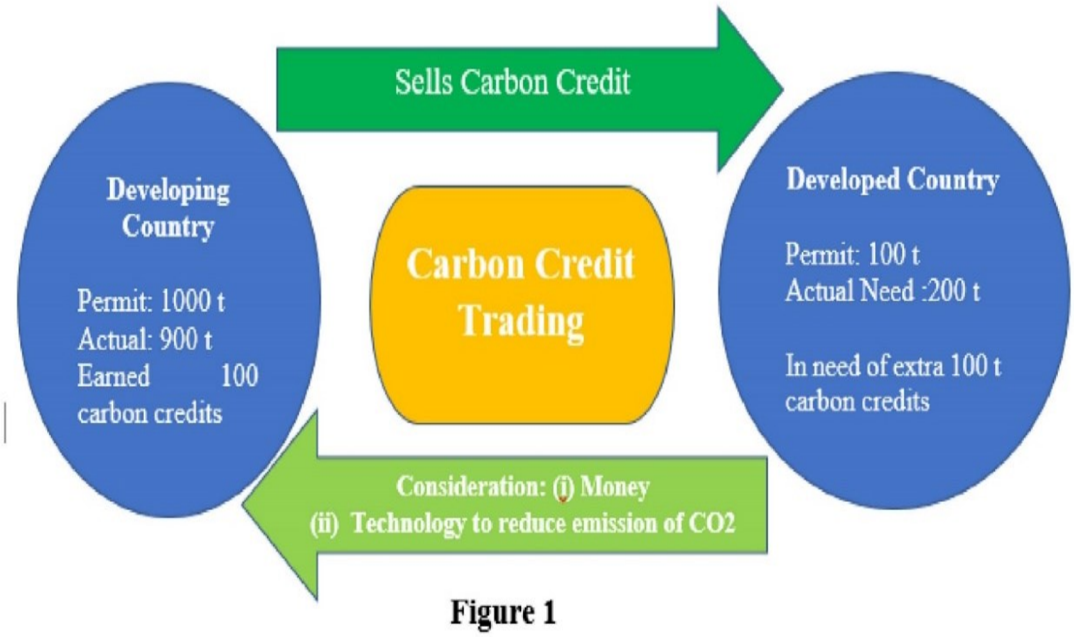
2. International Emissions Trading (IET)

This is a facility provided to developed countries so that they can trade in the international carbon credit market to cover their shortfall in assigned amount units.

Developing countries with surplus units can sell them to countries that are exceeding their emission targets. This is explained in the following diagram.

Figure 3.1

International Emissions Trading



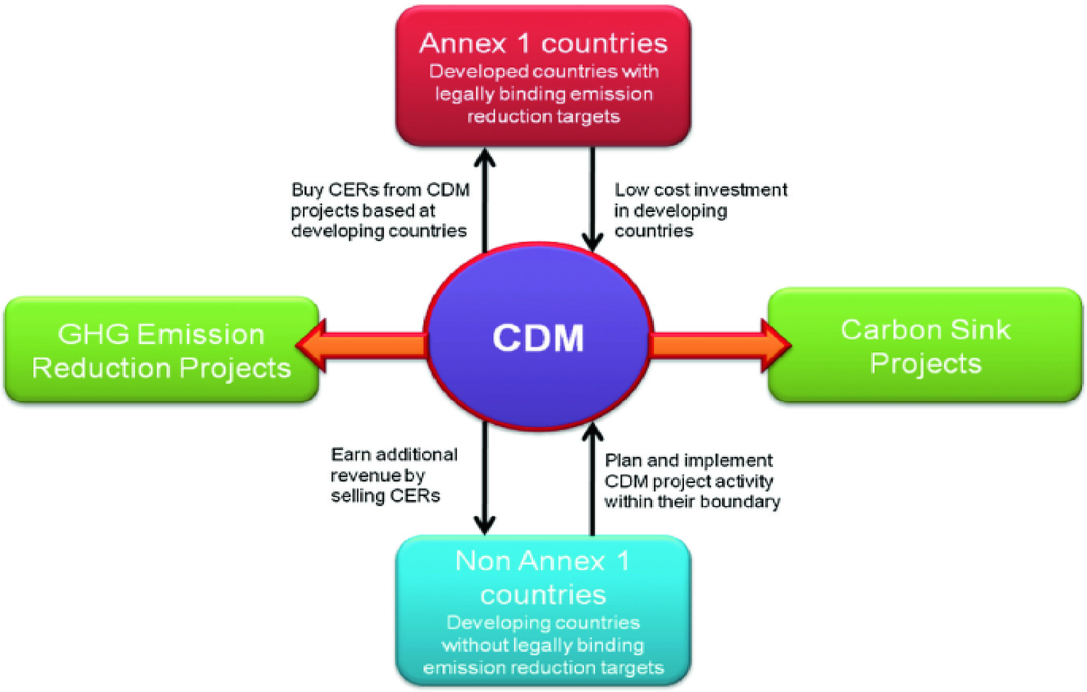
Source: The Daily Guardian, September 17, 2022

3. Clean Development Mechanism (CDM)

A developed country can sponsor a greenhouse gas reduction project in a developing country where the cost of greenhouse gas reduction project activities is usually much lower, but the atmospheric effect is globally equivalent. The developed country would be given credits (Certified Emission Reductions- CERs) for meeting its emission reduction targets, while the developing country would receive capital investment and clean technology or beneficial land use, land-use change, and forestry. Only a portion of the company's total earnings of carbon credits can be transferred to the company of the developed country under CDM. The rest is issued to the host party which they can sell in the international market to the developed companies in Annex 1 countries which have not been able to meet their carbon emission reduction targets. This CDM mechanism is explained in the diagram below.

Figure: 3.2

The Workings of the CDM Mechanism



Source: Touseef Ahamad and Deepthi, "Clean Development Mechanism and Green Economy."

3.5 Greenhouse Gases Controlled under Kyoto Protocol

Under the Kyoto Protocol, the following gases are considered 'greenhouse gases' which have to be controlled.

Table 3.2

Greenhouse Gases which have to be Controlled under Kyoto Protocol

Greenhouse Gas	Chemical Symbol	Sources
Carbon Dioxide	CO_2	Occurs naturally. Other sources are landfills, coal mines, paddy fields, natural gas systems, and livestock.
Methane	CH_4	There are many anthropogenic (influenced by humans) and natural sources that release methane. Landfills, oil and gas infrastructure, agricultural practices, coal mining,

Greenhouse Gas	Chemical Symbol	Sources
		stationary and mobile combustion, wastewater treatment, and certain industrial operations are only a few examples of the sources of anthropogenic emissions of methane.
Nitrous Oxide	N_2O	Generated by burning fossil fuels, in the manufacture of fertilizer, and by the cultivation of soils.
Perfluorocarbons (PFCs)	Various compounds	Human-made chemicals. A by-product of aluminium smelting. Also used as a replacement for CFCs in manufacturing semiconductors.
HFC's	Various compounds	Human-made chemical. Used largely in refrigeration and insulating foam.
Sulphur Hexafluoride	SF_6	Used largely in heavy industry to insulate high-voltage equipment and to assist in the manufacture of cable cooling systems.

Source: Compiled by the research scholar

3.6 Carbon Credit– the Concept

A carbon credit is a generic term to assign a value to a 'reduction' or 'offset' of greenhouse gas emissions. A carbon credit is usually equivalent to one ton of carbon dioxide equivalent ($CO2_e$). A carbon credit can be used by a business or individual to reduce their carbon footprint by investing in an activity that has reduced or sequestered greenhouse gases at another site.

"Carbon credits are those bits of paper that allow corporates to buy and sell the right to pollute the air." (Srinivas, Nidhi, June 1, 2008, *The Economic Times*). Hence Carbon Credits can be in the form of ERUs, generated by a Joint Implementation project, CERs generated from a clean development mechanism project or RMU, a removal unit based on land-use, land-use change, and forestry (LULUCF) activities such as reforestation.

3.7 Clean Development Mechanism

The Clean Development Mechanism (CDM) gives opportunities to corporates in developing and least-developed countries to not only participate in the emission-reduction drive but also earn revenue by trading in carbon credits. This is possible by setting up CDM projects which reduce greenhouse gas emissions, thereby generating Certified Emission Reductions (CERs). One metric ton of carbon saved by such projects equals one Certified Emission Reduction (CER) unit and can be traded and sold to entities in developed countries to meet their emission reduction targets under the Kyoto Protocol.

The mechanism was developed to include the developing nations to achieve sustainable development and reduce emissions and at the same time, give industrialized countries a flexible mechanism to meet their emission reduction targets. CDM projects are owned by various types of entities, depending on the sector, project type, and other factors. Some of the different types of entities that own CDM projects are public sector companies, private sector companies, Hindu Undivided Families (HUFs), joint ventures, special purpose vehicles (SPVs), non-governmental organizations (NGOs), and community-based organizations. It reflects the diversity of approaches and the actors involved in climate change mitigation.

The projects which are aspiring to register with UNFCCC under the CDM mechanism have to qualify through a rigorous and public registration and issuance process which is designed to ensure measurable and verifiable emission reduction which would not have taken place (additionality condition) otherwise. The whole mechanism is run by the CDM Executive Board (EB), which in turn is answerable to the countries which have ratified the Kyoto Protocol. Before registering as a CDM project with the UNFCCC, it must first be approved by the Designated National Authority (DNA) of the host country (https://cdm.unfccc.int/faq/index.html). In India, the Central Government constituted the National Clean Development Mechanism (NCDMA) Authority, which is the DNA, for the evaluation and approval of projects, according to the UNFCC guidelines.

3.7.1 National Clean Development Mechanism Authority (NCDMA)

The Conference of Parties (COP-7) to UNFCCC decided that, for registering the projects under the CDM, it has to first get the approval of a National Authority for the CDM in the host country and get a confirmation that the project is assisting the host country in achieving sustainable development. India ratified the UNFCCC-backed Kyoto Protocol in August 2002 and to fulfill this prerequisite, the Ministry of Environment and Forests (Climate Change), constituted the National Clean Development Authority (NCDMA) on 16th April 2004 under an extraordinary gazette (https://ncdmaindia.gov.in/viewPDF.aspx?pub=notification.pdf). Hence, the NCDMA is the DNA of India for CDM Projects. The NCDMA is chaired by the Secretary (Environment and Forests) and members are either the officer bearers of Foreign Secretary, Finance Secretary, Secretary of Industrial Policy and Promotion, Secretary of Ministry of Non-conventional Energy Sources, Secretary of Ministry of Power, Secretary of Planning Commission, Joint Secretary (Climate Change), Ministry of Environment & Forests, and Director (Climate Change) Ministry of Environment & Forests or their nominees. The office of NCDMA is situated on the 6th floor, Jal Wing, Indira Paryavaran Bhawan, Jorbagh, New Delhi

3.7.2 Functions of NCDMA

a) To evaluate and approve the projects as per the guidelines, rules, and modalities of CDM.

b) To assess the probability of eventual successful implementation of CDM projects and to assess the extent to which the said project will help in meeting sustainable development objectives and to prioritize the projects according to national priorities.

c) To ensure that the project proposal meets the national sustainable development priorities, is compatible with local priorities, and that the stakeholders have been duly consulted.

d) Financial review of the project proposals has to be carried out to rule out the diversion of official development assistance and also that the market environment of the CDM project does not lead to under-valuation of CERs, particularly of externally aided projects.

e) To maintain a registry of approved CDM projects, their potential to generate CERs, and confirm that these have been realized.

f) To ensure that project developers have reliable information relating to all aspects of CDM, including providing a database on organizations designated by UNFCCC to carry out validation, monitoring, and verification of CDM project activities.

g) To collect, compile, and publish technical and statistical data relating to CDM project activities in India.

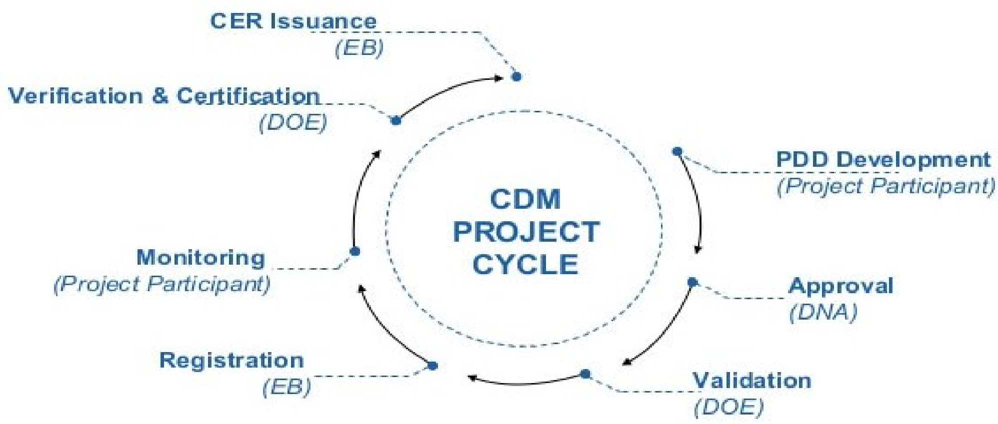
The National Clean Development Authority should report to Central Government once in three months (https://ncdmaindia.gov.in/ViewPDF.aspx?pub=notification .pdf).

3.7.3 CDM Project Cycle

Any legal entity in a developing country, desirous of undertaking a CDM project to generate carbon credits, needs to go through several stages, which is known as the CDM Project Cycle. The steps in CDM Project Cycle are project design document preparation, getting approval from the national authority, validation by Designated Operational Entity (DOE), registration by the CDM Executive Board, regular monitoring of the emission reduction, verification, and certification by the DOE, and issuance of carbon credits. The cycle can be shown briefly as under.

Figure 3.3

Project Cycle



Source: https://biomasspower.gov.in/biomass-info-global-CER-VER.php

The CDM Project Cycle has seven steps (CDM Executive Board, UNFCCC, 2008) which can be understood in brief as follows.

1. Project Design Document

The first step is the preparation of a Project Design Document (PDD). Before drawing up the PDD, the promoters have to first define the goal that is to be achieved by the implementation of the project. Following that, the objectives have to be set, identify the risk, limitations, and assumptions. The budget for the carbon project has to be prepared and the process of approval and monitoring has to be understood. After that, the PDD can be prepared in the appropriate format.

The format of the PDD has the following Sections.

Sections	Title
Sec A	Project Activity
Sec B	Baseline and monitoring methodologies
Sec C	Duration of Project Activities
Sec D	Environmental impacts
Sec E	Stakeholder’s comments

Source: CDM Executive Board, UNFCCC, 2008

a) Sec A. Project Activity

Sec A has sub-sections from A1 to A4.

- Sec A1-This section of the PDD indicates the title of the project, the current version number of the document, and the date when the document was completed.
- Sec A2- The technology used for the project, the emission sources, and gases included in the project for calculating total emissions and baseline emissions are to be given in detail.
- Sec A3- A list of project participants, and the name of parties who have given their approval for sharing their knowledge with the host party is given here. Also, details of whether the parties involved wish to be considered as project participants are to be mentioned clearly in a table format.
- Sec A4- The PDD clearly states the host party's name and address, the project's physical location, and the category to which the project can be classified. This section also contains an explanation of the environmental safety aspects of the technology to be used in the project. In addition, the estimated amount of emission reduction that is expected from the project on an annual basis over the crediting period and the parties, which are funding the project, should be mentioned.

b) Sec B. Baseline and monitoring methodology

This section of the PDD clearly states the approved baseline taken from the UNFCCC CDM website for the project. It states the number of emissions that are existing for various GHG gases in the atmosphere before the greenhouse-gas reduction project. The target emission for each greenhouse gas that is to be achieved with the implementation of the CDM Project is also given and the additionality of the project is explained. A detailed explanation of the methodologies that are to be used for achieving the objective is mentioned. The relevant equations in the approved methodologies that will be applied to calculate the project emissions and leakage emissions expected during the crediting period are provided in the document. A detailed description of the monitoring plan, the arrangements made for data collection, achieving the targeted reductions, and the parties involved in monitoring the same are to be mentioned.

c) Sec C. Duration of the Project Activity/ Crediting Period

This section mentions the date from which the crediting period of the project activity starts and the length of the crediting period in years and months.

d) Sec D. Environmental Impacts

Documents showing the environmental impact of the project, which, the Host Party considers significant, should be included in the PDD.

e) Sec E. Stakeholders' Comments

Comments are invited from local stakeholders and it is compiled and submitted in the PDD. The host party has to explain how it has taken due account of the comments received from stakeholders.

2. National Approval

This stage in CDM Project Cycle is getting the approval of the Designated National Authority (DNA). The PDD is submitted to the DNA and it assesses the potential of achieving the sustainable development goals of the host country through the project. Then it issues a letter of approval, which confirms that the country has ratified the Kyoto Protocol, and it is voluntarily participating in the CDM Project.

3. Validation

In this stage, the projects have to be validated by the Designated Operational Entity (DOE). DOEs are independent auditors who are approved by the CDM Executive Board (CDM EB). The DOE validates the project proposals by verifying whether the project will satisfy the greenhouse-gas reduction targets.

4. Registration

After the validation, the DOE submits a request for registration of CDM project activities to the CDM Executive Board. After the updated PDD, written approval of the host party, and other documents mentioned in the UNFCCC checklist are submitted for registration, the registration fee is paid.

5. Monitoring

At this stage, the project participant is responsible for monitoring the actual greenhouse-gas emissions and documenting all steps involved in the calculation of emission reductions according to the methodology given in the PDD.

6. Verification and Certification

The sixth stage is the verification stage, where the DOE is entrusted to verify whether the said reductions in greenhouse gas have occurred or not and to see that the monitoring activity was carried out according to the approved monitoring plan. A verification report/certificate is issued by the DOE, stating that the CDM project has achieved the emission reduction in the specified period to the project participant and the CDM Executive Board.

7. Issuance of Certified Emission Reductions

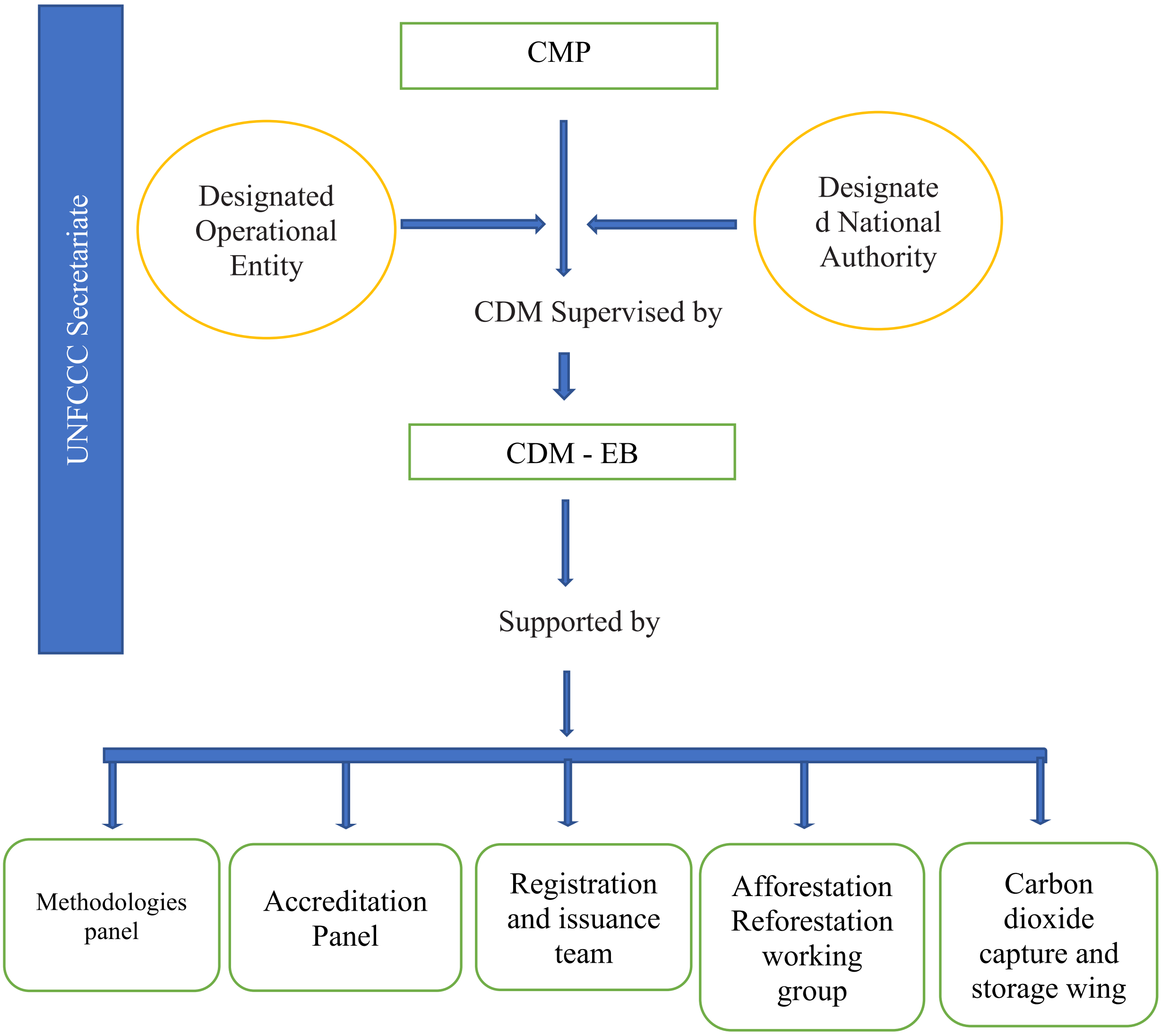
The certificate given by the DOE to the CDM EB constitutes a request to issue CERs to the extent of reduction of emissions as mentioned in the report. Within 15 days after verification of the report, the procedure to issue CERs is started. If a party involved in the project activity or three members of EB request a review of the project, the issuance request goes for a review. Once the decision to issue CERs is taken by the Executive Board, the CDM Registry administrator issues a specified number of CERs to the pending account of the Executive Board. Out of that, the Registry administrator forwards the quantity of CERs which is equal to the value of administrative expenses and other related costs incurred to the appropriate accounts in the CDM registry. The rest of the CERs are issued to the project participants, and Parties involved, at their request.

3.7.4 Governance of CDM at the UNFCCC

The administrative setup of the UNFCCC for the implementation of CDM projects is as follows:

Figure 3.4

Governance of CDM at the UNFCCC



Source: Compiled by the researcher

1) **CMP**

CMP is the acronym for Conference of Parties (COP) serving as the Meeting of the Parties to the Kyoto Protocol. The COP was first held in Berlin, Germany in March

1995 and has been meeting every year since. The COP is the supreme decision-making body of the UNFCCC. All countries that are party to the UNFCCC are represented in the COP, which, has the task of reviewing the implementation of the convention and supervising the institutional and administrative arrangements. It decides on the recommendations made by the Executive Board and designates Operational entities that are given provisional accreditation by the Executive Board (https://cdm.unfccc .int/EB/governance.ht ml).

2) CDM EB

The CDM Executive Board (CDM EB) works under the authority and guidance of the CMP. CDM EB is the final authority for the registration and issuance of CERs to the CDM Project Participants. It must supervise the activities of the CDM and issue CERs to deserving projects after proper validation and verification.

3) DOE

A designated operational entity (DOE) is usually any domestic legal entity or an international organization accredited and designated by the CDM EB on a provisional basis until it is confirmed by the CMP. The first function among the two main functions of a DOE is to validate a proposed CDM project activity and subsequently request its registration to the CDM EB. The second function is to verify the emission reductions of a registered CDM project and to request the CDM EB to issue CERs for the same. As on 19 November 2019, 30 DOEs have been accredited and provisionally designated for validation functions and are listed on the UNFCCC site (https://cdm.unfccc.int/DOE/list/index.html).

4) DNA

A country, which is participating in CDM activities has to designate a national authority (DNA), which will evaluate each project proposal under CDM submitted in the prescribed format. The DNA has to give a letter of approval that the host country is a voluntary participant in the CDM activities.

For assisting the CDM Executive Board in doing its duties, it has established various committees, panels, or working groups according to its functions. They are as follows.

1) Methodologies Panel

The methodologies panel develops various guidelines for methodologies and decides the baseline of different types of CDM Projects. This panel is also responsible to verify and approve the new baselines and monitoring methodologies, which are proposed by parties to a CDM project if such methodologies and baselines are not yet set by the UNFCCC.

2) Accreditation Panel

The Accreditation Panel is entrusted with developing recommendations, to assist the CDM EB in decision-making. The panel must give accreditation to operational entities according to the standards and procedures set for it.

3) Registration and Issuance Team

This team consists of external experts who assist the CDM EB in assessing any requests for registration of project activities and also in assessing the request for issuance of CERs.

4) Afforestation and Reforestation Working Group

This panel exclusively deals with preparing recommendations for new baseline and monitoring methodologies for CDM afforestation/reforestation project activities in consultations with the methodologies panel.

5) Carbon Dioxide Capture and Storage Working Group

This working group prepares recommendations on submitted proposals for new baseline and monitoring methodologies for carbon dioxide capture and storage.

3.7.5 Type of Entities Owning CDM Projects

CDM projects can be owned by various types of entities, public and private, depending on the type of CDM projects which match their interests. Some of the different types of entities that own CDM projects are:

a) Public sector companies: These are companies that are owned and operated by the government or other public entities. They may own CDM projects related to renewable energy, waste management, or other sectors.

b) Private sector companies: These are companies that are owned and operated by private individuals or entities. They may own CDM projects related to a variety of sectors, including energy, manufacturing, and waste management.

c) HUFs: Hindu Undivided Family is a form of business that is owned and carried out jointly by members of a family and is a unique form of business found only in India. The Karta who is typically the oldest member of the family runs the business on behalf of all members of the family.

d) Joint ventures: Joint ventures are partnerships between two or more companies that come together for a specific project or business opportunity. Joint ventures can own CDM projects related to a variety of sectors.

e) Special Purpose Vehicles (SPVs): These are companies that are created for a specific purpose, such as developing and operating a CDM project. SPVs may be owned by a single company or by a group of companies.

f) Non-Governmental Organizations (NGOs): These are non-profit organizations that work in various sectors, including environment and sustainability. NGOs may own CDM projects related to sustainable agriculture, forestry, or other sectors.

g) Community-based organizations: These are organizations that are owned and operated by local communities. They may own CDM projects related to renewable energy, waste management, or other sectors that benefit the community.

Overall, the ownership of CDM projects can vary depending on the areas of interest of each type of entity, reflecting the diversity of approaches to involvement in climate change mitigation.

3.7.6 Sources of Renewable Energy Used in the CDM Projects

CDM (Clean Development Mechanism) projects are designed to encourage the development and deployment of clean and renewable energy technologies in developing countries. Therefore, sources of renewable energy in CDM projects are varied and can include:

1. Wind power: Wind turbines can generate electricity without producing greenhouse gas emissions, making them an excellent source of renewable energy in CDM projects. Wind energy projects can range from small-scale turbines for individual homes to large wind farms that generate electricity for entire communities.

2. Solar power: Solar energy is another popular source of renewable energy in CDM projects. Solar panels can be used to generate electricity, heat water, or power other devices. In addition, concentrated solar power (CSP) plants can be used to generate electricity on a larger scale.

3. Natural gas is not typically considered a renewable energy source for CDM projects because it is a fossil fuel, meaning it is a non-renewable resource that is finite and will eventually run out. While natural gas is cleaner-burning than coal or oil, it still produces greenhouse gas emissions when it is burned.

   However, natural gas can still play a role in reducing greenhouse gas emissions through the use of certain technologies. For example, natural gas can be used in combination with carbon capture and storage (CCS) technology, which captures the carbon dioxide emitted during natural gas combustion and stores it underground. This can significantly reduce the amount of greenhouse gases emitted into the atmosphere.

In addition, natural gas can also be used as a "bridge" fuel to transition away from more polluting fossil fuels towards renewable energy sources. For example, natural gas can be used to replace coal or oil in power generation, which can significantly reduce greenhouse gas emissions in the short term while renewable energy technologies are being developed and deployed.

Overall, while natural gas is not considered a renewable energy source for CDM projects, it can still play a role in reducing greenhouse gas emissions in certain contexts. However, it is important to continue investing in and deploying renewable energy technologies to ultimately transition away from fossil fuels and towards a more sustainable energy future.

4. Hydropower: Hydropower uses the force of falling or flowing water to generate electricity. Hydropower projects can range from small-scale installations, such as waterwheels, to large hydroelectric dams that generate electricity for entire regions.

5. Biomass: Biomass energy is produced from organic matter, such as wood, agricultural waste, and municipal waste. This energy source can be used for heating, electricity generation, and transportation fuels.

6. Waste heat can indeed be a source of renewable energy, as it involves capturing and using the heat that would otherwise be wasted in industrial processes or power generation. This type of energy is often referred to as "waste heat recovery." Waste heat can be recovered in industrial processes, power generation, transportation, buildings, etc.

7. Thermal oxidation is a commonly used technology for emission reduction in Clean Development Mechanism (CDM) projects. Thermal oxidation can be used to treat emissions of volatile organic compounds (VOCs) and other hazardous air pollutants, which are often generated by industrial processes such as chemical manufacturing or oil and gas production. By using thermal oxidation to destroy these pollutants, CDM projects can reduce their emissions and generate Certified Emission Reductions (CERs), which can be sold on carbon markets.

8. Waste Hydrogen gas: In some industrial processes, waste hydrogen gas is generated as a by-product and is often released into the atmosphere. However, this waste gas can be captured and used as a fuel source, reducing the need for fossil fuels and reducing greenhouse gas emissions. CDM projects that utilize waste hydrogen gas as a source of energy can generate Certified Emission Reductions (CERs) by displacing fossil fuel use and reducing greenhouse gas emissions. Additionally, the use of waste hydrogen gas can provide economic and social benefits by providing a local source of renewable energy and reducing waste.

9. Coal reduction can be considered as a source of energy for CDM projects, as reducing coal consumption can result in a reduction of greenhouse gas emissions. Coal is a fossil fuel that is commonly used for electricity generation and industrial processes, but it is a significant contributor to global greenhouse gas emissions. CDM projects aimed at coal reduction can take several forms. One approach is to improve the energy efficiency of existing coal-fired power plants or industrial processes, which can reduce the amount of coal needed to produce a given amount of energy or product. Another approach is to replace coal with lower-emitting fuels, such as natural gas, renewable energy sources, or waste-derived fuels. CDM projects that focus on coal reduction can generate Certified Emission Reductions (CERs) by reducing greenhouse gas emissions and displacing fossil fuel use. Additionally, these projects can provide economic and social benefits by reducing dependence on fossil fuels, improving energy security, and promoting sustainable development.

10. Geothermal energy: Geothermal energy is produced by harnessing the heat from the earth's core. Geothermal energy projects can range from small-scale installations, such as geothermal heat pumps for homes, to large geothermal power plants that generate electricity for entire communities.

11. Ocean Energy: Ocean energy harnesses the power of the ocean to generate electricity. This includes technologies such as tidal energy, wave energy, and ocean thermal energy conversion (OTEC).

Overall, renewable energy sources in CDM projects will depend on the specific needs and resources of the project site. The goal is to find the most suitable and sustainable source of renewable energy to meet the energy demand while reducing greenhouse gas emissions.

3.7.7 Methodologies to Calculate Emission Reductions

For any CDM Project, environmental and methodology integrity is vital for the proper mitigation of emissions. Methodologies help establish the baseline emissions of a project. It can be used to monitor, quantify and accurately measure the emissions once the project starts. The difference between the baseline and actual emissions shows the amount of emission reduction that has taken place due to the implementation of the CDM Project. This forms the basis for the issuance of CERs. Hence, it is very important to have a standard set of methodologies. The UNFCCC releases a standard set of methodologies after updating regularly, which covers sector-wide emissions. (UNFCCC, 2019).

The CDM methodologies are quite complex but standardized to suit diverse sectors, techno-economic situations, and geographical regions. The methodologies can broadly be classified into five categories.

1) Methodologies for large-scale clean development mechanism project
2) Methodologies for small-scale clean development mechanism project
3) Methodologies for large-scale afforestation and reforestation CDM Project activities
4) Methodologies for small-scale afforestation and reforestation CDM Project activities
5) Methodologies for carbon capture and storage (CCS) project activities

The first four categories of methodologies are approved but have no approved method for CCS project activities (UNFCCC, 2019).

Under the CDM method of reduction of emissions, the parties to the project have to submit for approval, the methodologies that are going to be adopted for recording the emission of gases. If no suitable methodologies are available, the project participant can submit a proposal for a new methodology in the prescribed format and it will be evaluated by the Methodologies Panel of the CDM Executive Board. The new methodology may be approved or rejected by the Board and if rejected, the project participants can resubmit a fresh proposal after considering the recommendations of the Panel.

3.7.8 Standardized Baseline for Measuring Emission Reduction

The Marrakech Accord defines the baseline for a CDM project activity as "the scenario that reasonably represents the anthropogenic emission by sources of greenhouse gases that would occur in the absence of the proposed project activity". Hence, baselines are the emissions that would occur if the CDM project is not implemented. There is a list of standardized baselines developed by the methodologies panel of UNFCCC. The benefits of a standardized baseline are that along with reducing emissions, it helps ensure environmental integrity by reducing the transaction cost and bringing transparency, objectivity, and predictability to the activities. It helps in implementing CDM projects even in remote, unrepresented regions. It simplifies the process of measuring, reporting, and verifying. The dual aims of CDM are to promote sustainable development along with the reduction of greenhouse gases. The net benefits will be reaped by all people in the society directly or indirectly.

A methodology, that has been standardized, gives a standardized baseline for the following.

1) Additionality

The emission reductions under the CDM projects must be real, measurable, verifiable, and additional to what would have taken place without the project. Hence, the amount of GHG emissions from a CDM project should not be equal to or more than the baseline scenario (https://cdm. unfccc. int/faq/ index.html).

2) *Baseline for emissions*

The baseline is the scenario that represents the GHG emissions that would occur in the absence of the proposed CDM project activity (https://cdm. unfccc.int/faq/index.html).

In some cases, if certain activities mentioned in the standard baselines, were implemented, they would be considered additional. In addition, in other cases, the baseline emission factor is given for estimating the baseline emissions.

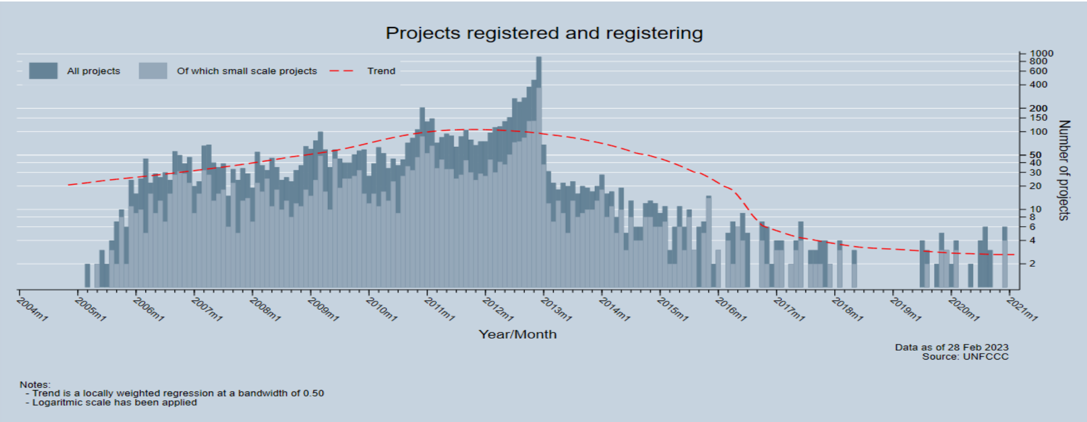
3.7.9 Period of Registration

The CDM projects can be divided into two categories depending on the period of registration. The period of registration can be divided as per the commitment period under Kyoto Protocol i.e., 2000-2012 and 2013-2020. The Period of registration of a CDM project can affect the formulation and implementation of the project in several ways. One key factor is the evolving regulatory environment for CDM projects over time. CDM projects were first introduced under the Kyoto Protocol in 2005, and the initial years saw significant growth in the number of registered projects. The regulatory framework for CDM projects has undergone several changes over time, with updates to the rules and procedures governing project registration, monitoring, and verification. As a result, the requirements for CDM project formulation and implementation may differ depending on the Period of registration. For example, projects registered in the early years of the CDM may have been subject to different eligibility criteria or baseline and monitoring methodologies compared to projects registered in later years. Additionally, changes in the market for carbon credits and the availability of financing for CDM projects may have also changed and affected the formulation and implementation of projects over time. Furthermore, the Period of registration can also impact the overall viability of CDM projects. As the demand for carbon credits has fluctuated over time, the economic viability of CDM projects may have also varied depending on the Period of registration. Hence, while the Period of registration can influence the formulation and implementation of CDM projects, it is important to note that all CDM projects must meet the current regulatory requirements and follow best practices for sustainable development.

The following figure shows the trend of projects registered from 2004 to 2021.

Figure 3.5

Projects registered from 2004 to 2021



Source: https://cdm.unfccc.int/Statistics/Public/files/202302/regnum.pdf

As can be seen from the above graph, the amount of CDM registered projects has decreased drastically from 2013 onwards due to the changing scenario in the second commitment period. It can also be inferred that small-scale projects are preferred by entities for registering with CDM.

3.7.10 Crediting Period

Projects can generate CERs only during a specific period which is known as the crediting period. The crediting period is the period for which reductions from the baseline are verified and certified by designated operational entities for issuance of certified emission reductions (CERs). Thus, the crediting period is the time for which the project can entail carbon credits for emission reduction.

The Project participants can choose between two approaches for the crediting period:

1. Crediting Period- renewable: A renewable crediting period has a crediting period of a maximum of seven years which may be renewed twice (maximum 21 years) at the most. For each renewal, an operational entity has to determine whether the baseline is still valid (paragraph 49 (a) of decision 17/CP.7).

or

2. Crediting Period- fixed: In this option, the length and starting period of a crediting period are determined once with no option for a renewal or extension once the project activity has been registered. The length of the crediting period can be a maximum of ten years for a proposed CDM activity (paragraph 49 (b) of decision 17/CP.7) (https://cdm.unfccc.int/Panels/meth/meeting/02-03/meth3gloss.pdf).

3.7.11 Registration Fee

The project participants have to pay a registration fee at the time of registration to cover the administrative costs. The registration fee is a one-time fee, based on the estimated annual emission reductions as validated by the DOE, and is usually paid by the project participants through the DOE.

3.7.12 Share of Proceeds

Share of Proceeds is the fee, paid on the verified carbon emission reductions that have been monitored over a period. If after the first monitoring period after the implementation of the project, the share of proceeds is less than the registration fee, the balance is adjusted against the second monitoring period.

The fees are always paid in US dollars and all transfer charges are borne by the participating parties to the project.

3.7.13 CDM Registry

The first Conference of Parties serving as the meeting of the Parties to the Kyoto Protocol in its first session held in Montreal in 2005, had ruled that the CDM Executive Board shall develop and maintain the CDM registry according to the requirements set out in Appendix D to the report (FCCC/KP/CMP/2005/8/Add.1). The CDM registry is in a standardized electronic form with a database which contains, data regarding issuance, holding, transfer and acquisition of CERs.

The CDM registry has the following accounts:

1. One account for the Executive Board, into which the CERs are issued before being transferred to various accounts.

2. One holding account for the Party, not included in Annex 1, and which is hosting the CDM project activity.

3. One account to cancel ERUs, CERs, AAUs, and RMUs equal to excess CERs issued, as determined by the Executive Board if the accreditation of a DOE has been withdrawn or suspended.

4. One account to hold and transfer CERs corresponding to the share of proceeds to cover administrative expenses and to assist in meeting costs of adaptation.

3.7.14 Trading Carbon Credits

The third mechanism under Kyoto Protocol was International Emission Trading or IET. This mechanism aims to provide a platform to exchange the excess credits with those entities in developed countries, which have not reached their target emission reductions as per the Kyoto Protocol. This mechanism also helps in the price discovery of carbon credits and in maintaining its liquidity.

The carbon credits can be sold privately or in the international market and settled the account between countries. Each of these international trades is validated by the UNFCCC. These trades are facilitated by the Climate exchanges which act as a spot market for the allowances, as well as futures and option trading with carbon credits as the underlying asset. Carbon prices are normally quoted in Euros per ton of carbon dioxide or its equivalent (CO_2e). Currently, many exchanges are trading in carbon allowances: the European Climate Exchange, NASDAQ OMX Commodities, European Energy Exchange, PowerNext, Commodity Exchange Bratislava, Air Carbon Exchange, and others.

Figure 3.6

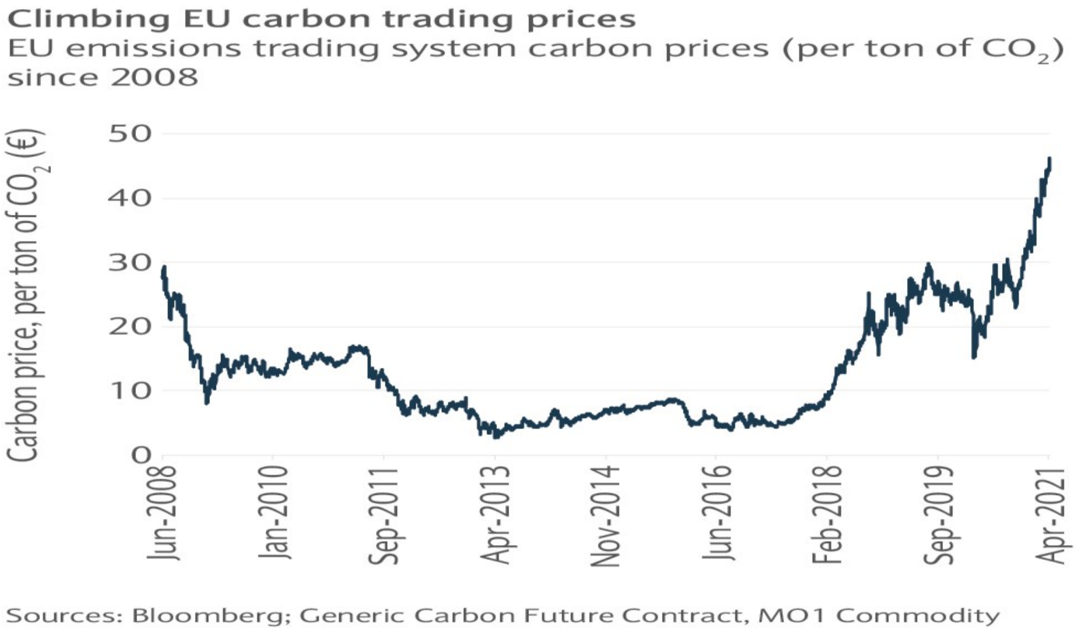
CER and New Zealand allowance price developments

Source: (Betz, , et al., 2022).

From Figure 3.6, it can be inferred that the price of CER is less than EU Allowance and NZ allowance prices but is moving in tandem with their prices, After 2013, the price of CERs has remained very low and is not very attractive for investment. The reason is the oversupply of CERs in the market compared to the demand for the same from Annex 1 countries, and also the regulation that only 13% of the requirements of credits can the European Union countries, satisfy using CERs.(Sadefo Kamdem et al., 2016)

Figure 3.7

Price of Carbon Future Contract over the Years



There was a dip in the prices of Carbon Future Contract (Bloomberg; Generic Carbon Future Contract, MO1 Commodity) after 2008 as the supply of carbon credits was more than the demand from Annex 1 countries and there was uncertainty regarding the future of CDM projects. After 2018 there can be seen a revival in the demand and prices for Carbon Credits. This is going to encourage new entities to generate carbon credits.

3.7.15 Types of Carbon Markets

There are now two types of carbon markets, the "Mandatory carbon market" and the "Voluntary carbon market". The mandatory market is used by companies and governments which are legally mandated to offset their emissions as per the established emission limits established under the UNFCCC. It is regulated through international, regional, and sub-national carbon reduction schemes such as the Clean Development Mechanism under the Kyoto Protocol, the European Union Emissions Trading Scheme (EU-ETS,) and the California Carbon Market.

The voluntary carbon market operates outside the compliance market. It is a step taken by private individuals and companies to purchase carbon credits voluntarily. Such individuals and companies are motivated to buy Verified Emission Reduction credits (VER) to neutralize their carbon footprint mainly due to Corporate Social Responsibility (CSR) and public relations. In the voluntary market, companies can buy directly from other companies or carbon funds. Like in the mandatory market, all VERs sold in the voluntary market have to be verified by an independent third party and must be developed and calculated according to the existing VER standards. The VERs cannot be used to setoff carbon footprint to achieve obligations under the Kyoto Protocol but CERs can be purchased by entities in the voluntary market to offset their carbon footprint (https://climatetrade.com/voluntary-market-and-mandatory-carbon-credit-market/). The voluntary carbon offset market was worth about $2 billion in 2021 and is expected to grow to $10-40 billion in value by 2030, transacting 0.5-1.5 billion tons of carbon dioxide equivalent, compared with 500 million tons currently as per Shell in a report co-authored by the Boston Consulting Group (BSG). (https://www.reuters.com/markets/carbon/voluntary-carbon-markets-set-become-least- five-times -bigger-by-2030-shell-2023-01-19/)

3.7.16 Rules Regarding the Trading of CERs from the First Commitment Period after 2012

The CERs, AAUs, and ERUs valid for the first commitment period can be traded into or out of the accounts of a party until the end of the true-up period. True-up period is the time followed after the commitment period, by which such parties had to achieve their emission reduction targets of the first period and it comes to 18th November 2015. This applies to all Annex 1 parties and the CERs valid for the first commitment cannot be traded after this date unless they are 'carried over' to the second commitment period at which point it become valid for the second commitment period (https://cdm.unfccc.int/faq/index.html). Each party can decide which CERs in its national registry are to be carried over. It is not possible to carry over the CERs which expire at the end of the commitment period in which they are issued, and ICERs which expire at the end of the project crediting period.

3.8Accounting and Disclosure of Carbon Credits

The accounting and disclosure practices of CDM projects in financial statements depend on the specific requirements of the project and the country where the project is implemented. Generally, CDM project financial statements should provide information on the financial performance of the project, including revenue, expenses, and net income or loss. The financial statements should also disclose any significant accounting policies and estimates used in the preparation of the financial statements, as well as any contingencies or commitments that may impact the financial position of the project.

Furthermore, CDM projects must comply with the relevant accounting standards and regulations in the country where they are implemented. This may include requirements related to the disclosure of related party transactions, income tax, and environmental liabilities.

Finally, CDM projects are also required to provide information on the emission reductions achieved by the project, as well as the corresponding CERs generated. This information should be disclosed in the project's sustainability or environmental reports, as well as in the financial statements if the emission reductions have a material impact on the financial performance of the project.

Overall, the disclosure practices of CDM projects in financial statements should provide stakeholders with transparent and reliable information on the financial performance and environmental impact of the project.

To ensure consistency and transparency in the accounting of CDM transactions, there should be accounting standards. But there are no standards yet, only guidelines developed by the United Nations Framework Convention on Climate Change (UNFCCC), International Financial Reporting Standard (IFRS), Generally Accepted Accounting Principles (GAAP), and Verified Carbon Standard (VCS). In India, the Institute of Chartered Accountants of India issued a guideline in 2012 (Council of the Institute of Chartered Accountants of India, 2012) on the accounting and disclosure of CDM transactions.

The guidelines for accounting and disclosing transactions related to CDM are as follows.

1) **Self-generated CERs should be accounted for as per AS 2 Valuation of Inventories**

CERs are non-monetary assets without a physical form but they do not strictly fall under the meaning of "intangible assets" as per AS 26. The reason is that CERs are not held for use in the production and supply of services and neither are CERs used for administrative purposes nor are they used to rent to others. Instead, CERs generated by the generating entity are held for sale. According to AS 26 (paragraph 2), intangible assets held for sale in the ordinary course of business are excluded from it and are to be accounted for as per AS2 Valuation of Inventories. This guideline state that, CERs should be measured at cost or net realizable value, whichever is less(Council of the Institute of Chartered Accountants of India, 2012).

2) **Income from the sale of CER is recognized following AS 9. Revenue Recognition**

The CERs are recognized as inventories so the entities should apply AS 9 to recognize revenue in respect of the sale of CERs. (Accounting Standards Board of Institute of Chartered Accountants of India, 2012).

3) **Accounting of Intangible assets created during R&D for generation of CER was done as per AS 26 Intangible Assets**

The guideline for accounting of intangible assets created during research and development for the CDM projects to reduce emissions states that the expenditure involved has to be accounted for as per AS 26, Intangible assets(Council of the Institute of Chartered Accountants of India, 2012).

4) **Accounting of all tangible assets created for the generation of CER was done as per AS 10 Fixed Assets.**

An entity has to use a tangible asset like equipment or devices to reduce carbon emissions. Such tangible assets come under the provisions of AS 10 Fixed Assets(Council of the Institute of Chartered Accountants of India, 2012).

5) **CER certified by UNFCCC is disclosed under the head inventories and shown separately from Raw materials, Work-in-progress, and finished products**

An entity should present CERs as part of Inventories in the balance sheet separately from other categories of inventories like raw materials, work-in-progress, and finished products (Council of the Institute of Chartered Accountants of India, 2012).

6) **The company has disclosed the 'Number of CER held as inventory and basis of valuation' in the financial statements.**

This disclosure guideline says that CERs issued to the party by UNFCCC and held as inventory, has to be declared in the financial statements and also the basis of valuation has to be mentioned(Council of the Institute of Chartered Accountants of India, 2012).

7) **The company has disclosed the 'Number of CER under certification' in the financial statements**

As per the disclosure norms in guidelines on self-generated CERs, the number of CERs under certification has to be disclosed in the financial statements(Council of the Institute of Chartered Accountants of India, 2012). CERs under certification mean once the DOE certifies the carbon mitigation and it is submitted to UNFCCC, it is considered under certification (UNFCCC, 2008).

8) **The company has disclosed the 'Depreciation and operating maintenance costs of Emission Reduction Equipment expensed during the year' in the financial statements.**

As per the disclosure norms in guidelines on self-generated CERs, the depreciation and operating maintenance costs of **Emission Reduction Equipment** expensed during the year have to be disclosed separately in the financial statements(Council of the Institute of Chartered Accountants of India, 2012).

The total CDM projects registered by NCDMA in India are shown in the following

Table 3.3

CDM Projects Registered as on 31st March 2022

Sl. No.	States	No. of Projects in India	Cumulative%
1	Maharashtra	398	13
2	Gujarat	391	26
3	Tamil Nadu	379	38
4	Karnataka	264	47
5	Rajasthan	252	55
6	Andhra Pradesh	228	63
7	Multi-State	205	69
8	Uttar Pradesh	175	75
9	Chattisgarh	107	79
10	Himachal Pradesh	101	82
11	Madhya Pradesh	95	85
12	Orissa	83	88
13	West Bengal	82	90
14	Punjab	76	93
15	Uttarakhand	51	95
16	Haryana	37	96
17	Jharkhand	32	97
18	Kerala	19	97
19	Delhi	17	98
20	Assam	16	99
21	Bihar	10	99
22	Sikkim	10	99
23	Jammu & Kashmir	6	99
24	Goa	4	100
25	Meghalaya	4	100
26	Puducherry	3	100
27	Telangana	3	100

Sl. No.	States	No. of Projects in India	Cumulative%
28	Arunachal Pradesh	2	100
29	Andaman & Nicobar	1	100
30	Chandigarh	1	100
31	Tripura	1	100
	Total (No. of Projects)	3053	

Note: The data for CDM projects registered before November 2015 is taken from https://ncdmaindia.gov.in/PreviousProjects.aspx and the data for CDM projects registered from December 2015 to March 2022 is from https://ncdmaindia.gov.in/ReportsPublic.aspx.

As on 31st March 2022, 3053 CDM projects have been registered with NCDMA. If the number of CDM projects in each state were analyzed, it is seen that the maximum number of CDM projects (63%) are in Maharashtra, Gujarat, Tamil Nadu, Karnataka, Rajasthan, and Andhra Pradesh and only 37% are in other states and union territories. The concentration of CDM projects in these industrialized states is understandable, given that the industrial sector is particularly amenable to mitigation (www.ideasforindia.in).

The total CDM projects registered by NCDMA in India sector-wise as on 31st March 2022 is given below.

Table 3.4

Classification of CDM Projects Approved Sector-wise in India by NCDMA as on 31st March 2022

Sl No.	Sector	No. of Projects	Percentage %
1	Afforestation and reforestation	28	1
2	Agriculture	4	0
3	Chemical industries	19	1
4	Energy demand	229	8
5	Energy distribution	10	0
6	Energy industries (renewable/non-renewable sources)	2380	79

Sl No.	Sector	No. of Projects	Percentage %
7	Fugitive emissions from fuels (solid, oil, and gas)	4	0
8	Fugitive emissions from the production and consumption of halocarbons and sulphur hexafluoride	5	0
9	Manufacturing industries	245	8
10	Metal Production	5	0
11	Mining/mineral production	4	0
12	Transport	13	0
13	Waste handling and disposal	73	2
	Total (No. of Projects)	3019	100

Note: The data for sector-wise CDM projects registered before November 2015 is taken from https://ncdmaindia.gov.in/PreviousProjects.aspx and the data for sector-wise CDM projects registered from December 2015 to March 2022 is from https://ncdmaindia.gov.in/ReportsPublic.aspx.

The sector-wise classification in Table 3.4 shows that the maximum number of CDM projects (79%) are registered in Energy Industries (renewable/non-renewable) sector. India is the third-largest producer and consumer of electricity worldwide with an installed power capacity of 408.71 GW as of October 31, 2022 (https://www.ibef.org/industry/power-sector-india). In October 2021, India retained its third rank on the EY Renewable Energy Country Attractive Index 2021 (https://www.ibef.org/industry/renewable-energy). Globally, India ranks fourth in renewable energy capacity in Large hydropower, fourth in wind power, and, fourth in solar power capacity (Ministry of New and Renewable Energy, 2022). That is the reason that 79% of the CDM projects in the Energy Industries sector are from the renewable energy sector in India (https://hrccc.harenvironment.gov.in/cdm).

3.9 Energy Industries (Renewable/Non-Renewable)

Energy industries refer to the sectors of the economy that produce, generate, and distribute energy. There are two main types of energy industries: renewable and non-renewable.

Renewable energy industries involve the production of energy from sources that can be replenished naturally and sustainably over time. Examples include solar, wind, hydro, geothermal, and biomass energy. Characteristics of renewable energy industries include:

1. Low or zero greenhouse gas emissions: Renewable energy sources emit little to no greenhouse gases, making them more environmentally friendly than non-renewable sources.

2. Reliance on natural resources: Renewable energy sources depend on natural resources, such as sunlight, wind, and water, which are available in varying degrees depending on geographic location.

3. High initial costs: While renewable energy sources can save money in the long run, they often require significant upfront investments in infrastructure, equipment, and technology.

Non-renewable energy industries, on the other hand, involve the production of energy from sources that cannot be replenished over time. Examples include fossil fuels such as coal, oil, and natural gas. Characteristics of non-renewable energy industries include:

1. High greenhouse gas emissions: Non-renewable energy sources emit significant amounts of greenhouse gases, contributing to climate change.

2. Dependence on finite resources: Non-renewable energy sources are finite and will eventually run out, making them less sustainable than renewable sources.

3. Low initial costs: Non-renewable energy sources often have lower upfront costs than renewable sources, but can be more expensive in the long run due to fluctuating prices and limited availability.

It is important to note that non-renewable energy projects are generally viewed as less sustainable and environmentally friendly than renewable energy projects. As such, the CDM has placed greater emphasis on promoting renewable energy projects in recent years, and non-renewable energy projects must meet strict criteria for additionality, sustainability, and contribution to sustainable development to be eligible for CDM funding.

While the primary goal of the CDM is to promote sustainable development and reduce greenhouse gas emissions, the mechanism does not explicitly exclude non-renewable energy projects.

Non-renewable energy projects may be allowed under the CDM if they meet certain criteria, such as:

1. Additionality: The project must result in emissions reductions that would not have occurred in the absence of the project.

2. Sustainability: The project must be designed and implemented in a way that minimizes negative environmental and social impacts.

3. Contribution to sustainable development: The project must contribute to the sustainable development of the host country, such as by creating jobs or improving energy access.

The majority of the projects in Energy Industries have registered their projects under CDM in India.

Table 3.5

CDM Projects Registered and Approved under Energy Industries (Renewable/Non-Renewable) Sector in India as on 31st March 2022

Sl. No.	State	No. of Projects	Percent	Cumulative Percent
1	Tamil Nadu	343	14.41	14
2	Gujarat	328	13.78	28
3	Maharashtra	286	12.02	40
4	Karnataka	236	9.92	50
5	Rajasthan	221	9.29	59
6	Andhra Pradesh	147	6.18	66

Sl. No.	State	No. of Projects	Percent	Cumulative Percent
7	Multi-State	169	7.10	73
8	Himachal Pradesh	99	4.16	77
9	Uttar Pradesh	99	4.16	81
10	Chhattisgarh	82	3.45	84
11	Punjab	64	2.69	87
12	Madhya Pradesh	67	2.82	90
13	West Bengal	47	1.97	92
14	Orissa	43	1.81	94
15	Uttarakhand	41	1.72	95
16	Haryana	23	0.97	96
17	Jharkhand	21	0.88	97
18	Kerala	16	0.67	98
19	Assam	11	0.46	98
20	Sikkim	10	0.42	99
21	Bihar	8	0.34	99
22	Jammu Kashmir	5	0.21	99
23	Goa	4	0.17	100
24	Meghalaya	3	0.13	100
25	Delhi	3	0.13	100
26	Pondicherry	1	0.04	100
27	Others	1	0.04	100
28	Telangana	1	0.04	100
29	Tripura	1	0.04	100
	TOTAL	**2380**		

Note: The data for state-wise Energy Industries (renewable/non-renewable) sector, CDM projects registered before November 2015 is taken from https://ncdmaindia.gov.in/PreviousProjects.aspx and the data for state-wise Energy Industries (renewable/non-renewable) sector CDM projects registered from December 2015 to March 2022 is from https://ncdmaindia.gov.in/ReportsPublic.aspx.

From Table 3.5, it can be inferred that 1561 numbers of CDM projects, or 66% of all CDM projects in Energy Industries (renewable/non-renewable) are situated in Tamil Nadu, Gujarat, Maharashtra, Karnataka, Rajasthan, and Andhra Pradesh. Since these states are highly industrialized and also the climate is conducive to tapping renewable energy, the companies can very easily register for CDM projects and hence, the states are at the forefront of earning carbon credits.

3.10 Expected Outcomes of the CDM Project

The outcomes to be expected from a CDM project while approving it are as follows:

1. Social well-being: One of the objectives behind CDM projects is to alleviate poverty by generating employment, providing basic amenities to the people, and removing social disparities leading to improved quality of life for the people residing in the vicinity of the project.

2. Economic well-being: The CDM project activity should generate additional profits for the project proponents.

3. Environmental well-being: The CDM project should not in any way affect resource sustainability or lead to resource degradation. The project should be bio-diversity friendly, should not have an adverse effect on human health, and should lead to reduced pollution in general.

4. Technological well-being: The CDM project activity should lead to the transfer of the latest technology which is environmentally safe and able to upgrade the existing technological base. The transfer of technology can be within the country or from other developed countries. (Ministry of Environment, 2023).

3.11 CDM Benefits

The Clean Development Mechanism was included in the Kyoto Protocol with the dual objective of involving the developing/underdeveloped countries in the mitigation of greenhouse gases and helping the developed countries to fulfill their commitments to reduce emissions. This has resulted in benefits for both developed and developing countries in various ways. It can be very rightly said that we as responsible citizens of this world would not have been this successful in the dissemination of renewable energy and other new technology in the developing world without the active role of CDM Projects. This was the opinion of Christiana Figueres, Former head of UN Climate Change (UNFCCC, 2018).

The CDM project, not only automatically builds awareness of renewable energy and environmental issues, but also helps to bring continuous electricity to many remote villages for the first time. This means reduced blackouts and saving a lot of time for villagers in domestic and farming activities. Voluntary action is encouraged now by UNFCCC under the Climate Neutral Now Policy, which has encouraged several major companies like Aviva, Microsoft, Sony, etc. to go **carbon neutral.** They support carbon offsetting and sustainable community development in emerging nations.

This is a mechanism, which helps developing countries earn some money by selling carbon credits and get the benefit of the latest and energy-saving technologies from more developed countries. This, in turn, improved the standard of living of the communities where the projects are implemented through an increase in employment opportunities.

Some of the highlights of achievements and benefits reaped by society from all the CDM projects from 2001 to 2018 are as follows. ((UNFCCC, 2018)

1. 111 non-annexure 1 countries with registered CDM activities.
2. 172 CDM Designated National Authorities
3. 7803 projects are registered with the UN till 2018
4. A total of 140 countries are involved in mitigation activities out of which 36 o of the least developed countries of the world are there.
5. 30 accredited independent Designated Operational Entities validate the projects and verify the emission records kept by the parties to the project.

6. 2 billion tons of carbon dioxide equivalent reduced in the developing world.

7. 303.8 billion US Dollars have been invested in clean development projects.

8. 25 % of all CDM projects help in improving, protecting, and efficiently use of natural resources. 152 million plants have been planted until 2018 as part of these projects.

Some of the methodologies approved by the UNFCCC play a direct role in improving the living conditions of women and children. Such projects are which gives access to household fittings like lights, and refrigerators, and optimize or make redundant certain chore undertaken by women and children like collecting firewood, cooking, getting water from far-off sources, etc. This improves the living environment of women and children which makes them participate in the projects and contribute to the decision-making process. Thus, CDM projects give recognition to projects, which are women-friendly, and empower them, or improve their lives by labeling certain methodologies as “women and children”.

From the above data from reports of UNFCCC, we can conclude the following.

1. The feedback from stakeholders of CDM proves that these types of projects are an important tool to counter climate change.

2. CDM has improved and evolved a lot from its formative years. From a “learning by doing” approach, it has become a robust, tangible, and global market mechanism. (UNFCCC, 2018)

3. Criticisms that, were leveled against CDM in the formative years, have been proved wrong with positive results emerging. Offsetting as a concept was criticized as it gave rich and developed countries an excuse to avoid mitigation in their country and purchase CERs from developing countries at less cost. But over the years it is proved that even such offsetting has led the developed countries to measure their sessions and have tried to reduce or control them so that they have

to purchase less amount of CERs to compensate for attaining their target reductions.

4. The stakeholders of a project both local and global are consulted at every stage and to maintain transparency, virtually every document of the project is available online.

5. Additionality is an important criterion for validating and verifying a CDM project. Each CER that is issued to a project should truly represent a reduction of one ton of carbon dioxide or its equivalent, which would not have been possible without the CDM project. Thus, a CDM project brings environmental integrity and hence ensures additionality.

6. The time lag in processing the PDD, its approval validation, and verification resulted in frustration and backlogs. This was solved by automatic registration and streamlining project assessment by placing a rooster of CDM experts on call to vet the projects.

7. CDM has helped not only the big emitters like China, India, and Mexico but even the low emitting regions by establishing rules for a program of activities that allow an unlimited number of very small project activities which automatically qualify under the CDM. Standard baselines were created for such projects in various sectors. It benefitted the spread of CDM in sub-Saharan Africa and hence helped in regional distribution.

3.12 Chapter Summary

In this chapter, the events leading to the signing of the Kyoto Protocol, the mechanisms under the Kyoto Protocol that help the companies/countries to participate in the Protocol, the concept of carbon credit, the Clean Development Mechanism, the workings of National Clean Development Mechanism Authority have been explained in detail. Also, the steps in a CDM Project Cycle, how the CDM projects are governed at UNFCCC, methodologies, and baselines used for measuring emission reduction, how are the carbon credits tracked, how they can be traded, in which markets, how it has to be accounted for and disclosed in books of accounts, how many CDM projects are there in India and in which industries, what are the UNFCCC reports saying of the benefits of CDM Projects have been covered in this chapter. ‘The next chapter is ‘Materials and Methods’ which deals with the research methodology adopted to carry out the research work.

Chapter 4

Materials and Methods

This chapter outlines the methods adopted to conduct the research and provides a framework to understand how the findings have been arrived at. The research questions and hypotheses are clearly defined and also the research design, type, data collection methods, statistical methods used to analyze, and limitations of the methodology are also discussed.

4.1 Research Approach

Deductive and Inductive approaches are the two different approaches used in research. Deductive research aims at testing an existing theory, and the inductive approach aims at developing a theory. In the deductive approach, the researcher starts with the theory and hypotheses and then conducts research to see whether the theory and hypotheses can be proven with the selected sample. Thus, in deductive research, they move from general to specific. This approach is also known as the top-down approach. While in the inductive approach, the researcher observes real events, trends, or social processes, finds patterns, resemblances, and regularities in experience, and reaches conclusions. In other words, they move from data to theory, or specific to general. Hence, it is called the bottom-up approach (Schmitz, A. (2012)).

This study made use of a deductive approach to understand the fit between the empirical data received and theoretical knowledge in clean development mechanism projects and its objectives of sustainable development. After carrying out an exhaustive review of the reports of UNFCCC, Project development documents of various projects in India and abroad, journal articles, newspaper articles, and internet resources on the Kyoto Protocol and its market mechanisms, the research problem was formulated. The objectives of the study and hypotheses were formulated to test the theoretical model. An Interview schedule was prepared to collect primary data from the top-level management of various Indian Companies. The empirical data thus helped to enhance our understanding and resolve the research problem. Hence, the deductive approach facilitated the discovery of new dimensions to the specific problems relating to CDM projects in the Indian context.

4.2 Research Process

Research is a process of systematic investigation to find data to add to a body of knowledge in a particular subject area. Hence, it is a process that is done in stages. The first stage involves a literature review which was done extensively and helped the researcher to narrow down the area of research and find the research gap. The literature review gave a clear picture of the existing knowledge in the field and it was understood that little work has been done to understand the problems in the formulation and implementation of CDM projects in India, complications in generating carbon credits, its accounting, and the extend of sustainable development goals achieved. The objectives were finalized, the population was identified, and the sample and the data collection method were decided. A pilot study was conducted using an interview schedule and the instrument was tested for reliability and validity. The interview schedule was revised based on these tests and further data was collected. After that, the data were prepared for analysis by coding the questions, checking extreme values, and removing half-answered responses. The prepared data were analysed using SPSS 22.0 software.

4.3 Methodology and Database

4.3.1 Research Design

The study is both descriptive and exploratory in nature. The first phase of research was exploratory with a literature review, forming research questions and a statement of objectives, identifying the variables to be studied, and formulation of the hypothesis. The second phase of research led to understanding the data collected through descriptive research design. Descriptive research included explaining the characteristics of the population and finding out the cause-effect relationship among the variables. These phases are detailed under each research design given below.

4.3.1.1 Exploratory research

Exploratory research is used to investigate a problem that is under-investigated and poorly understood. Exploratory research in this study started with a review of the available literature in the form of reports released by the UNFCCC from time to time and the project design documents uploaded on the CDM website of UNFCCC by various project participants. The literature review showed that an in-depth study on the difficulties faced by Indian Companies when participating in sustainable development through the Kyoto Protocol is needed, especially when India is second only to China in terms of the number of projects registered as CDM with the UNFCCC (Chittawadagi, M. B. (2015)). For further understanding of the situation in India, discussions were held with officials of the National Clean Development Authority, New Delhi, and informal discussions were held with chartered accountants and industrial experts in the field of clean development mechanisms in Chennai and Bangalore. A survey instrument was designed with the insight from these discussions and literature review. It was followed up with a pilot study and the survey instrument was tested for reliability and validity. After necessary changes were made to the interview schedule, the data was collected according to the sampling techniques decided.

4.3.1.2 Sampling Design

Sampling Design is the systematic process of selecting a sample from a population of interest to make observations and statistical inferences about that population. As it is practically not feasible to study the entire population due to cost constraints and practical difficulties, a sample is selected that truly represents the population, and inferences derived from the sample can be generalized back to the population of interest. This study aims to analyze and describe the problems and prospects of setting up CDM projects, the generation of carbon credits, and the accounting of the transactions relating to CDM projects.

4.3.1.3 Data Base

i) Population

The National Clean Development Authority (NCDMA), is the Designated National Authority (DNA) for giving Host Country Approval (HCA) to CDM projects in India. There are 3053 CDM projects in India, which have been approved by National CDM Authority as on March 2022. These projects are classified into thirteen different sectors like Afforestation & deforestation, Agriculture, Energy Demand, Energy Industries (renewable/non-renewable), Chemical Industries, etc as per the sectors in which these projects are functioning. As per the NCDMA, the majority (79%) of the projects are in the Energy Industries (renewable/non-renewable) sector (Table 3.3). As the CDM projects are distributed among thirteen different sectors, and as the methodology of measuring emissions in these sectors is completely different, it will not be appropriate to select samples from all these sectors and compare them. Hence, the researcher has taken the Energy Industries (renewable/non-renewable) sector, which has the maximum number of projects for the research. As per the CDM Registry in UNFCCC, all the projects which are registered with NCDMA have not received Certified Emission Reduction Units (CERs). Only 604 projects in the energy industries sector have received CERs till March 2022 (https://cdm.unfccc.int/Projects /projsearch.html). The state-wise number of projects which received CERs in the Energy Industries Sector is as follows:

Table 4.1

State-Wise Number of Energy Industry Projects that received CERs as on March 2022

Sl.No.	States	No. of Energy Industry Projects which received CERS
1	Tamil Nadu	91
2	Maharashtra	79
3	Karnataka	79
4	Gujarat	58
5	Rajasthan	56

Sl.No.	States	No. of Energy Industry Projects which received CERS
6	Andhra Pradesh	51
7	Chhattisgarh	30
8	Multi-State	29
9	Himachal Pradesh	28
10	Uttar Pradesh	25
11	Punjab	21
12	Madhya Pradesh	15
13	West Bengal	10
14	Uttarakhand	7
15	Orissa	5
16	Haryana	5
17	Kerala	4
18	Jharkhand	2
19	Bihar	2
20	Assam	1
21	Sikkim	1
22	Goa	1
23	Puducherry	1
24	Telangana	1
25	Andaman & Nicobar	1
26	Tripura	1
	Total (No. of Projects)	604

Source: https://cdm.unfccc.int/Projects/projsearch.html

From table 4.1, it can be inferred that the majority of the projects which were issued CERs (68.87%) are situated in the six states of Tamil Nadu, Maharashtra, Karnataka, Gujarat, Rajasthan and Andhra Pradesh.

ii) Sources of Data

The data for the study has been collected from both secondary and primary sources.

a) *Secondary data*

The study made use of data published in various sources as follows:

1. Websites of UNFCCC, NCDMA, Ministry of Environment Forest and Climate Change
2. Reports published by Indian and Foreign Companies
3. Reports published by various foreign government agencies related to emission control, and CDM activities.
4. Reports published by DOEs and other agencies engaged in the business of CDM registration, verification, and validation.
5. Scientific journals related to sustainable development, climate change, and clean energy like Journal of Cleaner Production, Applied Energy, Energy, Energy Policy, Science of the total environment, Renewable & Sustainable Energy Review, etc.
6. Published theses.
7. Books on Climate Change.
8. Newspaper articles.
9. Conference Proceedings.

b) *Primary Data*

Primary data was collected to understand better the situation in India concerning CDM projects. The advantage of primary data is that the researcher gets the solutions to specific questions related to the research problem formulated. Its accuracy is more when the researcher collects the data directly from the main source. It also helps in getting up-to-date data and peripheral information can also be collected in the process.

The researcher tried to get data online using a questionnaire during December 2020 to March 2022 but the response was not good due to covid-19 and various other reasons. Then the researcher collected data by visiting the corporate offices of the companies from September 2021 to June 2022 using a structured interview schedule. The researcher prepared a sample frame and collected data from respondents. The demographic characteristics of the projects and the companies involved were collected along with the level of awareness, the extent of government support, experiences during CDM project development, generation of carbon credits, and the economic, technological, social, and environmental effects. The data was collected from the states of Tamil Nadu, Karnataka, Gujarat, Rajasthan, Maharashtra, and Andhra Pradesh.

iii) Sampling Technique

Since CDM projects are situated across the country, a Multistage Stratified Sampling method was used to select the samples. CDM Projects registered under NCDMA and approved by UNFCCC is taken. The maximum number (79%) of projects approved belong to the Energy Industries Sector. The number of energy sector projects in different states are widely varying due to many reasons like availability of wind, sunlight, CDM policy of the state governments, awareness about CDM projects and other factors. The number of energy industries sector projects which received CERs were 604 in India. The maximum number (69%) of projects which received CERs from UNFCCC in energy industries sector are situated in the six states of Tamil Nadu, Gujarat, Maharashtra, Karnataka, Rajasthan, and Andhra Pradesh. Hence, they were selected for the study.

iv) Sampling Frame

A sampling frame is a list of the population of interest. It is the group of components that a researcher can use to select a sample from the population. The sample frame of this study consists of the top six states which has maximum (69%) Energy Industries projects which received CERs 2022 March. Hence the sample frame is as follows.

Table 4.2

Sampling Frame of the study

Sl. No.	States	No. of Projects which received CERs
1	TAMIL NADU	90
2	GUJARAT	61
3	MAHARASHTRA	79
4	KARNATAKA	79
5	RAJASTHAN	57
6	ANDHRA PRADESH	50
	TOTAL	**416**

Source: https://cdm.unfccc.int/Projects/projsearch.html

From Table 3.5 (Chapter 3), it was revealed that there were 1561 projects in the Energy Industries in these six states. But Table 4.2 shows that only 27% (416) of the projects registered in the above six states have received CERs till March 2022.

v) Sample size determination

The statistical formula used to select the sample size n is Krejcie, R.V., & Morgan, D.W. (1970).

$$S = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2 P(1-P)}$$

X^2 = the table value of chi-square for 1 degree of freedom at 95% confidence level (3.841)

N = Population size

P = Population Proportion

D = Degree of accuracy expressed as a proportion

Using the above formula, 113 is the sample size determined, calculated as follows

For this study N= 604, P=.90, d= .05

$$
\begin{aligned}
S &= \frac{1.96^2 \times 604 \times 0.90(0.10)}{0.05^2(604-1)+1.96^2 \times 0.90(0.10)} \\
&= \frac{3.8416 \times 54.36}{1.5075 + 3.8416 \times 0.09} \\
&= \frac{208.829376}{1.853244} \\
&= 112.68 = 113
\end{aligned}
$$

Thus 113 is the required sample size for adequately representing the population of this study. The details of the sample selected are presented in table 4.3

Table 4.3

Distribution of Sample Selected for the Study

Sl. No.	State	No. of Projects Which Received CERs	Sample Taken	Sample Taken % of Total Projects in Each State
1	TAMIL NADU	90	24	27
2	GUJARAT	61	17	28
3	MAHARASHTRA	79	21	27
4	KARNATAKA	79	21	27
5	RAJASTHAN	57	16	28
6	ANDHRA PRADESH	50	14	28
	TOTAL	**416**	**113**	

Source: Primary data

Approximately 27% of the projects in energy industries which have received CERs in the six states have been taken as samples.

vi) Profile of the targeted Respondents

To understand whether is a conducive atmosphere for developing Clean Development Mechanism Projects in India, the factors facilitating earning of carbon credits form them, the sustainable outcomes, and the compliance of the guidelines for related accounting and disclosure norms adopted by Indian Companies, an Interview schedule was prepared. It was prepared keeping in mind the type of respondents who will be able to answer the questions related to the research objectives. Hence, with the help of the interview schedule, the top-level management of various Indian Companies working in various positions like Directors, Presidents, Vice presidents, General Managers, Assistant General Managers, CFOs, and others, who were actively involved in the planning, implementation and operations of CDM projects were interviewed. In most of the companies, along with the top-level executives, the finance managers were also interviewed for the questions related to the accounting and disclosure of carbon credits.

vii) Variables used in the study

The present study aims to examine the factors affecting CDM Project development, earning of carbon credits, the sustainable outcomes achieved through it as well as the accounting treatment of transactions related to CDM projects and the specific disclosure of status of CERs and related matters. The variables used to study the above matters are listed below as per the objectives.

Table 4.4

Variables Used in the Study

Sl. No./ Obj. No.	Dependent Variables	Sl. No.	Independent Variables
I	To measure the influence of Stakeholders' Awareness and Government Support in creating a conducive atmosphere in promoting CDM Projects.		
1	Stakeholders' Awareness	1	States
		2	Type of Company
		3	Sources of Renewable Energy
		4	Period of Registration
2	Government Support	1	States
		2	Type of Company
		3	Sources of Renewable Energy
		4	Period of Registration

Sl. No./ Obj. No.	**Dependent Variables**	**Sl. No.**	**Independent Variables**
II	To investigate the factors enabling the Indian Companies to form and implement Clean Development Mechanism projects.		
3	CDM Project Development	1	States
		2	Type of Company
		3	Sources of Renewable Energy
		4	Period of Registration
		5	Activity Scale
		6	Stakeholders' Awareness
		7	Government Support
III	To analyse the factors facilitating the Earning of Carbon Credits		
4	Earning Carbon Credits	1	States
		2	Type of Company
		3	Sources of Renewable Energy
		4	Period of Registration
		5	Stakeholders' Awareness
		6	Government Support
		7	CDM Project Development
IV	To examine the compliance of accounting and disclosure of Carbon Credits as per the guidance note issued by ICAI.		
5	Accounting and Disclosure Standards	1	AS 2 Valuation of Inventories
		2	AS 9 Revenue Recognition
		3	AS 26 Intangible Assets
		4	AS 10 Fixed Assets
		5	CERs certified by UNFCCC are disclosed separately under inventories
		6	Disclosed the depreciation and operating maintenance costs of Emission Reduction Equipment expensed during the year separately

Sl. No./ Obj. No.	Dependent Variables	Sl. No.	Independent Variables
V	To evaluate the accomplishment of sustainable development outcomes of CDM Projects.		
6	Sustainable Development Outcomes (Economic Benefits, Technological Benefits, Social Benefits, Environmental Benefits)	1	States
		2	Type of Company
		3	Sources of Renewable Energy
		4	Period of Registration
		5	CDM Project Development
		6	Earning Carbon Credits

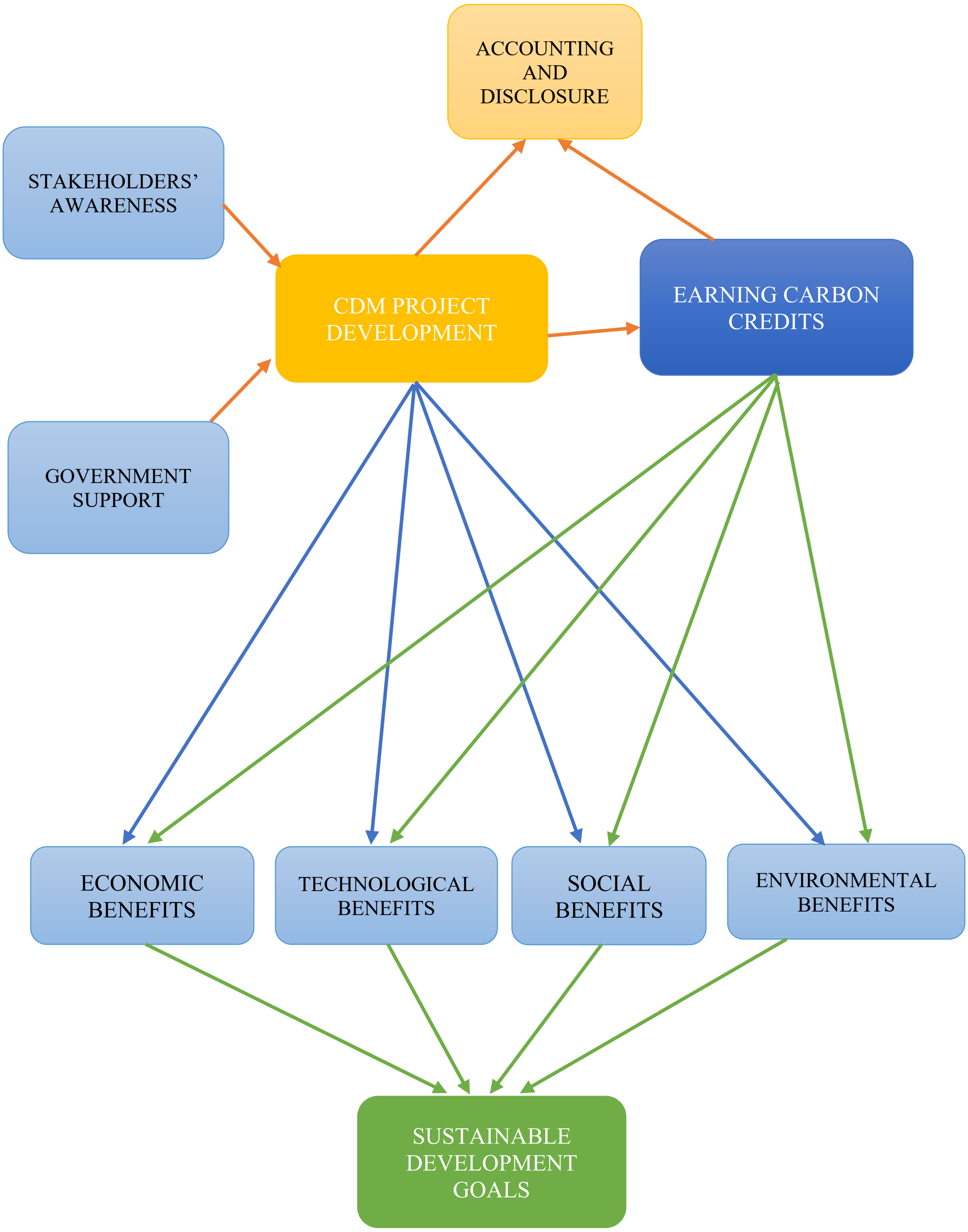
Source: Primary Data

c) Conceptual Model

A conceptual model is a framework that is initially used in the business to outline the possible courses of action or to present an idea or thought (Elangovan & Rajendran, 2015). This conceptual model is developed in a logical manner in an attempt to build a suitable theory related to CDM project formulation, implementation and the resulting outcomes.

Figure: 4.1

Conceptual Model



d) Data Collection Instrument

A structured interview schedule was designed after considering the objectives of the study and review of many Project Development Documents of various projects, UNFCCC reports, and other secondary data. Industry experts, chartered accountants and statisticians were then consulted and required modifications were made. The questions are arranged in four sections.

1. First section is for demographic data regarding the projects
2. Second section covers the latent variables: - Awareness, Government Support, Experiences during the formulation and implementation of the project, Earning Carbon Credit.
3. Third section is to know the level of compliance of companies to the guidelines issued by ICAI for accounting of carbon credits
4. To evaluate the Sustainable Development Outcomes of CDM Projects.

Close-ended and open-ended questions were used to deeply understand the challenges faced by Indian Companies in registering, implementing the CDM projects, earning carbon credits, and understanding the sustainable development outcomes and the accounting issues related to it. In all the measures the scale anchors ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). Likert scale is used to measure the latent variables except the Accounting of Carbon Credits, for which dichotomous questions were framed to know whether the accounting and disclosure of CDM transactions are as per the guidelines issued by ICAI in 2012 or not.

e) Pilot study

A pilot study was conducted to test the reliability and validity of the interview schedule. Initial consultations with industry experts helped in designing the research protocol and assessing if it is realistic and workable. After that 44 projects in Tamil Nadu and Karnataka were taken for the pilot study. The analysis of the pilot study helped in understanding the adequacy of the instrument to measure the variables and their reliability. This helped in finalising the relevant constructs and their dimensions specific to the contextual setting used in the study.

f) Test of Reliability

It is important to assess the reliability and consistency of an instrument. Reliability was tested using SPSS by computing Cronbach's alpha. According to Field (2005), Cronbach's alpha of 0.7 and above are acceptable values of consistency. The analysis of 44 data sets showed an overall reliability greater than 0.7. Responses which reduced the consistencies were removed and the overall reliability was found to be 0.75. The details of the reliability analysis are shown below.

Table 4.5

Reliability Analysis

Construct	Pilot Analysis		
Items	No. of Items	Cronbach's alpha	No. of Items after tool revision
Demographic Variables	10		8
Stakeholders' Awareness	5	0.771	4
Government Support	5	0.774	4
CDM Project	14	0.768	14
Earning Carbon Credits	13	0.805	13
Level of Compliance with Accounting & Disclosure Standards	9		9
Economic Benefit	5	0.836	5
Technological Benefit	6	0.836	4
Social Benefit	6	0.750	5
Environmental Benefit	5	0.833	5

Source: Primary Data

As per table 4.5, it can be inferred that the 44 data sets in the pilot study have the required reliability and consistency as the overall alpha value is 0.75 and the alpha values for each construct was more than 0.7. The questionnaire was thus found to be reliable and acceptable for further data collection.

g) Test of Validity

Validity refers to the extent to which an instrument measures what it intends to measure. Hence it is an important measure of the interview schedule.

1) Content validity

Content validity evaluates how well an instrument covers all the relevant parts of a theoretical concept, theme or idea it aims to measure (Nikolopoulou, K. (2022)). The items related to awareness, government support, CDM project formulation and Implementation, Earning Carbon Credits were ascertained for content validity by interacting with industry experts. Measurement of accounting and disclosure norms adopted by the companies was validated with chartered accountants. The measurement of dependent variables like economic, technological, social, and environmental benefits was validated using UNFCCC reports, and PDD documents as well as consulting the industry experts in the field of CDM projects.

2) Criterion Validity

Criterion validity evaluates how accurately a test measures the outcome it was designed to measure. Correlations between the scores on the test and the criterion variable are calculated using a correlation coefficient. A correlation coefficient expresses the strength of the relationship between two variables in a single value between -1 and +1. A positive correlation between a test and the criterion variable shows that the test is valid. No correlation or a negative correlation indicates that the test and criterion variable do not measure the same concept (Nikolopoulou, K. (2022)).

h) Test of Normality

The normality of the data was checked using the Kolmogorov-Smirnov test and the Shapiro-Wilk test. The p-value was less than 0.05 in most of the constructs; hence it was concluded that the data is not normal. The test details are presented below:

Table 4.6

Tests of Normality

Variables	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Shareholders' Awareness	.106	113	.003	.970	113	.013
Government Support	.138	113	.000	.954	113	.001
CDM Project Development	.094	113	.017	.983	113	.173
Earning Carbon Credits	.119	113	.000	.967	113	.007
Economic Benefits	.130	113	.000	.970	113	.012
Technological Benefits	.114	113	.001	.970	113	.012
Social Benefits	.117	113	.001	.944	113	.000
Environmental Benefits	.153	113	.000	.929	113	.000

a. Lilliefors Significance Correction
Source: Primary Data

i) Data Analysis Design

The raw data was collected using an interview schedule by the researcher and was first converted into a usable form for analysis by error checking, verification of missing data, then assigning codes, values, value labels, classifying according to the type of data, and entering into SPSS package. After testing Reliability, Validity and finding it within acceptable limits, the test for normality was done. As the data was found not to be normal, non-parametric tests were used to analyze the data. The analysis of the data has been performed using SPSS 22.0. Mathematical and statistical tools like Percentages, Mean, Median, Standard Deviation, Correlation, Kendall-Theil Regression, Mann Whitney U Test, Kruskal Wallis Test, and Exploratory Factor analysis were used.

1. Percentages, Mean, Median and Standard Deviation

Five-point Likert scale was used to measure the constructs. The variables are described using Percentages, Mean, Median and Standard Deviation. Percentages are used to calculate the proportion of a unit of data item to the total and are used to compare one quantity against another. Mean is a measure of the central position or an average of a given set of data and according to the Likert scale, a score of 3 denotes that the respondent is neutral toward the statement, a score of less than 3 denotes disagreement with the statement, and a score of more than 3 denotes agreement with the statement. The following is a list of interpretations for the mean score taken in the study 1.0-2.49 (disagreement), 2.5-3.4 9(neutral) 3.5-5.0 (agreement) (Oxford, 1990). Median is defined as the centre value of an ordered list of values. It is used to find the central tendency of the data as it is not normal. Standard deviation is a measure of how dispersed the data is in relation to the mean. A high standard deviation means the data are more spread out from the mean and vice-versa.

2. Exploratory Factor Analysis

Exploratory factor analysis (EFA) is a statistical method used to discover the factor structure of a measure and to examine its internal reliability. EFA is usually done when researchers have no hypotheses about the nature of the underlying factor structure of their measure. That means in an exploratory study, there will be little or no literature explaining the tools used to study a phenomenon or characteristics. Hence when the researcher tries to build a scale for the first time, EFA helps in understanding the different dimensions of the construct. Thus, EFA helps to reduce a large number of variables into fewer number of factors. In order to conduct EFA, sample adequacy has to be ensured using Kaiser-Meyer-Olkin (KMO) test. KMO is a test conducted to examine the strength of the partial correlation (how the factors explain each other) between the variables and it measures the sample adequacy for each variable in the model. It is done to understand if the data is suitable for conducting factor analysis. KMO values range from 0 to 1 and a value nearer to 1.0 are considered ideal while a value less than 0.5 are unacceptable. Bartlett's Test of Sphericity was used to test that variances are equal for all samples. The significance value of Bartlett's Test of Sphericity must be less than 0.05 for the factor analysis to be acceptable. The Principal Component Analysis extraction method was used and the Communalities derived. A communality is the extent to which an item correlates with all other items. Higher communalities above 0.5 are better. If communalities for a particular variable are low (between 0.0-0.5), then that variable may struggle to load significantly on any factor.

The low values are identified in the "Extraction" column. Low values have to be removed. To get the best fitted factor, varimax rotational method was used. EFA was conducted using IBM SPSS Statistics 22.

3. Mann Whitney U Test

Mann Whitney U Test is used to compare differences between two independent groups when the dependent variable is either ordinal or continuous but not normally distributed. If the p-value is below 0.05, the null hypothesis can be rejected and at least one significant difference can be assumed.

4. Kruskal Wallis H Test

The Kruskal–Wallis H test (1952) is a nonparametric approach to the one-way ANOVA. The procedure is used to compare three or more groups on a dependent variable that is measured on at least an ordinal level (Leon, 1998). It tests whether the groups originate from the same distribution. If the null hypothesis is rejected, it means that one or more of the groups has a different median or that it comes from a different distribution. If such significant differences arise, pairwise comparison is done and the pairs which are significantly different is found out. The effect size for Kruskal-Wallis test is calculated as the eta squared based on the H-statistic: eta2[H] = (H - k + 1)/(n - k); where H is the value obtained in the Kruskal-Wallis test; k is the number of groups; n is the total number of observations. The eta-squared estimate assumes values from 0 to 1 and multiplied by 100 indicates the percentage of variance in the dependent variable explained by the independent variable. The interpretation values commonly used in published literature are: 0.01- < 0.06 (small effect), 0.06 - < 0.14 (moderate effect) and >= 0.14 (large effect). (Tomczak & Tomczak, 2014).

5. Spearman's Rank Corelation

The Spearman's Rank Corelation is a method of testing the strength and direction (positive or negative) of the corelation (relationship or connection) between two variables. The Spearman's Rank Corelation can take a value from +1 to -1. A value of +1 means perfect association of rank. A value of 0 means that there is no association of ranks and a value of -1 means that a perfect negative association of rank exists. The assumptions of Spearman's corelation are that two variables compared must be ordinal (Likert scale) or Scale (interval or ratio) data. Also, one variable must be monotonically related with the other variable. That is, if one variable increases, the other variable should either increase or decrease. Cohen's standard may be used to evaluate the correlation coefficient to determine the strength of the relationship, or the effect size. Correlation coefficients between .10 and .29 represent a small association, coefficients between .30 and .49 represent a medium association, and coefficients of .50 and above represent a large association or relationship.

6. Kendell-Theil Regression

Kendall–Theil regression is a completely nonparametric approach to linear regression where there is one independent and one dependent variable. It is robust to outliers in the dependent variable. It simply computes all the lines between each pair of points, and uses the median of the slopes of these lines. The method yields a slope and intercept for the fit line, and a *p*-value for the slope can be determined as well (Farooqi & Thomas, 2019). The Kendell-Theil Robust Line Software version 1.0 was used in the study.

4.4 Chapter Summary

The chapter describes the research approach, the research process and research design adopted. It explains the process of identifying the sources of data, justifying the sampling design adopted, variables identified for the study and the conceptual model developed. It also describes the tool used for data collection, targeted respondents, and testing the validity of the tool after pilot study and lists the tools used for analysis of data. The results and discussions on the various analysis carried out on the primary data are reported in Chapter 5.

Chapter 5

Results & Discussion

5.1 Introduction

An extensive Literature review has led the researcher to understand that as in Article 12, paragraph 2, of the Kyoto Protocol, the purpose of the CDM is to assist developing countries in achieving sustainable development and in contributing to the ultimate objective of the Convention to reduce human-induced greenhouse gas formation and to assist developed countries in complying with their emission limitation and reduction commitments (Kirkman et al., 2012). Thus, the Clean Development Mechanism was set up to give countries some flexibility in how they meet their targets under the Kyoto Protocol while funding sustainable development. Today, the CDM is helping to address climate change through more investments in the development of industries and sustainable development. The success of CDM projects can be measured by measuring a project's actual outcomes compared to its expectations. The expectations from a CDM project by a country are as follows:

1. Reduction of Emissions: - One of the main reasons why the Kyoto Protocol was signed under the UNFCCC was to reduce the amount of carbon or carbon equivalent emissions. Hence, emission reduction can be measured by checking the number of carbon credits received by the projects. One ton of Carbon dioxide reduced is issued one carbon credit. The ratio of carbon credits issued to the project, and the expected number of carbon credits as mentioned in the PDD, will give a fair idea of the performance rate of the project (Lo & Cong, 2022).

2. Economic Contributions to a Country: The economic contributions of a clean development project can be calculated by the ratio of the total amount of actual emission reductions and estimated revenues to the GDP of a given host country (Lo & Cong, 2022).

3. Social well-being: The CDM project activity should lead to the alleviation of poverty by generating additional employment, removal of social disparities, and contributing to the provision of basic amenities to people leading to improvement in the quality of life of people(Alexeew et al., 2010).

4. Environmental well-being: This should include a discussion of the impact of the project activity on resource sustainability and resource degradation, if any, due to the proposed activity; bio-diversity friendliness; impact on human health; reduction of levels of pollution in general (Alexeew et al., 2010).

5. Technological well-being: One of the other aims of the e CDM project other than reducing emissions was the transfer of the latest green technology from developed to developing countries. The CDM project activity should lead to the transfer of environmentally safe and sound technologies comparable to best practices to assist in the up-gradation of the technological base. The transfer of clean technology can be within the country as well as from other developed/developing countries (UNFCCC, 2010).

5.2 Objectives of the Chapter

The results of the statistical analysis of the primary data are presented in this chapter. The analysis was conducted to determine whether India has an environment favourable for developing and implementing CDM projects. It also sought to understand the challenges faced by Indian businesses in obtaining carbon credits, how these credits are recorded and disclosed in the books of accounts, and whether CDM projects can actually achieve the sustainability objectives set forth by the Kyoto Protocol as listed above.

5.3 *Part 1- Demographic Information of the Sample*

The first part of the chapter deals with understanding the demographic information that is pertinent to the study. The researcher anticipated that the demographic data will have an impact on the study's variables and constructs. hence, a deeper understanding of them is required to comprehend their significance for the constructs that will be analysed in the following sections of the chapter. The following is the descriptive analysis of the demographic information collected.

5.3.1 State-wise CDM Projects in the Study

The frequency analysis of the projects in the sample taken shows the following: -

Table 5.1

Sample Size of State-wise CDM Projects

Sl. No.	States	Frequency	%	Cumulative %
1	Tamil Nadu	24	21	21
2	Maharashtra	21	19	40
3	Karnataka	21	19	58
4	Gujarat	17	15	73
5	Rajasthan	16	14	88
6	Andhra Pradesh	14	12	100
	Total	113	100	

Source: Primary data

The country was divided into 36 parts with 28 states and 8 union territories. The sample was taken from six states, namely Tamil Nadu, Maharashtra, Karnataka, Gujarat, Rajasthan, and Andhra Pradesh, as the maximum number (66%) of the Energy Industries projects are based in these states as explained in Chapter 4.

5.3.2 Activity Scale of the CDM Projects

Table 5.2

CDM Projects Based on Scale of Activity

Activity Scale	Frequency	%	Cumulative %
Large	63	55.8	55.8
Small	50	44.2	100
Total	113	100	

Source: Primary data

Out of the total 113 CDM projects in the sample, 63 (55.8%) are large-scale projects and 50 (44.2%) are small-scale projects.

CDM projects can be classified as large-scale or small-scale projects, based on their size and the number of carbon credits they are expected to generate. Small-scale CDM projects (SSC) are defined as projects that are expected to generate less than or equal to 15,000 Certified Emission Reductions (CERs) per year. The main types of small-scale CDM projects include renewable energy systems, energy efficiency improvements, and sustainable agriculture or forestry projects. Large-scale CDM projects (LSC) are defined as projects that are expected to generate more than 15,000 CERs per year. The main types of large-scale CDM projects include power generation, industrial processes, and waste management projects.

The classification of a project as small-scale or large-scale has implications for the project development process and the requirements for approval. Small-scale CDM projects are subject to simplified procedures, while large-scale CDM projects require more comprehensive documentation and a more rigorous validation and verification process. The classification of a project on the basis of activity scale also affects the eligibility for certain financing mechanisms, such as the CDM Loan Scheme and the Carbon Fund (https://cdm.unfccc.int/Projects/pac/pac_ssc.html).

5.3.3 Types of Entities Owning a CDM Project in the Sample

The frequency table of the sample on the basis of the type of entities owning CDM Project is as follows: -

Table 5.3

Types of entities owning CDM Projects in the Sample

Type of Company	Frequency	%
Public Company	38	34
Private Company	60	53
HUFs	15	13
Total	113	100

Source: Primary data

In this study, 34% (38 projects) of the projects were owned and operated by Public Companies whereas 53% (60 projects) of the projects were owned and operated by Private Companies and 13% (15 projects) by Hindu Undivided Families (HUFs). As the sample projects are from Energy Industries, such projects were found to be owned by Public Companies, Private Companies, and HUFs in the sample.

5.3.4 Sources of Renewable Energy Used by the Sample Projects

The frequency analysis of the sample based on renewable energy sources is given below.

Table 5.4

Sources of Renewable Energy Used in the Sample Projects

Sl. No.	Sources	Frequency	%
1	Wind Power	66	58
2	Solar Power	14	12
3	Natural Gas	13	12
4	Hydropower	8	7
5	Biomass	6	5
6	Waste Heat	3	3

Sl. No.	Sources	Frequency	%
7	Thermal Oxidation	1	1
8	Waste Hydrogen gas	1	1
9	Coal reduction	1	1
	Total	113	100

Source: Primary data

In the sample collected, the maximum number of energy projects (66 nos. or 58.4%) use wind energy and 14 projects use solar energy and 13 use natural gas for carbon reduction. Hence the energy industries projects in the study, use mostly wind, solar and natural gas for reducing emissions and earning carbon credits.

5.3.5 Period of Registration of the Sample Projects

The frequency table of the sample based on the period of registrations is as follows:

Table 5.5

Period of Registration of the Sample Projects

Period	Frequency	%
2000 - 2012	93	**82**
2013 - 2020	20	**18**
Total	113	**100.0**

Source: Primary data

The projects were divided into these two commitment periods to analyze the difference in the experiences of these project participants in formulating and implementing the projects, also the differences in earning from carbon credits due to the changing market conditions. Table 5.5 shows that 82% of the projects were registered in the 2000-2012 period. Only 18% of the projects were registered in the second commitment period. It shows a drop in the number of registrations in the second commitment period. This trend coincides with Figure 3.5 in Chapter 3 taken from CDM, UNFCCC website where it is observed that there is a fall in the number of registrations after 2013.

5.3.6 Viability of Renewable Energy Project without Kyoto Protocol

The majority of the companies that invest in Renewable Energy Projects were already in the same business of energy generation. So, the respondents were asked if they would have invested in renewable energy projects and not fossil fuel energy if they didn't have the convenience of registering their projects with the UNFCCC and earning carbon credits for the emission reductions. The results were as follows: -

Table 5.6

Renewable Energy Projects are Viable without Kyoto Protocol

Response	Frequency	%
Yes	71	63
No	42	37
Total	113	100

Source: Primary data

63% of the respondents believe that the projects would have been viable and implemented without Clean Development Mechanism options under Kyoto Protocol. While 37% of the respondents believed that CDM has helped them in implementing carbon-reducing projects and earning carbon credits. The majority of the companies were already in the energy generation business whether non-renewable energy or the renewable energy business. The Government of India started promoting renewable energy in India in 1981 with the setting up of a Commission for Additional Sources of Energy in the Department of Science and Technology. (Bhattacharya & Jana, 2009). So, it can be safely assumed that the finding of the study is true that the energy projects would have come up even without CDM projects. But there were many firms, like Jalaram Cements, and Devika Industries (owned by Premier Diamonds), which came into this industry just for the sake of getting tax advantages and the additional revenue from the sale of carbon credits. It can thus be said that 37% of the sample projects were started to earn revenue from carbon credits and other tax benefits. Hence it can be inferred that the Kyoto Mechanism has encouraged many business houses to enter into the renewable energy sector.

5.3.7 Verification and Certification of Projects

The CDM project participants have to get their emission reductions verified and certified by a DOE. Unless otherwise exempted by the CDM EB, the DOE for verification and certification must be different from the DOE which helped in the registration of the project with UNFCCC.

Table 5.7

Intervals of Verification and Certification of Projects

Intervals of Verification and Certification of Projects	Frequency	%
Annually	11	10
Bi-annually	9	8
As and when necessary	93	82
Total	113	100

Source: Primary data

The above table shows that the majority (82%) of the project participants, go for verification and certification "As and when necessary". Only 10% do it annually and 8 % do it bi-annually.

The monitoring report is prepared by the Project Participants before verification and is checked by the DOE during verification. Only if there is a correction in the monitoring report, a separate additional report is attached to the monitoring report to be submitted to the UNFCCC, CDM website using a dedicated interface along with the request for issuance. The timing and frequency of submission of verification reports by the DOE are not specified in the official documents. It is decided by the companies when they want the reductions in emissions to be verified and certified. They usually go for verification and certification when they get a buyer for the CERs and when they are satisfied with the offered price for the same. Also, the other reason is that the cost of verification and certification can be saved if it is done only when necessary. Otherwise, they have to shell out a minimum fee for every verification. The project participants that go for regular annual or bi-annual verification are those projects that have a captive buyer for CERs like the other parties from Annex 1 countries, which had helped with the transfer of technology or initial idea for the project or any other party that entered into a contract for the sale of CERs.

Hence, it can be inferred that only 10 to 18% of the sample companies have a stable income from the sale of CERs, while others have to wait for a rise in the price of the CERs in the international market and find a buyer for it. It can be concluded that the majority of the project participants are not getting a steady income from the CDM projects as envisaged in the beginning.

5.3.8 Market for Certified Emission Reductions

One of the main incentives to invest in carbon emission reduction projects is to earn additional income in the form of revenue from the sale of CERs. It has to be noted that, just by implementing a CDM project, there is no guarantee that the company will earn carbon credits as it depends on the completion of many more procedures like monitoring the emission reductions, getting it verified by a DOE, getting approval of UNFCCC to receive carbon credits. There are also verification expenses that have to be incurred at this stage and the companies have to decide if they want their project to be verified to earn carbon credits, and the cost of verification will be compared with the expected income from the carbon market.

Table 5.8

Sale of Certified Emission Reductions

Sale	Frequency	%
Yes	98	87
No	15	13
Total	113	100

Source: Primary data

The above table shows that only 87% of the project participants in the sample, were able to sell the CERs issued to them. 13 % had either not got the CERs issued or after receiving the CERs, were not able to sell them. Hence, most of the project participants were able to sell the CERs, and a few of them were not motivated to verify their monitoring reports by a DOE, due to the falling prices of CERs in the later years after 2008 (Figure 3.2, Chapter 3).

Part 1 of this chapter thus discusses eight different demographic features of the sample collected in the study and each of these features provides valuable insights into the CDM projects in India in a significant manner. Part 2 of this chapter is designed to examine how favourable the Indian environment is for CDM project formation and implementation. It thoroughly examines the interrelationships between Stakeholders' Awareness, Government Support, and CDM Project Development and the demographic features in order to visualize the necessary changes that the government and relevant authorities should implement in the administration of CDM projects.

5.4 *Part 2 – Stakeholders' Awareness and Government Support for CDM Project Development*

CDM (Clean Development Mechanism) is a project-based mechanism under the Kyoto Protocol, aimed at promoting sustainable development in developing countries while reducing greenhouse gas emissions. CDM projects typically involve technology transfer and capacity building to promote the use of renewable energy, energy efficiency, and sustainable land use practices. First of all, there should be a conducive environment for the formation and implementation of CDM projects if the stakeholders including the project participants, state as well as central government, and local communities have awareness about CDM projects and the government gives proper policy support for it. The development and implementation of CDM projects can bring economic, social, environmental, and technical benefits to the locality, country, and the whole world. However, there are also many challenges associated with developing and implementing CDM projects like initial funding, technical expertise, regulatory challenges, demonstrating additionality to earn carbon credits, and global market uncertainties. Hence, to address these challenges, careful planning, stakeholder engagement, and collaborations across sectors and borders are required.

This section of the analysis examines the stakeholders' knowledge of the CDM project's formation, implementation, and development as well as the Government Support that is offered to the businesses in relation to the formation, implementation, and development of CDM projects. In addition to that, it also describes the construct 'CDM Project Development' and its dimensions.

5.4.1 Stakeholders' Awareness

CDM projects involve collaboration between various stakeholders, including project developers, host country governments, and local communities. When stakeholders understand the benefits of CDM projects and their contribution to climate change mitigation, they are more likely to collaborate and work towards the project's success.

The stakeholder theory propounded by Dr. R. Edward Freeman in his landmark book "Strategic Management: A stakeholder approach" is based on the understanding that stakeholders are those groups without whose support the organization would cease to exist, Freeman. R.E (2010). Hence, it can be said that the awareness among the stakeholders of the CDM project and the Government Support would make the process of formulation and implementation of the CDM project easier. Here, an attempt is made to highlight the level of awareness about CDM projects among the stakeholder that was felt by the project participants when dealing with them. For this study, the stakeholders considered are the Project Participants (the company themselves), State Government, Central Government, and Local communities. Five-point Likert scale was used for understanding the level of Stakeholders' Awareness from the point of view of the project participants. The result of the dimension reduction of Stakeholders' Awareness is presented below.

5.4.1.1 EFA of Stakeholders' Awareness

Table 5.9

KMO and Bartlett's Test of Stakeholders' Awareness

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.757**
Bartlett's Test of Sphericity	Approx. Chi-Square	116.563
	df	6
	Sig.	**.000****

*Source: Primary data, **Significant at 1% level*

The KMO of "Stakeholders' Awareness" is **0.757** and Bartlett's Test is significant at a 1% level of significance and it shows that there is a substantial correlation in data, which allows the researcher to proceed with factor analysis.

The Principal Component Analysis extraction method was used and the Communalities derived are below:

Table 5.10

Communalities of Stakeholders' Awareness

Item No.	Items	Initial	Extraction
1	There was awareness about the CDM Projects among the Project Participants.	1.000	.514
2	State Government entities were aware of the prerequisites for CDM project development and its benefits.	1.000	.700
3	Central Government entities were aware of the prerequisites for CDM project development and its benefits.	1.000	.642
4	The Local Communities were aware of the benefits of the CDM Project to the society and environment.	1.000	.530

Extraction Method: Principal Component Analysis
Source: Primary data

In the above table, all the Communalities of the variables were above 0.5. Therefore, the researcher proceeded with the analysis.

For extracting factors from the variables, an analysis of the Eigenvalue is required. The scale constructed and the components extracted should be able to explain the maximum variance in the data. Eigenvalue represents the total amount of variance that can be explained by a principal component. The table below shows the total variance explained by the variables under the study.

Table 5.11

T*otal Variance Explained of Stakeholders' Awareness*

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.385	59.631	59.631	2.385	59.631	59.631
2	.659	16.464	76.096			
3	.569	14.230	90.325			
4	.387	9.675	100.000			

Extraction Method: Principal Component Analysis.
Source: Primary data

The above table explains that 59.631 % of the total variance in Stakeholders' Awareness is explained by one component.

Table 5.12

Component Matrix[a] of Stakeholders' Awareness

Sl. No.	Item No.	Items	Component 1
1	2	State Government entities were aware of the prerequisites for CDM project development and its benefits.	0.836
2	3	Central Government entities were aware of the prerequisites for CDM project development and its benefits.	0.801
3	4	The Local Communities were aware of the benefits of the CDM project to the society and environment.	0.728
4	1	There was awareness about the CDM Projects among the Project Participants.	0.717

Extraction Method: Principal Component Analysis.
a. 1 component extracted.
Source: Primary Data

The component matrix shows that there is only one component and it is measured by Item 2 and is followed by Items 3,4 and 1.

5.4.1.2 Analysis of Stakeholders' Awareness

Table 5.13

Frequency Distribution of Stakeholders' Awareness

Stakeholders		Extremely Aware	Moderately Aware	Somewhat Aware	Slightly Aware	Not At all Aware	Total
Project Participants	N	12	18	41	38	4	113
	%	11	16	36	34	4	
	C%	11	27	63	96	100	
State Governments	N	9	27	30	37	10	113
	%	8	24	27	33	9	
	C%	8	32	58	91	100	

Stakeholders		Extremely Aware	Moderately Aware	Somewhat Aware	Slightly Aware	Not At all Aware	Total
Central Government	N	8	15	50	35	5	
	%	7	13	44	31	4	113
	C%	7	20	65	96	100	
Local Communities	N	0	2	42	37	32	
	%	0	2	37	33	28	113
	C%	0	2	39	72	100	

Source: Primary data
Note: C% represents cumulative percentage

From Table 5.13 it is observed that, even among the project participants, the majority (36%) were only Somewhat Aware of CDM projects when they thought of investing in the project. 11% were extremely aware, 16% were moderately aware, 34 % were slightly aware and 4% were not aware at all at the beginning of this journey. It can be said that a **cumulative 63%** of the project participants had an average or more awareness of the CDM projects.

Regarding the awareness level of State government entities, the respondents felt that 33% (which is the majority) were slightly aware of the CDM projects, only 8% felt that they are Extremely Aware, 24% were moderately aware, 27% were somewhat aware and 9 % felt that the State governments are not at all aware. Hence, a **cumulative 58%** of State Government entities, had an average or more level of awareness in CDM projects.

When it comes to the awareness of Central Government entities, 44% (majority) felt that they are somewhat aware, only 7% are extremely aware, 13% are moderately aware, 31% are slightly aware and 4% are not at all aware. A **cumulative 65%** of the Central Government entities were having more than the average level of awareness of CDM projects.

The respondents felt that the majority of the people near the project localities were not much aware of CDM projects or their benefits to society. According to them, 28 %, of the public is Not at all Aware. 33% were Slightly Aware, 37% were Somewhat Aware and 2% were Moderately Aware. None of the respondents felt that the public in their locality was Extremely Aware. A **cumulative of only 39**% felt that there was an average or more awareness among the local communities of the CDM project.

Hence, based on the cumulative awareness score of the sample, it can be inferred that more than half of the respondents felt that, the project participants, state government, and central government had more than average level of awareness about CDM projects. The local communities had the least amount of awareness about CDM projects. Among the locals, none of them were extremely aware, only 2% were moderately aware and 39% were somewhat aware of the CDM project.

Table 5.14

Descriptive Statistics of Stakeholders' Awareness

Item No.	Items	N	Mean	Median	Std. Deviation
1	There was awareness about the CDM Projects among the Project Participants.	113	2.96	3.00	1.034
2	State Government entities were aware of the prerequisites for CDM project development and its benefits.	113	2.89	3.00	1.113
3	Central Government entities were aware of the prerequisites for CDM Project Development and its benefits.	113	2.88	3.00	.946
4	The Local Communities were aware of the benefits of the CDM Project to the society and environment.	113	2.12	2.00	.847

Source: Primary data

From the above descriptive statistics, it can be seen that three out of four items have a mean score between 2.5-3.49 and a median of 3, hence most of them are somewhat aware of CDM Projects and the standard deviation is very high which indicates that there are wide variations in the opinion. Hence, it can be inferred that the level of awareness was neither good nor bad and it can be concluded that, the project participants and, state/Central agencies were somewhat aware of CDM projects, and, the awareness level among the local communities was the least with a mean score of 2.12 and median of 2.

Analysis to see whether the awareness of the Stakeholders has any difference with respect to the independent variables of the CDM Project like State, Type of Companies, Renewable Energy, and Period of Registration is done as follows.

5.4.1.3 Stakeholders' Awareness of CDM Projects and States

To examine whether the Stakeholders' Awareness of the CDM Project is significantly different across states, the Kruskal Wallis H test was performed and the hypothesis formed was as under: -

Hypothesis:

H_0: There is no significant difference in Stakeholders' Awareness of CDM projects across the States.

H_1: There is significant difference in Stakeholders' Awareness of CDM projects across the States.

Table 5.15

Stakeholders' Awareness Based on States

Construct	States	N	Mean Ranks	Test Statistic	Df	p-value	Effect Size
Stakeholder Awareness	Rajasthan	15	56.07	5.65	5	.342	-
	Gujarat	17	65.24				
	Maharashtra	22	49.11				
	Andhra Pradesh	15	51.40				
	Tamil Nadu	24	67.02				
	Karnataka	20	51.55				

Source: Primary data

Table 5.15 above, shows that there are differences in the mean ranks for Stakeholder Awareness of CDM Projects across the six states in the sample. Kruskal-Wallis H test conducted shows that the test statistic = 5.65, p-value = 0.342. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted that there is no significant difference in Stakeholder Awareness across the states where the CDM projects are situated.

5.4.1.4 Stakeholders' Awareness of CDM Projects and Type of Company

The Kruskal Wallis H test was performed to study whether the project participants' experience with Stakeholder Awareness of CDM projects differs based on the Type of Company which owns the project. The hypothesis set was as follows: -

Hypothesis:

H_0: There is no significant difference in Stakeholders' Awareness of CDM projects based on the Type of Company owning them.

H_1: There is significant difference in Stakeholders' Awareness of CDM projects based on the Type of Company owning them.

Table 5.16

Stakeholders' Awareness Based on Type of Companies

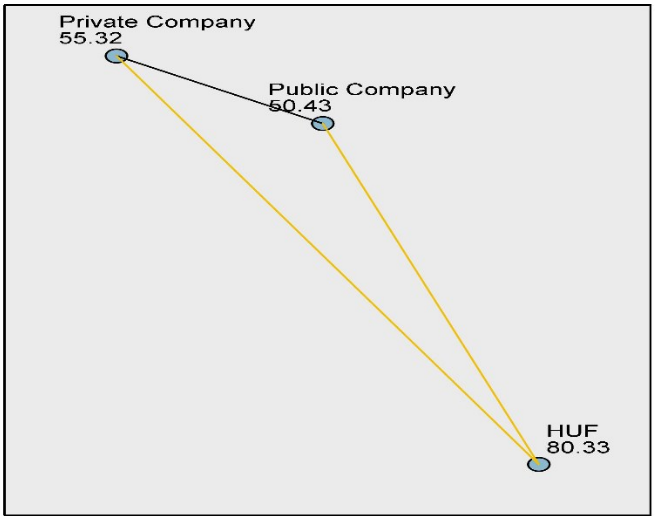
Construct	Type of Company	N	Mean Ranks	Test Statistic	Df	p-value	Effect Size
Stakeholders' Awareness	Public Company	38	50.43	9.378	2	**0.009****	.067
	Private Company	60	55.33				
	HUF	15	80.33				

*Source: Primary data, **The mean ranks are significantly different at 1% level*

From Table 5.16 above, it can be seen that there are differences in the mean ranks for Stakeholders' Awareness of CDM Projects based on the Type of Company owning them. The Mean rank for HUF was better than both Public Companies and Privat Companies. For analyzing whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted. The test statistic = 9.387, ***p-value is 0.009*****, and effect size = 0.067. Since the p-value is less than 0.05, the test statistic is significant at a 1% level of significance and the effect size is between 0.06 and 0.14, hence, it has a moderate effect. The null hypothesis is thus rejected, and hence, there is a significant difference in the Stakeholders' Awareness of the CDM projects based on the Type of Company owning the projects. Further analysis was done by Multiple Pairwise Comparisons of Types of Companies and the results are shown in Figure 5.1 and Table 5.17.

Figure 5.1

Pairwise Comparison of Types of Companies



Source: Primary data

Table: 5.17

Multiple Pairwise Comparison of Stakeholders' Awareness based on Type of Companies

Pairs of Type of Company	Test Statistic	p-value
Public Company-HUF	-29.899	**0.008****
Private Company-HUF	-25.008	**0.024***

*Source: Primary data, **Significant at 1% level, *Significant at 5% level*

The Multiple Pairwise Comparison shows that the Stakeholders' Awareness of CDM projects based on the Public Company and HUF, Private Company, and HUF are significantly different from each other. For the pair, Public Company-HUF, ***p-value is 0.008***** and for Private Company-HUF ***is .024**** as depicted in Figure 5.1 and Table 5.17. There is no significant difference between a Private Company and a Public Company.

5.4.1.5 Stakeholders' Awareness and Sources of Renewable Energy

The Kruskal-Wallis H test was carried out to see if there is any significant difference in Stakeholders' Awareness of CDM Projects based on the type of renewable energy used for earning carbon credits. The hypothesis was as follows: -

Hypothesis:

H_0: There is no significant difference in the Stakeholders' Awareness of the CDM Projects using different Sources of Renewable Energy.

H_1: There is significant difference in the Stakeholders' Awareness of the CDM projects using different Sources of Renewable Energy.

Table 5.18

Stakeholders' Awareness based on Sources of Renewable Energy

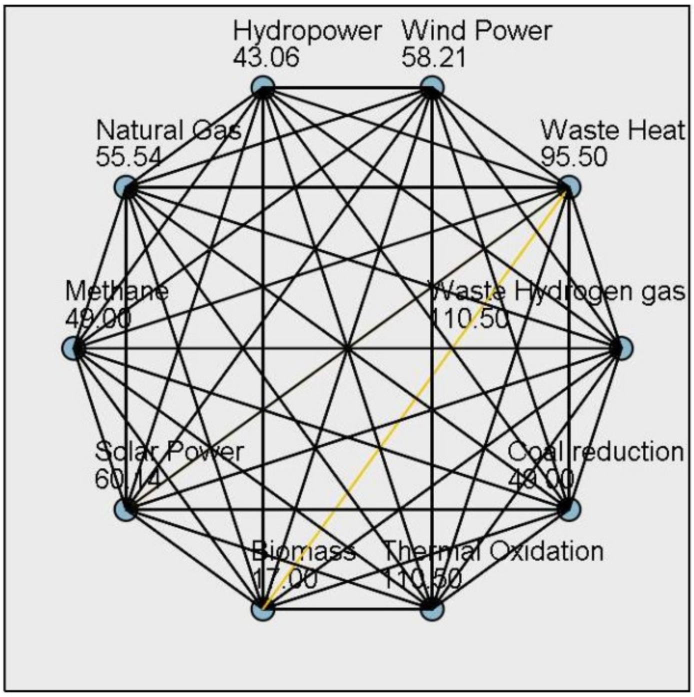
Construct	Source of Renewable Energy	Mean Ranks	Test Statistic	Df	*p-value*	Effect Size
Stakeholder Awareness	Biomass	17	18.915	9	**.026***	.096
	Solar Power	60.14				
	Wind Power	58.21				
	Natural Gas	55.54				
	Thermal Oxidation	110.5				
	Hydropower	43.06				
	Methane	49				
	Waste Hydrogen gas	110.5				
	Coal reduction	49				
	Waste Heat	95.5				

*Source: Primary data, *The mean ranks are significantly different at 5% level*

From Table 5.18 above, it can be seen that there are differences in the mean ranks for Stakeholders' Awareness of CDM Projects based on the source of energy used for production. For investigating whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted. The result showed a significant difference in the mean ranks of Stakeholders' Awareness. The Stakeholders' Awareness was better concerning Thermal Oxidation, Waste Hydrogen Gas, and very low concerning Biomass. The test statistic = 18.915 and ***p-value is .026****. Since the p-value is less than 0.05, the test statistic is significant at a 5% level of significance and the effect size is moderate. Hence, the null hypothesis is rejected, so there is a significant difference in the Stakeholders' Awareness of the CDM projects using different sources of energy. Hence, further analysis was done by Multiple Pairwise Comparisons of Sources of Renewable Energy and the results are shown in Figure 5.2 and Table 5.19.

Figure 5.2

Pairwise Comparison of Stakeholders' Awareness based on Sources of Renewable Energy



Source: Primary data

Table 5.19

Multiple Pairwise Comparison of Stakeholder Awareness based on Sources of Renewable Energy

Source of Renewable Energy	**Test Statistic**	***p-value***
Biomass-Waste Heat	-3.296	**.044***

*Source: Primary data, *Significant at 5% level*

The Multiple Pairwise Comparison shows that the Stakeholders' Awareness of CDM projects using Waste Heat and Biomass as Sources of Renewable Energy are significantly different from each other with a ***p-value of 0.044**** as depicted in Figure 5.2 and there is no significant difference among other Sources of Renewable Energy.

5.4.1.6 Stakeholders' Awareness and Period of Registration of CDM Projects

The Period of registration has been divided into two periods based on the two commitment periods/phases under the Kyoto Protocol. To examine if there is a significant difference in Stakeholders' Awareness of projects that are registered in different phases of the Kyoto Protocol, the Mann-Whitney U Test was conducted. The hypothesis set is as follows: -

Hypothesis:

H_0: There is no significant difference in the Stakeholders' Awareness of the project based on different registration periods.

H_1: There is significant difference experienced in the Stakeholders' Awareness of the project participants between the different registration periods.

The test statistic of the Mann-Whitney U Test is given below.

Table 5.20

Stakeholders' Awareness based on Period of Registration

Construct	Period of Registration	N	Mean Ranks (Median)	Mann-Whitney U Test Statistic	*p-value*
Stakeholders' Awareness	2000 - 2012	93	57.38	895.00	0.791
	2013 - 2020	20	55.25		

Source: Primary data

From the above table, the test revealed that there is no significant difference in Stakeholders' Awareness of CDM projects in the period 2000-2012 (Mean Rank= 57.38, n = 93) and the period 2013-2020 (Mean Rank= 55.25, n = 20). The test statistics is U = 895.00 and *p-value* = 0.791. Since the *p-value* is more than 0.05, the null hypothesis is accepted.

Mann-Whitney U test results show that the test statistic is not significant at a 5% level of significance. It can be said that the project participants have the same type of experience concerning awareness among stakeholders for the CDM projects in India whether it is the first commitment period (2000-20012) or the second commitment period (2013-2020). It shows that there has been very little effort taken to increase the level of awareness among the general public, project participants, and state and central government after the first commitment period.

5.4.2 Government Support

The support of the Government is critical for the formation and implementation of CDM projects. The CDM projects require support from the governments both central and state, through policies and regulations that facilitate the development of CDM projects, such as tax incentives, subsidies, favourable regulatory frameworks, and their guidance at each stage of the project implementation.

5.4.2.1 EFA of Government Support

Table 5.21

KMO and Bartlett's Test of Government Support

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.753**
Bartlett's Test of Sphericity	Approx. Chi-Square	120.103
	df	6
	Sig.	**.000****

*Source: Primary data, **Significant at 1% level*

The KMO of "Government Support for CDM Projects" is 0.753 and Bartlett's Test is significant at a 1% level of significance and it shows that there is a substantial correlation in data.

Table 5.22

Communalities of Government Support

Item No.	Items	Initial	Extraction
1	Strong Economic Incentives were provided by Central Government	1	0.528
2	Coordination between State Governments in Policymaking	1	0.519
3	The Central Government Policy Initiatives have helped the formulation of the project.	1	0.609
4	Special Economic Packages were declared by State Government for CDM Projects	1	0.738

Extraction Method: Principal Component Analysis
Source: Primary data

From Table 5.22, it is evident that all the variables have communalities above 0.5. Therefore, all the variables were taken for extracting the components.

Table 5.23

Total Variance Explained of Government Support

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.394	59.854	59.854	2.394	59.854	59.854
2	.687	17.174	77.029			
3	.545	13.631	90.660			
4	.374	9.340	100.000			

Extraction Method: Principal Component Analysis.
Source: Primary data

The above table explains that 59.631 % of the total variance in Stakeholders' Awareness is explained by one component.

For extracting factors from the variables, Eigenvalue1 was taken which is required to explain the maximum variance in the data by the principal component. The table above shows that 59.854% of the total variance in Government Support is explained by one component.

Table 5.24

Component Matrix[a] of Government Support

Sl. No.	Item No.	Items	Component 1
1	4	Special Economic Packages were declared by State Government for CDM Projects	0.859
2	3	Central Government Policy Initiatives	0.78
3	1	Strong Economic Incentives were provided by Central Government	0.727
4	2	Coordination between State Governments in Policymaking	0.72

Extraction Method: Principal Component Analysis
a. 1 Component extracted
Source: Primary data

The component matrix shows that only one component is measured by Item 4 and followed by Items 3, 1, and 2.

5.4.2.2 Analysis of Government Support

The results of the study concerning the State and Central Government Support received by companies in India are as below.

Table 5.25

Frequency Distribution of Government Support

Items		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Strong Economic Incentives were provided by Central Government	N	2	35	53	21	2	
	%	2	31	47	19	2	113
	C%	2	33	80	98	100	
Coordination between State Governments in Policymaking	N	11	35	41	24	2	
	%	10	31	36	21	2	113
	C%	10	41	77	98	100	
Central Government Policy Initiatives	N	16	38	42	15	2	
	%	14	34	37	13	2	113
	C%	14	48	85	98	100	
Special Economic Packages by State Government	N	10	28	45	27	3	
	%	9	25	40	24	3	113
	C%	9	34	73	97	100	

Source: Primary data
Note: C% represents cumulative percentage

The result depicted in Table 5.25 revealed that 47% of the respondents are noncommittal to the statement of getting support from the government in the form of "strong economic incentives", a cumulative score of 33% agree to the statement and 21% (19+2) do not agree.

For businesses with CDM projects in multiple states, cooperation between state governments on policy positions is essential. The growth of CDM projects may face difficulties if state standards and rules change because they will need to be studied each time a project is carried out in a different state. 41% agree or strongly agree that they did not encounter any problems of different policies of states but 36% were non-committal and 23% (21% + 2%) either disagreed or strongly disagreed.

48% Strongly Agree or Agree, 37% are neutral and 15% (13% + 2%) Disagree or Strongly disagree that the Central Government did take initiatives to encourage CDM projects in India.

A cumulative score of 34% of the respondents believe that they got State Government Support in the form of Special Economic Packages, 40% are neutral and, 27% (24% +3%) disagree or strongly disagree with it.

Looking at the cumulative score, we can say that up to 33 to 48% of the respondents agree with the statements on Government support but around 73 to 85% of the respondents cumulatively do not disagree with the statement either. 15 to 27% disagree with the statements of receiving government support

Table 5.26

Descriptive Statistics of Government Support

Item No.	Items	N	Mean	Median	Std. Deviation
1	Strong Economic Incentives were provided by Central Government	113	3.12	3.00	.792
2	Coordination between State Governments in Policymaking	113	3.26	3.00	.962
3	Central Government Policy Initiatives	113	3.45	3.00	.954
4	Special Economic Packages by Government	113	3.13	3.00	.968

Source: Primary data

Table 5.26 reveals that all the statements have a mean score between 2.5-3.49 and all the means are 3, which indicates a fairly moderate agreement with the statements. Hence, it can be inferred that the companies did get some sort of help and backing from the government.

The following analysis is done to see whether there is any correlation between Government Support and the independent variables of the CDM project, such as state, company type, renewable energy, and registration period.

5.4.2.3 Government Support for CDM Projects and State

The Kruskal Wallis H test was used to determine whether there are significant differences in Government Support between states and the following hypothesis was developed:

Hypothesis:

H_0: There is no significant difference in Government Support for CDM projects between the states.

H_1: There is significant difference in Government Support for CDM projects across the states.

Table 5.27

Government Support Based on States

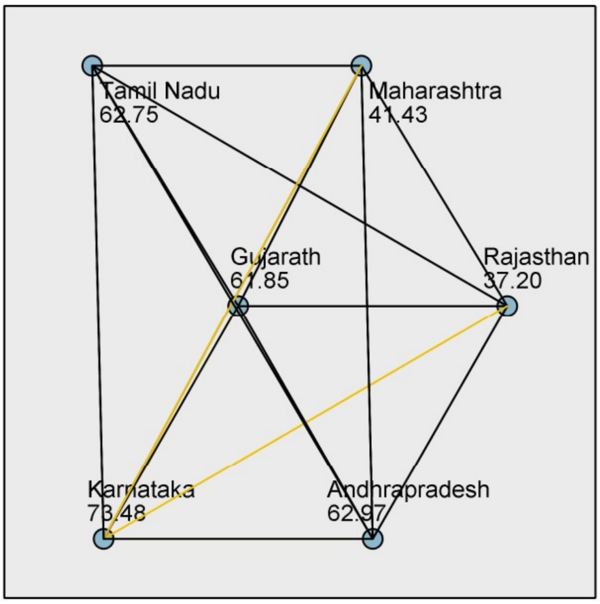
Construct	States	N	Mean Ranks	Test Statistic	Df	*p-value*	Effect Size
Government Support	Rajasthan	15	37.20	17.342	5	**0.004****	.12
	Gujarat	17	61.85				
	Maharashtra	22	41.43				
	Andhra Pradesh	15	62.97				
	Tamil Nadu	24	62.75				
	Karnataka	20	73.48				

*Source: Primary data, **The mean ranks are significantly different at 1% level*

Based on the State where the CDM projects are situated, Table 5.27 above demonstrates that there are variations in the mean ranks for Government Support for CDM Projects. The Kruskal-Wallis H test was used to determine whether this difference is statistically significant or not. The test statistics are χ^2 = 17.342 and ***p-value is 0.004**** and since the *p-value* is less than 0.01, the test statistic is significant at 1% level of significance. The null hypothesis is thus rejected and it can be inferred that the difference in mean ranks is significant among the states and since the effect size =0.12 and it is between 0.06 and 0.14, it has a moderate effect. Hence, further analysis was done by Multiple Pairwise Comparisons of States and the results are shown in Figure 5.3 and Table 5.28.

Figure 5.3

Pairwise comparisons of Government Support Based on States



Source: Primary data

Table 5.28

Multiple Pairwise Comparison of Government Support Based on States

States	Test Statistic	*p-value*
Rajasthan-Karnataka	-36.275	0.017*
Maharashtra-Karnataka	-32.043	0.022*

*Source: Primary data, *Significant at 5% level*

The Multiple Pairwise Comparison shows that Government Support for CDM projects between Rajasthan and Karnataka and Maharashtra and Karnataka are significantly different from each other with a *p-value* of 0.017* and 0.022* respectively. The test statistic is therefore significantly different at 5% level of significance between the states.

5.4.2.4 Government Support for CDM Projects and Type of Company

The Kruskal Wallis H test was performed to study whether the project participants' experience with Government Support for CDM projects differs based on the type of company which owns the project. The hypothesis set was as follows: -

Hypothesis:

H_0: There is no significant difference in Government Support for CDM projects based on the Type of Company owning them.

H_1: There is significant difference in Government Support for CDM projects based on the Type of Company owning them.

Table 5.29

Government Support based on Type of Companies

Construct	Type of Company	N	Mean Ranks	Test Statistic	Df	*p-value*	Effect Size
Government Support	Public Company	38	56.18	5.24	2	0.073	-
	Private Company	60	61.7				
	HUF	15	40.27				

Source: Primary data

From Table 5.29 above, it can be seen that there are differences in the mean ranks for Government Support for CDM Projects based on the Type of Company owning them. The Mean rank for Private companies is the best at 61.7 followed by Public Companies at 56.18 and the least for HUF at 40.27. For analysing whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted. The test statistic = 5.24, *p-value* = 0.073. Since the p-value is more than 0.05, it is not significant at a 5% level of significance. The null hypothesis is thus accepted, and hence it is concluded that there is no significant difference in the Government Support for CDM projects based on the Type of Company owning the projects.

5.4.2.5 Government Support for CDM Projects and Sources of Renewable Energy

The Kruskal-Wallis H test was carried out to see if there is any significant difference in Government Support of CDM projects based on the type of renewable energy used for earning carbon credits. The hypothesis was as follows: -

Hypothesis:

H_0: There is no significant difference in the Government Support of the CDM project between the projects using different Sources of Renewable Energy.

H_1: There is significant difference in the Government Support of the CDM project between the projects using different Sources of Renewable Energy.

Table 5.30

Government Support Based on Sources of Renewable Energy

Construct	Sources of Renewable Energy	Mean Ranks	Test Statistic	Df	*p-value*	Effect Size
Government Support	Biomass	61.20	9.802	9	0.367	-
	Solar Power	58.04				
	Wind Power	53.27				
	Natural Gas	56.27				
	Thermal Oxidation	24.00				
	Hydropower	77.25				
	Methane	24.00				
	Waste Hydrogen gas	97.50				
	Coal reduction	97.50				
	Waste Heat	71.33				

Source: Primary data

From Table 5.30 above, it can be seen that there are differences in the mean ranks for Government Support of CDM projects based on the source of energy used for production. For investigating whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted. The test statistic = 9.802 and *p-value* = 0.367. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Government Support for the CDM project between the projects using different sources of energy.

Hence it can be concluded that the government has given more or less the same type of support to all CDM projects whatever may be the source of renewable energy.

5.4.2.6 Government Support for CDM Projects and Period of Registration

To examine if there is a significant difference in Government Support for projects which are registered in different phases of the Kyoto Protocol, Mann-Whitney U Test was conducted. The hypothesis set are as follows: -

Hypothesis:

H_0: There is no significant difference experienced in Government Support by the project participants between the different registration periods.

H_1: There is significant difference experienced in Government Support by the project participants between the different registration periods.

Table 5.31

Government Support and Period of Registration

Construct	Period of Registration	N	Mean Ranks (Median)	Mann-Whitney U Test Statistic	p-value
Government's Support	2000 - 2012	93	55.30	771.5	0.230
	2013 - 2020	20	64.93		

Source: Primary data

The Mann-Whitney U Test statistic revealed that there is no significant difference experienced in the ease of doing business due to Government Support for CDM projects in the period 2000-2012 (Mean Rank= 53.50, n = 93) and the period 2013-2020 (Mean Rank= 64.93, n = 20). The test statistic is U = 771.500 and *p-value* = 0.230. Since the p-value is more than 0.05, the null hypothesis is accepted.

Mann-Whitney U test results show that the test statistic is not significant at a 5% level of significance. It can be said that the project participants have the same type of experience concerning Government Support for the CDM projects in India whether it is the first commitment period (2000-20012) or the second commitment period (2013-2020). It shows that there has been very little effort taken to increase the level of Government Support among the general public, project participants, and state and central government after the first commitment period.

5.4.3 CDM Project Development

When a company decides to go for CDM projects, it is expected that the company has an awareness of the clean development mechanism for reducing global emissions and the benefits that can be reaped from it. The awareness can be from their peers, chartered accountants who advise them on tax matters, government, etc. The problems faced in the development of CDM projects can be explained from different angles. It can be the bureaucratic hurdles for getting approval at each stage, lack of awareness, financial risks, cost escalation, support of staff for change in technology or regular monitoring, and timely completion of the project.

5.4.3.1 EFA of CDM Project Development

The results of exploratory factor analysis done on the construct CMD Project Development using SPSS are as below.

Table 5.32

KMO and Bartlett's Test of CDM Project Development

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.713**
Bartlett's Test of Sphericity	Approx. Chi-Square	419.406
	Df	91
	Sig.	**.000****

*Source: Primary data, **Significant at 1% level*

The KMO of "CDM Project Development" is 0.713 and Bartlett's Test is significant at a 1% level of significance and shows a substantial correlation in data.

Table 5.33

Communalities of CDM Project Development

Item No.	Items	Initial	Extraction
1	Easy availability of Initial Capital	1.000	0.561
2	PDD was prepared within a reasonable amount of time.	1.000	0.503
3	Registration of the project with the NCDMA was easy.	1.000	0.540
4	Support from the existing staff of the company for the CDM project	1.000	0.522
5	Support from the people residing in the project vicinity for the CDM project.	1.000	0.684
6	Sufficient infrastructure was available at the proposed project site.	1.000	0.612
7	Coordination with the state and central agencies was easy in getting approval for the project.	1.000	0.766
8	Local skilled labour was available to set up the CDM project.	1.000	0.561
9	No opposition from the existing staff when new technology was introduced (if any)	1.000	0.563
10	Strong support of banks and other financial Institutions for the project	1.000	0.565
11	Installation of the machinery/new technology was done without any problems	1.000	0.610
12	CDM project was commissioned on time.	1.000	0.576
13	Cost of the CDM project did not exceed the estimated cost.	1.000	0.704
14	Monitoring of operations was done without any problem.	1.000	0.716

Extraction Method: Principal Component Analysis.
Source: Primary data

From the above table, it is evident that all the variables have communalities above 0.5. Therefore, all the variables were taken for extracting the components.

Table 5.34

Total Variance Explained by CDM Project Development

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	3.632	25.939	25.939	3.632	25.939	25.939	2.604	18.602	18.602
2	2.077	14.838	40.777	2.077	14.838	40.777	2.012	14.369	32.971
3	1.519	10.847	51.624	1.519	10.847	51.624	1.946	13.900	46.871
4	1.254	8.958	60.582	1.254	8.958	60.582	1.919	13.710	60.582
5	.940	6.712	67.294						
6	.735	5.247	72.541						
7	.664	4.743	77.284						
8	.607	4.336	81.620						
9	.590	4.218	85.838						
10	.548	3.913	89.751						
11	.491	3.507	93.258						
12	.347	2.475	95.733						
13	.324	2.315	98.048						
14	.273	1.952	100.000						

Extraction Method: Principal Component Analysis.
Source: Primary data

The above table explains that 60.582 % of the total variance in the CDM project Development is explained by four components.

Table 5.35

Component Matrix[a] of CDM Project Development

Sl. No.	Item No.	Items	Component 1	2	3	4
1	5	Support from the people residing in the project vicinity for the CDM project.	0.821			
2	3	Registration of the project with the NCDMA was easy.	0.694			
3	8	Local skilled labour was available to set up the CDM project.	0.686			
4	2	PDD was prepared within a reasonable amount of time.	0.681			
5	1	Easy availability of Initial Capital	0.562			
6	7	Coordination with the state and central agencies was easy for getting approval		0.849		
7	10	Strong support of banks and other financial Institutions for the project		0.741		
8	6	Sufficient infrastructure was available at the proposed project site.		0.716		
9	14	Monitoring of operations was done without any problem.			0.815	
10	13	Cost of the CDM project did not exceed the estimated cost.			0.788	
11	12	CDM project was commissioned on time.			0.719	
12	11	Installation of the machinery/new technology was done without any problems				0.767
13	4	Support from the existing staff of the company for the CDM project				0.718
14	9	No opposition from the existing staff when new technology was introduced (if any)				0.648

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.
Source: Primary data

The rotated component matrix shows that there are four main dimensions of the CDM project Development construct. The first component is measured by Item 5 and is followed by Items 3,8,2 and 1. The second component is measured by Item 7 and it is followed by 10 and 6. The third component is measured by Item 14 and is followed by 13 and 12 while the fourth component is measured by Item 11 and is followed by 4 and 9.

5.4.3.2 Stages of CDM Project Development

The CDM project development consists of four dimensions which are the stages of project development. The first stage is **Project Formation** and there are certain factors facilitating the smooth formation of CDM projects like the support of local people, smooth registration with NCDMA, availability of skilled labour, preparation of project development document, and availability of initial capital. The second stage is **Project Execution**, and the important areas of execution of a project are coordination with central and state agencies, support of banks for the project, and on-site infrastructure. The third stage is **Project Operations** where monitoring of operations, timely project completion within the predetermined cost, and commissioning of the project are the elements. The fourth dimension is **Project Support** where for the formation and smooth operation of CDM projects, the support of existing staff and their cooperation in the installation of new technology are important factors. Each of the above stages are separately analysed using frequency distribution and descriptive statistics are as below.

A. Project Formation

Project Formation is the initial stage of CDM Project Development. Project Formation includes community support, regulatory compliance, access to skilled labour, thorough planning, and financial readiness. In order to study the Project Formation details, five statements have been asked.

Table 5.36

Frequency Distribution of Project Formation

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Support from the local people was received	N	17	43	46	7	0	113
	%	15	38	41	6	0	
	C%	15	53	94	100	100	
Registration of the project with NCDMA was done on time	N	21	46	42	4	0	113
	%	19	41	37	4	0	
	C%	19	59	96	100	100	
Skilled labour available locally	N	21	42	37	13	0	113
	%	19	37	33	12	0	
	C%	19	56	88	100	100	
PDD was prepared in time	N	32	45	36	0	0	113
	%	28	40	32	0	0	
	C%	28	68	100	100	100	
Easy availability of Initial Capital	N	26	32	45	8	2	113
	%	23	28	40	7	2	
	C%	23	51	91	98	100	

Source: Primary data
Note: C% represents cumulative percentage

As per Table 5.36, it is evident that very few (7 numbers) respondents amounting to 6% of the total disagreed with the statement that "Support of the local people was received for the CDM project". 41% were neutral and a cumulative 53% either agreed or strongly agreed that they got support from the local people for the project.

Registration of a project which we envisage to be a Clean Development Mechanism Project under UNFCCC has to be first registered with the National Clean Development Mechanism Authority, India. Many documents have to be submitted and conditions have to be fulfilled to get them registered. So, to the question that the registration with NCDMA was done on time, a cumulative of 59% either agreed or strongly agreed, 37% of the respondents were neutral and 4% disagreed and felt that there was some delay.

Regarding the availability of skilled labourers for setting up the project, 56% either agreed or strongly agreed that they were locally available and 33% were neutral and 12% disagreed with the statement. All the companies are using contractors for setting up the plant as the equipment needed for wind, solar, hydro, and other renewable energy source require skilled labourers. Such labourers are specially trained by the manufacturing units of such equipment. Hence, the project participants are not directly recruiting employees from the locality.

Regarding the question of preparation of the Project Design Document which has to be submitted to the NCDMA at the time of registration, all the respondents were positive or neutral to the statement. None of them disagreed. 32% were neutral and a cumulative 68% either agreed or strongly agreed that the PDD was prepared in time.

For the start of any project, it is difficult to get initial capital as the proposals submitted to financial institutions are accepted or rejected based on the success or failure of other projects in the area. But it can be easy to get funding if there is proper awareness of the benefits of CDM projects like economic, technological, social, and environmental ones. If the government of the time supports such projects, that also makes a lot of difference in getting the financial support of the banks and other institutions. Hence, in the study, the table above shows that a cumulative 51% agreed or strongly agreed that getting initial capital was not a problem, while 40% are noncommittal and 9% (7%+ 2%) disagreed and strongly disagreed with the statement.

From the above discussions, we can infer that a cumulative of 51% to 68% either agreed or strongly agreed with the statements and we can say that the majority of the respondents had a positive experience while developing the CDM project. But a large section from 32% to 41% was neutral to the statements, which means that they either had a bad experience and are noncommittal or they neither had a bad experience nor a good one, that is, the problems that arose were tackled in time.

Table 5.37

Descriptive Statistics of Project Formation

Sl. No.	Items	N	Mean	Median	Std. Deviation
1	Support from the people residing in the project vicinity for the CDM project.	113	3.62	4	0.816
2	Registration of the project with the NCDMA was easy.	113	3.74	4	0.799
3	Local skilled labour was available to set up the CDM project.	113	3.63	4	0.918
4	PDD was prepared within a reasonable amount of time.	113	3.96	4	0.778
5	Easy availability of Initial Capital	113	3.64	4	0.973

Source: Primary data

The above table depicts that the respondents had all agreed to the statements relating to Project Formation as all the mean scores are in the bracket 3.5 – 5 (agreement) and the median is also 4. Hence overall there was a positive opinion among respondents regarding factors that facilitated the smooth Project Formation of CDM projects in India.

B. **Project Execution**

After planning for the project and getting the required approval from the authorities for implementing the project, the plan has to be executed in an efficient manner. This is the second stage of Project Development called **Project Execution**. The factors facilitating the execution of a project are the proper coordination with various State and Central Agencies, support of the banks and financial institutions, as well as the on-site infrastructure

Table: 5.38

Frequency Distribution of Project Execution

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Coordination with State & central agencies	N	18	26	38	29	2	
	%	16	23	34	26	2	113
	C%	16	39	73	98	100	
Support from Financial Institutions	N	11	29	49	21	3	
	%	10	26	43	19	3	113
	C%	10	35	79	97	100	
Sufficient Infrastructure at the project site	N	8	10	45	38	12	
	%	7	9	40	34	11	113
	C%	7	16	56	89	100	

Source: Primary data
Note: C% represents cumulative percentage

Table 5.38 depicts that a cumulative 39% of the respondents feel that the coordination with state and central agencies was easy, 34% are neutral and a cumulative of 28% (26% + 2%) disagreed or strongly disagreed with the statement. 28 22 45

The majority of respondents (43%) are neutral to the statement for strong support from financial institutions was received for the project and 22% (19% + 3%) disagreed or strongly disagreed with it. Only 35% of the respondents agreed or strongly agreed with the statement.

40% of the respondents choose to remain neutral to the statement about whether infrastructure was available in the project site, only 16% agreed or strongly agreed with it and the majority of the respondents (45%) disagreed or strongly disagreed.

From the above discussion, it can be inferred that only a cumulative of 16% to 39 % agreed with the statements related to Project Execution. A majority of the respondents 34% to 43% were neutral as they felt it was not sufficient for the smooth execution of the project and 22% to 45% of the respondents disagreed with the coordination of state and central agencies, support from financial institutions and sufficient infrastructure at the site.

Table 5.39

Descriptive Statistics of Project Execution

Sl. No.	Items	N	Mean	Median	Std. Deviation
1	Coordination with the state and central agencies was easy for getting approval.	113	3.26	3.00	1.067
2	Strong support of banks and other financial Institutions for the project	113	3.21	3.00	.949
3	Sufficient infrastructure was available at the proposed project site.	113	2.68	3.00	1.020

Source: Primary data

The above table shows that all the means lie between 2.5 and 3.49 and hence, it can be inferred that the respondents are mostly neutral to the statements relating to Project Execution in India. The median is also 3 which represents neutrality. There is a lack of coordination among state and central agencies felt by the respondents and also it was not easy to get capital from banks. The infrastructure was properly provided only in Gujarat and Rajasthan where they had solar and wind parks developed by the state government.

C. Project Operations

The execution of the project leads to the third stage which is **Project Operations.** Once the machinery is installed and commissioned, it should start production of energy using renewable sources. The company has to see that the project is completed on time and within the estimated cost. Then, it is the duty of the project participants to monitor the operations and simultaneously document the amount of emission reductions taking place as per the methodology given in the PDD.

Table 5.40

Frequency Distribution of Project Operations

Particulars		**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	Total
Monitoring of Operations for emission reduction	N	21	43	45	4	0	113
	%	19	38	40	4	0	
	C%	19	57	96	100	100	
The cost of the CDM project did not exceed budget	N	19	19	41	31	3	113
	%	17	17	36	27	3	
	C%	17	34	70	97	100	
CDM project commissioned on time.	N	18	33	36	23	3	113
	%	16	29	32	20	3	
	C%	16	45	77	97	100	

Source: Primary data
Note: C% represents cumulative percentage

Table 5.40 depicts that, 57% of the respondents agree or strongly agree that monitoring the day-to-day operations relating to emission reduction is easy, 40% are neutral and only 4% disagree with the statement. According to 34% of the respondents, the cost of the CDM project did not exceed the budget, more than that, 36% are neutral and 30% did not agree or strongly disagreed. A cumulative 45% think that the project was commissioned on time, 32% are neutral and 23% disagree or strongly disagree.

The above analysis shows that monitoring operations of the CDM project is relatively easy but the cost of the project and timely completion were not agreeable to 30% and 23% respectively.

Table 5.41

Descriptive Statistics of Project Operations

Sl. No.	Items	N	Mean	Median	Std. Deviation
1	Monitoring of operations was done without any problem.	113	3.72	4	0.807
2	The cost of the CDM project did not exceed the estimated cost.	113	3.18	3	1.096
3	CDM project was commissioned on time.	113	3.35	3	1.06

Source: Primary data

The descriptive statistics also follow the percentage analysis. The mean of 'Monitoring of operations was done without any problem' is 3.72 and the median is 4, which means that the majority are in agreement, the mean of 'CDM project was commissioned on time is 3, and the mean of 'Cost of CDM project did not exceed the estimated cost' are between 2.5 and 3.49 and the median for both are 3, which means that majority are neutral on those subjects.

D. Project Support

Every project needs the support of staff for successful completion of a project and its operations. The staff also have to support any new changes in the technology in production so that they can be trained to efficiently adapt to the changing scenario.

Table 5.42

Frequency Distribution of Project Support

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Installation of machinery/new technology was easy	N	31	46	36	0	0	113
	%	27	41	32	0	0	
	C%	27	68	100	100	100	
Support of existing staff for the project	N	38	51	21	3	0	113
	%	34	45	19	3	0	
	C%	34	79	97	100	100	
No opposition from staff for technology change	N	32	40	33	5	3	113
	%	28	35	29	4	3	
	C%	28	64	93	97	100	

Source: Primary data
Note: C% represents cumulative percentage

As per Table 5.42, it is evident that the installation of new machinery was easy as 68% were in agreement with the statement and the rest (32%) were neutral. 79% of the respondents were in agreement that the staff of the organization was supportive of the CDM project whereas 19% were neutral and only 3% disagreed. 64% of the respondents said that there was no opposition from staff for technology change, 29% were neutral and 7% (4%+ 3) either disagreed or strongly disagreed respectively with the statement.

From the above percentages, we can infer that in most of the cases, the change in technology and installation of new machinery was supported by the staff and hence it was an easy transition from old technology to new technology.

Table 5.43

Descriptive Statistics of Project Support

Sl. No.	Items	N	Mean	Median	Std. Deviation
1	Installation of the machinery/new technology was done without any problems	113	3.96	4	0.772
2	Support from the existing staff of the company for the CDM project	113	4.1	4	0.79
3	No opposition from the existing staff when new technology was introduced (if any)	113	3.82	4	0.984

Source: Primary data

The table for descriptive statistics for this dimension also corroborates the above percentage analysis. The means of all statements fall in the category, 3.5 – 5, which means agreement, and the median is also 4 in all the cases. Hence it can be concluded that there was strong support from the staff in the installation and change of technology for the implementation of the CDM project.

The analysis that follows examines the relationship between CDM Project Development and its stages and the project's independent variables, like state, company type, renewable energy sources, and registration period.

5.4.3.3 CDM Project Development and States

The Kruskal-Wallis H test was carried out to see if there is any significant difference in CDM Project Development based on the states where the projects are situated. The hypothesis was as follows: -

Hypothesis:

H_0: There is no significant difference in the CDM Project Development among the States

H_1: There is significant difference in the CDM Project Development among the States.

Table 5.44

CDM Project Development Based on States

Construct	States	N	Mean Ranks	Test Statistic	Df	p-value	Effect Size
CDM Project Development	Rajasthan	15	47.90	2.59601	5	.762	-
	Gujarat	17	65.41				
	Maharashtra	22	57.02				
	Andhra Pradesh	15	57.53				
	Tamil Nadu	24	54.19				
	Karnataka	20	59.63				

Source: Primary data

From Table 5.44 above, it can be seen that there are differences in the mean ranks for CDM Project Development based on the states where the projects are situated. The maximum mean rank is for Gujarat at 65.41 followed by Karnataka at 59.63, Andhra Pradesh at 57.53, Tamil Nadu at 54.19, Maharashtra at 57.02, and Rajasthan at 47.90. For investigating whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted. The test statistic =2.59601 and *p-value* = 0.762. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the CDM Project Development based on the states where the projects are situated.

Hence it can be concluded that the project participants got the same type of facilities for the smooth formation and implementation of CDM projects in all the States.

5.4.3.4 CDM Project Development and Type of Company

The Kruskal-Wallis H test was carried out to see if there is any significant difference in CDM Project Development based on the Type of Company Owning the Project. The hypothesis was as follows: -

Hypotheses:

1. H_0: There is no significant difference in Project Formation on the basis of Types of Companies.

   H_1: There is significant difference in Project Formation on the basis of Types of Companies.

2. H_0: There is no significant difference in Project Execution on the basis of Types of Companies.

   H_1: There is significant difference in Project Execution on the basis of Types of Companies.

3. H_0: There is no significant difference in the Project Operations on the basis of Types of Companies.

   H_1: There is significant difference in the Project Operations on the basis of Types of Companies.

4. H_0: There is no significant difference in the Project Support on the basis of Types of Companies.

   H_1: There is significant difference in the Project Support on the basis of Types of Companies.

5. H_0: There is no significant difference in Overall CDM Project Development on the basis of Types of Companies.

   H_1: There is significant difference in Overall CDM Project Development on the basis of Types of Companies.

Table 5.45

CDM Project Development based on Types of Companies

Stages of Project Development	Type of Company	N	Mean Ranks	Test Statistic	Df	P-value	Effect Size
Project Formation	Public Company	38	63.79	20.561	2	**0.000****	.169
	Private Company	60	61.56				
	HUF	15	21.57				
Project Execution	Public Company	38	48.66	14.897	2	**0.001****	.117
	Private Company	60	67.48				
	HUF	15	36.20				
Project Operations	Public Company	38	49.33	7.930	2	**0.019***	.054
	Private Company	60	64.97				
	HUF	15	44.57				
Project Support	Public Company	38	54.75	.479	2	0.787	-
	Private Company	60	58.97				
	HUF	15	54.83				
Overall CDM Project Development	Public Company	38	53.41	20.977	2	**0.000****	.173
	Private Company	60	67.33				
	HUF	15	24.80				

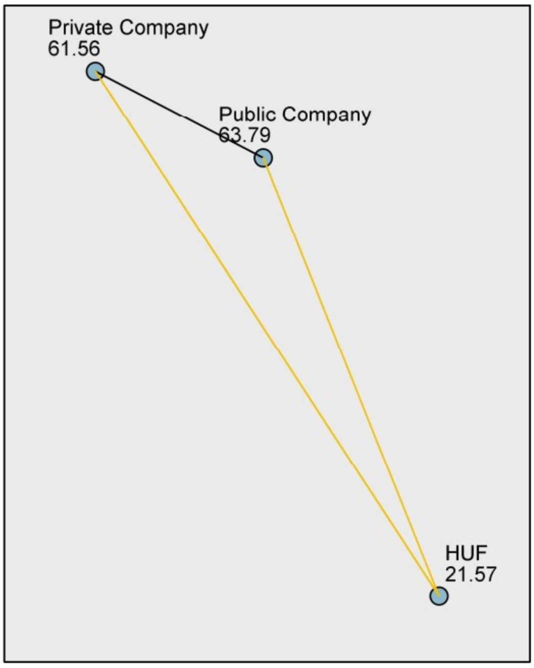
*Source: Primary data, **the mean ranks are significantly different at 1% level, *the mean ranks are significantly different at 5% level*

From Table 5.45 above, it can be seen that there are differences in the mean ranks for all the dimensions of CDM Project Development and also for the Overall CDM Project Development based on the Type of Company owning the projects. For analysing whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted.

The test statistics for **Project Formation** is 20.561, ***p-value* = 0.000****, and effect size = 0.169. Since the p-value is less than 0.01, the test statistic is significant at a 1% level of significance. The null hypothesis is thus rejected, and hence, there is a significant difference in the Project Formation based on the Type of Company owning the projects. The effect size is also more than 0.14, hence, it has a large effect. Further analysis was done by Multiple Pairwise Comparisons of Project Formation based on Types of Companies and the results are shown in Figure 5.4 and Table 5.46.

Figure 5.4

Pairwise Comparison of Project Formation Based on Types of Companies



Source: Primary data

Table 5.46

Multiple Pairwise Comparison of Project Formation Based on Types of Companies

Type of Company pairwise	Test Statistic	P-value
HUF-Private Company	39.992	**0.000****
HUF-Public Company	42.223	**0.000****

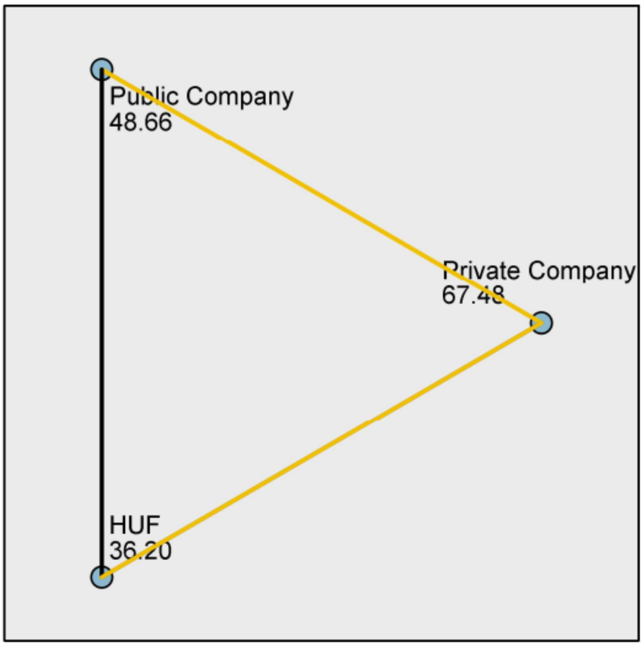
*Source: Primary data, **Significant at 1% level*

The Multiple Pairwise Comparison shows that the dimensions of **Project Formation** based on the Type of Company are significantly different from each other for HUF-Private Company with a ***p-value = 0.000**,*** and it is highly significant at a 1% level of significance. For HUF-Public Company the ***p-value = 0.000**** which is highly significant at a 1% level of significance. From **Figure 5.4,** there is no significant difference between Public Company-Private Company for the dimension of Project Formation.

The test statistic for **Project Execution** in **Table 5.45 is** = 14.897, ***p-value* = 0.001****, and effect size = 0.117. Since the p-value is less than 0.01, the test statistic is significant at a 1% level of significance, the null hypothesis is rejected, and hence, there is a significant difference in the Project Execution based on the Type of Company owning the projects. The effect size is between 0.06 and 0.14, hence, it has a moderate effect. Further analysis was done by Multiple Pairwise Comparisons of Project Execution based on Types of Companies and the results are shown in **Figure 5.5** and **Table 5.47.**

Figure 5.5

Pairwise Comparison of Project Execution Based on Types of Companies



Source: Primary Data

Table 5.47

Multiple Pairwise Comparison of Project Execution Based on Types of Companies

Type of Company pairwise	Test Statistic	P-value
HUF-Private Company	31.283	**0.003****
Public Company-Private Company	-18.825	**0.016***

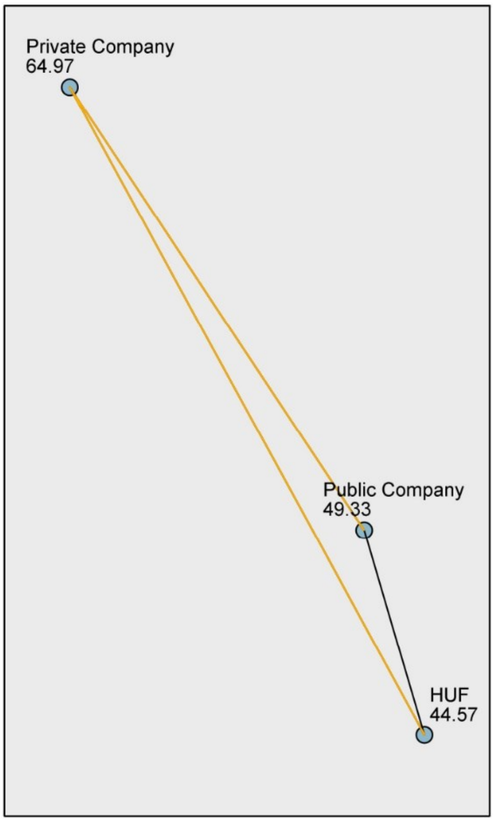
*Source: Primary data, **Significant at 1% level, *Significant at 5% level*

The Multiple Pairwise Comparison shows that **Project Execution** on the basis of types of company is significantly different from each other for HUF-Private Company with a ***p-value* of 0.003**** which is significant at a 1% level of significance and for Public Company-Private Company with a ***p-value* of 0.016*** which is significant at 5% level of significance. As depicted in **Figure 5.5,** there is no significant difference between HUF-Public Company for the dimension of **Project Execution**.

Table 5.45 shows that the test statistics for the **Project Operations** is 7.930, ***p-value* = .019***, and effect size = 0.054. Since the p-value is less than 0.05, the test statistic is significant at a 5% level of significance. The null hypothesis is thus rejected, and hence, there is a significant difference in the Project Operations based on the Type of Company owning the projects. The effect size is less than 0.06 and hence, it has a small effect. Further analysis was done by Multiple Pairwise Comparisons of Types of Companies and the results are shown in **Figure 5.6** and **Table 5.48.**

Figure 5.6

Pairwise Comparison of Project Operations Based on Types of Companies



Source: Primary data

Table 5.48

Multiple Pairwise Comparison of Project Operations Based on Types of Companies

Type of Company pairwise	Test Statistic	p-value
HUF-Private Company	20.400	**.030***
Public Company-Private Company	-15.638	**.020***

*Source: Primary data, *Significant at 5% level*

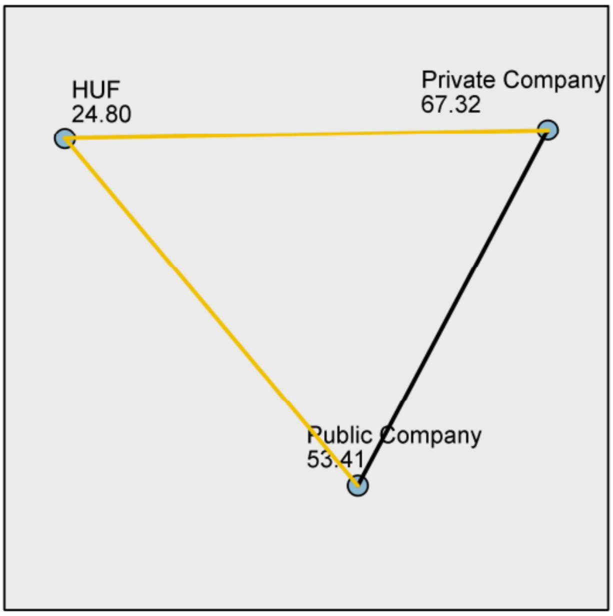
The Multiple Pairwise Comparison shows that in the case of dimension, **Project Operations** on the basis of Types of the Company, the projects are significantly different from each other for HUF-Private Company with a ***p-value* of .030*** which is significant at a 5% level of significance and for Public Company-Private Company with a ***p-value* of 0.020*** which is significant at 5% level of significance. As can be inferred from **Figure 5.6,** there is no significant difference between HUF-Public Company for the dimension **Project Operations.**

The test statistics for the **Project Support** as shown in **Table 5.45** is 0.479 *p-value* = .787. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. The null hypothesis is thus accepted, and hence, there is no significant difference in the Project Support based on the Type of Company owning the projects.

The test statistics for **Overall CDM Project Development** is 20.977, ***p-value is 0.000***, and effect size = 0.173. Since the p-value is less than 0.01, the test statistic is significant at a 1% level of significance. The null hypothesis is thus rejected, and hence, there is a significant difference in the Overall CDM Project Development based on the Type of Company owning the projects. The effect size is more than 0.14 hence, it has a large effect. Further analysis was done by Multiple Pairwise Comparisons of Overall CDM Project Development based on Types of Companies and the results are shown in **Figure 5.7 and Table 5.49**

Figure 5.7

Pairwise Comparison of Overall CDM Project Development Based on Types of Companies



Source: Primary data

Table 5.49

Multiple Pairwise Comparison of Overall CDM Project Development Based on Types of Companies

Type of Company pairwise	Test Statistic	P-value
HUF-Public Company	28.608	**0.012***
HUF-Private Company	42.525	**0.000****

*Source: Primary data, *Significant at 5% level, **Significant at 1% level*

As per **Table 5.49,** the Multiple Pairwise Comparison of Overall CDM Project Development based on Types of Companies is significantly different from each other for HUF-Public Company with ***p-value* = .012*** which is less than 0.05 and hence significant at a 5% level of significance. HUF and Private Companies are also significantly different with a **p-value of 0.000**** which is highly significant at a 1% level of significance. As depicted in **Figure 5.7,** there is no significant difference between Private Company and Public Company with respect to O**verall CDM Project Development.**

Thus, the Type of Company has a significant bearing on the ease of CDM Project Development in the country.

5.4.3.5 CDM Projects Development and Source of Renewable Energy

Here, the **CDM Projects Development** mean rank as per sources of renewable energy used by CDM projects is compared and analysed to see if there is a significant difference among them. For this, the Kruskal-Wallis H test is performed and the result is discussed below. The hypotheses formed are listed below.

Hypothesis:

1. H_0: There is no significant difference in **CDM Project Development** based on Sources of Renewable Energy used by the CDM projects

   H_1: There is significant difference in **CDM Project Development** based on Sources of Renewable Energy used by the CDM projects

Table 5.50

CDM Project Development Based on Sources of Renewable Energy

Construct	Source of Renewable Energy	N	Mean Ranks	Test Statistic	Df	p-value	Effect Size
CDM Project Development	Biomass	5	77.00	6.703	9	.668	-
	Solar Power	14	60.75				
	Wind Power	66	55.11				
	Natural Gas	13	44.62				
	Thermal Oxidation	1	82.50				
	Hydropower	8	65.19				
	Methane	1	49.00				
	Waste Hydrogen gas	1	93.00				
	Coal reduction	1	71.00				
	Waste Heat	3	57.17				

Source: Primary data

From **Table 5.50** above, it can be seen that there are differences in the mean ranks for **CDM Project Development** based on the source of energy used for production. For investigating whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted. The test statistic is 6.703 and *p-value* = .668. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the **CDM Project Development** using different sources of energy.

5.4.3.6 CDM Project Development and Period of Registration

Here, the **CDM Project Development** mean rank as per the Year of Registration of the project is compared and analysed to see if there is a significant difference among them. For this, the Mann-Whitney U Test is performed and the result is discussed below. The hypotheses formed are listed below.

Hypothesis:

1. H_0: There is no significant difference in **CDM Project Development** based on the Period of Registration of the CDM projects.

   H_1: There is significant difference in **CDM Project Development** based on the Period of Registration of the CDM projects.

Table 5.51

CDM Project Development Based on Period of Registration

Construct	Period of Registration	N	Mean Ranks (Median)	Mann-Whitney U Test Statistic	p-value
CDM Project Development	2000 - 2012	93	56.69	0.046	0.83
	2013 - 2020	20	58.43		

Source: Primary data

The mean ranks of **CDM Projects Development** based on the Period of Registration of the CDM projects were 56.69 and 58.43 for the period 2000-2012 and 2013-2020 respectively which are different so the Mann-Whitney U Test was conducted.

From the above table, the test statistics U = .046 and *p-value* = .83. As the p-value is more than 0.05 the test statistic is not significant at a 5% level of significance. Hence, the test accepts the null hypothesis and it is inferred that there is no significant difference in CDM Project Development based on the Period of Registration of CDM projects.

5.4.3.7 CDM Project Development and Activity Scale

The CDM Project Development may face difficulties based on the activity scale of the projects. The projects are classified as small-scale and large-scale based on the level of activity and the number of CERs generated in a year. If the project is able to reduce 15000 or more tonnes of carbon dioxide a year, then it is considered as large-scale project and vice versa. Hence it will be interesting to know whether the scale of the project has affected the level of ease in CDM Project Development. To examine if there is a significant difference in dimensions of CDM Project Development with respect to activity scale, Mann-Whitney U Test was conducted. The hypothesis set are as follows: -

Hypotheses:

1. H_0: There is no significant difference in the Project Formation between the Activity Scales.

   H_1: There is significant difference in the Project Formation between the Activity Scales.

2. H_0: There is no significant difference in Project Execution between the Activity Scales.

   H_1: There is significant difference in Project Execution between the Activity Scales.

3. H_0: There is no significant difference in the Project Operations between the Activity Scales.

H$_1$: There is significant difference in the Project Operations between the Activity Scales.

4. H$_0$: There is no significant difference in the Project Support between the Activity Scales.

   H$_1$: There is significant difference in the Project Support between the Activity Scales.

5. H$_0$: There is no significant difference in the overall CDM Project Development between the Activity Scales.

   H$_1$: There is significant difference in the overall CDM Project Development between the Activity Scales.

Table 5.52

CDM Project Development on the Basis of Activity Scale

Stages	Activity Scale	N	Mean Ranks (Median)	Mann-Whitney U Test Statistic	P-value
Project Formation	Large Scale	63	58.61	1473.50	0.555
	Small Scale	50	54.97		
Project Execution	Large Scale	63	51.57	1233.00	**0.046***
	Small Scale	50	63.84		
Project Operations	Large Scale	63	56.36	1534.50	0.813
	Small Scale	50	57.81		
Project Support	Large Scale	63	59.02	1447.50	0.452
	Small Scale	50	54.45		
Overall Total of CDM Project Development	Large Scale	63	56.24	1527	0.781
	Small Scale	50	57.96		

*Source: Primary data, *the mean ranks are significantly different at 5% level*

From Table 5.52 above, it can be seen that there are differences in the mean ranks for each of the dimensions of CDM Project Development for different Activity Scales. For testing whether this difference is statistically significant or not, the Mann-Whitney

U Test was conducted on all four dimensions and the Overall total of CDM Project Development.

The Mann-Whitney U Test statistic for Project Formation is 473.50 and *p-value* = 0.555. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Project Formation for the different activity scales.

The Mann-Whitney U Test statistic for Project Execution and activity scale is 1233.00 and ***p-value* = 0.046***. Since the p-value is less than 0.05, the test statistic is significant at a 5% level of significance. Hence, the null hypothesis is rejected, so there is a significant difference in the Project Execution for the different activity scales.

For further understanding, the mean scores were compared and it was seen that the mean of large-scale activity is 51.57 and the mean of small-scale activity is 63.84. It means, the statements related to coordination with state and central agencies, support from banks, and sufficient infrastructure. had more positive responses from small-scale project participants compared to large-scale projects.

As per **Table 5.52,** the Mann-Whitney U Test statistic for Project Operations is 1534.50 and *p-value* = 0.813. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Project Operations of the CDM project for the different activity scales.

The Mann-Whitney U Test statistic for Project Support is 1447.50 and *p-value* = 0.452. Since the *p-value* is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Project Support for the different activity scale.

The Mann-Whitney U Test statistic for CDM Project Development overall = 1527.00 and *p-value* = 0.718. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Overall CDM Project Development for the different activity scales.

Hence it can be concluded that most of the dimensions of CDM Project Development and the Overall CDM Project Development are not different for large-scale and small-scale activities except for Prerequisites for Project Execution.

The dimension, Project Execution is different for large-scale and small-scale activities. By Comparing the Means of the dimension based on activity scale, it can be inferred that the Project Execution was easier for the projects falling under the small-scale activity category. The variables in this dimension are, coordination with state and central agencies for getting approval for the project was easy, strong support from banks and other financial institutions for the project, and sufficient infrastructure was available at the proposed project site.

The relationship between Stakeholders' Awareness, Government Support and CDM Project Development is examined with the help of Correlation, Regression, and Kruskal Walis H test as depicted below.

5.4.3.8 Influence of Stakeholders' Awareness on CDM Project Development

To know the influence of stakeholders' awareness on CDM Project Development, first correlation analysis was done to examine if there is a correlation between Stakeholders' Awareness and CDM Project Development. Hence, the hypothesis set was as follows: -

H_0: There is no correlation between Stakeholders' Awareness and CDM Project Development

H_1: There is a correlation between Stakeholders' Awareness and CDM Project Development

Spearman's Rank Correlation was conducted using SPSS to study the correlation between Stakeholders' Awareness and CDM Project Development and its dimensions. The results are shown below:

Table 5.53

Correlation between Stakeholders' Awareness & Dimensions of CDM Project Development

Independent Variable	Dependent Variables	N	Spearman's rho	*p-value*	Results
Stakeholders' Awareness	Project Formation	113	-0.101	0.285	Not Significant
	Project Execution	113	0.02	0.830	Not Significant
	Project Operations	113	0.022	0.814	Not Significant
	Project Support	113	0.127	0.180	Not Significant
	Overall CDM Project Development	113	-0.04	0.674	Not Significant

Source: Primary Data

Table 5. 53 depicts Spearman's Rank Correlation between 'Stakeholders' Awareness' and the dimensions of 'CDM Project Development'. The table shows that the *p-value* of all the dimensions is more than .05 and hence there is no significant correlation between Stakeholders' Awareness and CDM Project Development.

5.4.3.9 Influence of Government Support on CDM Project Development

A correlation analysis was done to examine if there is a correlation between Government Support and the dimensions of CDM Project Development. Hence, the hypotheses set were as follows: -

1. H_0: There is no correlation between Government Support and Project Formation.

   H_1: There is a correlation between Government Support and Project Formation.

2. H_0: There is no correlation between Government Support and Project Execution.

H$_1$: There is a correlation between Government Support and Project Execution.

3. H$_0$: There is no correlation between Government Support and Project Operation.

   H$_1$: There is a correlation between Government Support and Project Operation.

4. H$_0$: There is no correlation between Government Support and Project Support.

   H$_1$: There is a correlation between Government Support and Project Support.

5. H$_0$: There is no correlation between Government Support and Overall CDM Project Development.

   H$_1$: There is a correlation between Government Support and Overall CDM Project Development.

Spearman's Rank Correlation was conducted using SPSS to study the correlation between Government Support and CDM Project Development and its dimensions. The results are shown below:

Table 5.54

Correlation between Government Support and the Dimensions of CDM Project Development

Independent Variable	Dependent Variables	N	Spearman's rho	p-value	Results
Government Support	Project Formation	113	0.221	**0.019***	Significant
	Project Execution	113	0.139	0.141	Not Significant
	Project Operations	113	0.004	0.967	Not Significant
	Project Support	113	0.107	0.260	Not Significant
	Overall CDM Project Development	113	0.211	**0.025***	Significant

*Source: Primary data, *correlation is significant at the 0.05 level (2-tailed).*

The above table shows Spearman's Rank Correlation between 'Government Support' and the dimensions of 'CDM Project Development'. The table shows that all four items in the 'CDM Project Development' construct, have a positive correlation but Project Formation has a significant correlation at a 5% level with a ***p-value* of 0.019***. Hence the null hypothesis is rejected and the alternative hypothesis that there is a significant correlation between Government Support and Project Formation is accepted.

The *p-value* of Project Execution, Project Operations and Project Support are .141, .967, and .260 respectively. Hence the null hypothesis is not rejected and it can be inferred that there is no significant correlation between Government Support with Project Execution, Project Operations and Project Support.

The correlation between Government Support and the overall construct of CDM Project Development is positive with a 5% level of significance at a ***p-value* of 0.025*.** Hence, we reject the null hypothesis and conclude that there is a correlation between Government Support and CDM Project Development.

This finding is highly significant as it shows that there is a positive effect on the various activities related to CDM Project Development when the state and central government agencies have favourable policies to assist the companies in CDM Project Development through their policy support.

For further analysis of the impact of Government Support on various dimensions of CDM Project Development, **Kendall-Theil Regression** was used. It helps in understanding the strength of the relationship between Government Support and Project Formation of CDM projects as well as Overall CDM Project Development as they show a significant correlation in **Table 5.54**.

a) The Kendell-Theil Robust Line Version 1.0 was used to get the regression line. The Kendall-Theil Regression equation obtained for the effect of Government Support on Project Formation was,

   Y= 15.75 + 0.25*X+ ei

Where, X = Government Support

Y= Project Formation

Median of Slopes = 0.25

Intercept =15.75

Hence, for every increase in Government Support, there will be a 0.25 increase in the ease of Project Formation during CDM Project Development.

b) The Kendall-Theil Regression equation obtained for the effect of Government Support on Overall CDM Project Development was,

Y= 42.5 + 0.5*X+ ei

Where, X = Government Support

Y= Overall CDM Project Development

Median of Slopes = 0.5

Intercept = 42.5

Hence, for every increase in Government Support, there will be a 0.5 increase in ease of CDM Project Development.

Thus, it can be inferred that Government Support plays a significant role in Project Formation and the successful CDM Project Development as a whole.

5.4.3.10 CDM Project Development as per the Level of Government Support

It will be meaningful if the ease of CDM Project Development is different for different levels of Government Support. To check whether Government Support is a factor in CDM Project Development, the total score of Government Support (4 x 5= 20) was divided into three categories, where Category 1 with a score of 4 to 9 is Low Government Support, Category 2 with a score of 10 to 14 is Moderate Government Support, and Category 3 with score 15 to 20 is High Government Support. A descriptive analysis was done which shows that there is considerable difference in mean scores among the three categories of Government Support. The Kruskal-Wallis

H test was conducted with the total of CDM Project Development taken as the test variable and Government Support as the grouping variable to see if the difference among the mean scores is significant. The following hypothesis was formed.

Hypothesis:

1. H_0: There is no significant difference in the CDM Project Development experience among projects based on the different levels of Government Support.

   H_1: There is significant difference in the CDM Project Development experience among projects based on the different levels of Government Support.

Table 5.55

CDM Project Development and Levels of Government Support

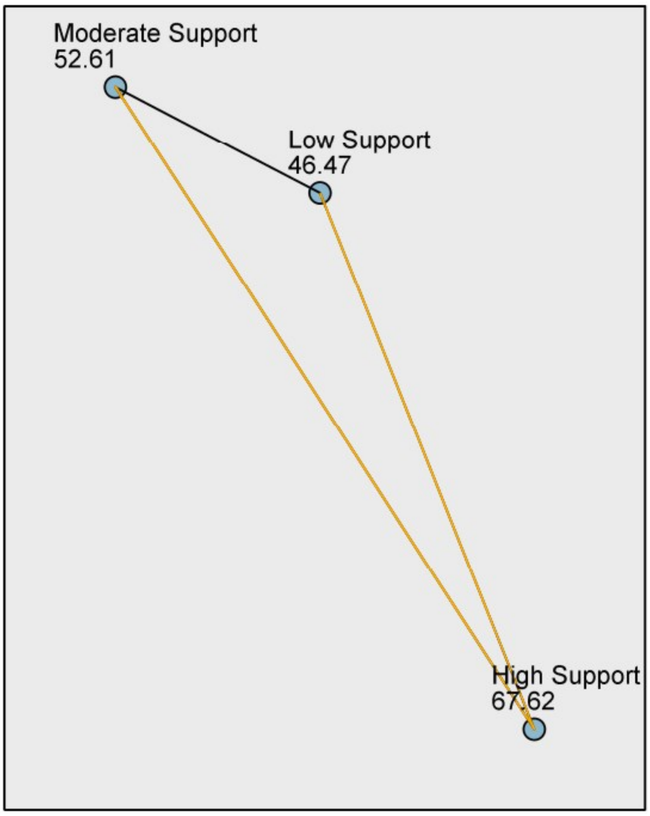
Construct	Levels of Government Support	N	Mean Ranks	Test Statistic	Df	p-value	Effect Size
CDM Project Development	Low Government Support	17	46.47				
	Moderate Government Support	56	52.61	6.994	2	**.03***	**.0454**
	High Government Support	40	67.63				

*Source: Primary data, *the mean ranks are significantly different at 5% level*

From the above table, it can be seen that the different category of Government Support has different mean scores and the Kruskal Wallis H test shows that it is significant. The test statistic is 6.994 and ***p-value is .03**** and effect size is .0454. Since the p-value is less than 0.05, the test statistic is significant at a 5% level of significance. Effect size is between 0.06 and 0.14, hence, it has a moderate effect. Thus, the null hypothesis is rejected and it is inferred that there is a significant difference in the **CDM Project Development** experience for different categories of project promoters who got different levels of Government Support. For further analysis, a pairwise comparison was conducted and the results are shown in Figure 5.8 and Table 5.56.

Figure 5.8

Pairwise Comparisons of CDM Project Development and Levels of Government Support



Source: Primary data

Table 5.56

Multiple Pairwise Comparisons of CDM Project Development and Levels of Government Support

Government Support Category	Test Statistic	p-value
Low Government Support - High Government Support	-21.154	**.025***
Moderate Government Support- High Government Support	-15.018	**.027***

*Source: Primary data, *Significant at 5% level*

The Multiple Pairwise Comparison shows that the ***p-value* = .025*** which is significant at 5% level of significance for the pair Low Government Support & High Government Support Category. Hence, the CDM Project Development are significantly different for project promoters who received Low Government Support and those who got High Government Support. The ***p-value* = .027*** for the Moderate Government Support & High Government Support Categories which is also significant at a 5% level of significance. Hence, the CDM Project Development is significantly different for projects which received Moderate Government Support and High Government Support. From the above, it can be inferred that Government Support has a high influence on the experience of the project developers in the CDM Project Development.

5.5 Part 3 -CDM Project Development and Earning Carbon Credits

As discussed above, the formation and implementation of clean development mechanism projects in India is a tough task, laced with many challenges. Once a CDM project is set up, the project is ready to generate carbon credits.

5.5.1 Earning Carbon Credits

Just merely commissioning a project does not qualify for receipt of carbon credits. Reducing the greenhouse gas in a project is again dependent on several uncertainties like, weather conditions, plant and equipment efficiency, availability of trained staff for running and maintaining the plant, and conducive employer-employee relationships. Many more procedures are to be followed for the issuance of carbon credits like monitoring the actual reduction in greenhouse gas reduction, verification of the reduction by the DOE and certifying it, and issuance of CERs by the CDM EB. Other things that affect the generation of carbon creds are the market uncertainties in the carbon trading market and delay in the issuance of CERs.

The above barriers to earning carbon credits have been evaluated using thirteen statements to gauge the experience of the project participants in earning carbon credits. Exploratory Factor Analysis was done to find out the dimensions of the construct ‘Earning Carbon Credits’ as follows.

5.5.1.1 EFA of Earning Carbon Credits

Table 5.57

KMO and Bartlett’s Test of Earning Carbon Credits

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.776**
Bartlett's Test of Sphericity	Approx. Chi-Square	526.566
	df	78
	Sig.	**.000****

*Source: Primary data, **Significant at 1% level*

The KMO of ‘Earning Carbon Credits’ is 0.776 and Bartlett’s Test is significant at a 1% level of significance and it shows that there is a substantial correlation in data.

Table 5.58

Communalities of Earning Carbon Credits

Item No.	Items	Initial	Extraction
1	Favourable weather conditions for renewable energy generation throughout the year	1	0.521
2	The actual revenue expense to run the plant was approximately the budgeted amount.	1	0.555
3	Trained and skilled employees were available for regular operations and maintenance of the plant	1	0.549
4	A long period for shutdown maintenance was not required on a regular basis.	1	0.553
5	There was no breakdown of the equipment	1	0.732
6	There were cordial relationships between the employer and the employee	1	0.508
7	Measuring and recording renewable energy generated/energy saved is easy	1	0.657
8	Procedures for verification of emission reductions are easy	1	0.824
9	Procedures for certification of emission reductions are easy	1	0.669
10	Tax holiday and other incentives from the government was helpful.	1	0.666
11	The price of Carbon Credits in the international market is stable	1	0.566
12	There was a demand for Carbon Credits in the international market	1	0.557
13	Carbon Credits are issued by the CDM Executive Board promptly.	1	0.564

Extraction Method: Principal Component Analysis
Source: Primary data

From above Table 5.58, it is evident that all the variables have communalities above 0.5. Therefore, all thirteen variables were taken for extracting the components.

Table 5.59

Total Variance Explained of Earning Carbon Credits

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.277	32.899	32.899	4.277	32.899	32.899	3.496	26.894	26.894
2	1.959	15.071	47.971	1.959	15.071	47.971	2.354	18.104	44.998
3	1.684	12.955	60.926	1.684	12.955	60.926	2.071	15.928	60.926
4	.770	5.926	66.853						
5	.745	5.731	72.583						
6	.708	5.444	78.027						
7	.581	4.472	82.499						
8	.533	4.102	86.601						
9	.504	3.877	90.478						
10	.436	3.352	93.830						
11	.313	2.407	96.236						
12	.269	2.070	98.306						
13	.220	1.694	100.000						

Extraction Method: Principal Component Analysis.
Source: Primary data

The above table explains that 60.926 % of the total variance in the 'Barriers to Earning Carbon Credits' construct is explained by three components.

Table 5.60

Component Matrix[a] of Earning Carbon Credits

Sl. No.	Item No.	Items	Component		
			1	2	3
1	5	There was no breakdown of the equipment	0.829		
2	2	The actual revenue expenditure to operate the plant was about what was budgeted	0.741		
3	3	Trained and skilled employees were available for regular operations and maintenance of the plant	0.714		

Sl. No.	Item No.	Items	Component		
			1	2	3
4	6	There were cordial relationships between the employer and the employee	0.666		
5	1	Favourable weather conditions for renewable energy generation throughout the year	0.663		
6	4	A long period for shutdown maintenance was not required on a regular basis.	0.647		
7	12	There was a demand for Carbon Credits in the international market	0.569		
8	8	Procedures for verification of emission reductions are easy		0.895	
9	7	Measuring and recording renewable energy generated/energy saved is easy		0.796	
10	9	Procedures for certification of emission reductions are easy		0.789	
11	10	Tax holiday and other incentives from the government was helpful.			0.796
12	13	Carbon Credits are issued by the CDM Executive Board promptly.			0.744
13	11	The price of Carbon Credits in the international market is stable			0.647

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
a. Rotation converged in 4 iterations
Source: Primary data

The rotated component matrix shows that there are three main dimensions of the 'Earning Carbon Credits' construct. The first component is measured by Item 5 and is followed by Items 2,3,6,1,4 and 12. The second component is measured by Item 8 and it is followed by 7 and 9. The third component is measured by Item 10 and is followed by 13 and 11.

5.5.1.2 Dimensions of Earning Carbon Credits

As per Table 5.60, there are three dimensions of Earning carbon credits. The first stage is **Facilities for Earning Carbon Credits,** under which comes the factors which facilitate the generation of carbon credit like the equipment had no breakdowns, the revenue expenditure to run the plant was reasonable, there were trained and skilled employees for operations and maintenance, there was cordial relationship between employer and employee, weather was favourable, maintenance of equipment did not lead to loss of production, demand for carbon credits in international markets was high. The second dimension is the **Procedure for Earning Carbon Credits** includes variables like there exist easy procedures for verification, easy methods to measure and record renewable energy production, and easy procedures for certification of emission reduction. The third dimension is **Other Incentives supporting Earning Carbon Credits** and includes statements like, tax holidays and other incentives were helpful, Issue of carbon credits by the CDM Executive Board in a reasonable time, and there were no fluctuations in the price of carbon credits in the international markets. The frequency distribution and descriptive statistics of each of the dimensions are analysed as follows: -

A. Facilities for Earning Carbon Credits

Table 5.61

Frequency Distribution of Facilities for Earning Carbon Credits

Items		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
No breakdown of the equipment	N	15	36	27	29	6	113
	%	13	32	24	26	5	
	C%	13	45	69	95	100	
Actual revenue expenditure was as per budget	N	9	39	48	14	3	113
	%	8	35	42	12	3	
	C%	8	42	85	97	100	
Trained and skilled employees were available for operations and maintenance	N	19	38	34	21	1	113
	%	17	34	30	19	1	
	C%	17	50	81	99	100	
There were cordial relationships between the employer and the employee	N	18	41	43	11	0	113
	%	16	36	38	10	0	
	C%	16	52	90	100	100	

Items		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Favourable weather conditions	N	5	14	33	41	20	
	%	4	12	29	36	18	113
	C%	4	17	46	82	100	
Long period for shutdown maintenance was not required	N	8	26	46	33	0	
	%	7	23	41	29	0	113
	C%	7	30	71	100	100	
Demand for Carbon Credits in the international market was high	N	5	7	28	47	26	
	%	4	6	25	42	23	113
	C%	4	11	35	77	100	

Source: Primary data
Note: C% represents cumulative percentage

As per Table 5.61, it is evident that a cumulative of only 45% of respondents Strongly Agreed or Agreed with the statement that 'There was no breakdown of the equipment'. 24% were neutral and a cumulative 31% (26 + 5) disagreed and strongly disagreed that there was no failure of equipment.

In the above table, we can see that the question of whether 'The actual revenue expenditure to operate the plant was about what was budgeted', a cumulative of only 35% of agreed or strongly agreed, 42% of the respondents were neutral and 15% disagreed or strongly disagreed and felt that high revenue expense is a barrier to earning carbon credits.

Regarding the question, 'Trained and skilled employees were available for regular operations and maintenance of the plant', 50% either agreed or strongly agreed that they were trained and skilled employees and 30% were neutral and 20% disagreed with the statement. All the companies are using contractors for running and maintenance of the equipment as they require skilled employees. Hence, they were not directly recruiting the employees from the locality, but the majority opined that the employees were recruited by the contractors from the local community for other jobs like security personnel, helpers etc as it was cheaper.

To the question of ‘There were cordial relationships between the employer and the employee’, 90% of the respondents were positive or neutral to the statement. 10% disagreed with the statement and admitted that some employer-employee ‘conflicts led to a decrease in carbon credit generated.

According to the study, ‘Favourable weather conditions for renewable energy generation throughout the year’ garnered only 17% positive response, 29% neutral, and 54% negative response. Hence it can be inferred that weather, fuel, and raw material shortage is a very big barriers to earning carbon credits.

The statement, ‘A long period for shutdown maintenance was not required on a regular basis.’ was met with 30% positive response, a majority were neutral at 41% and 29% disagreed with the statement. Hence as per the responses, it can be said that the equipment did need long periods of maintenance. It was disclosed by the respondents that the equipment used for generating renewable energy has to be maintained regularly to avoid total disruption and the maintenance takes a lot of time, especially in the case of old equipment.

Regarding the statement that there was a demand for Carbon Credits in the international market, only 10% gave a positive reply, 25 were neutral and a majority of 65% disagreed and strongly disagreed that there is a demand for Carbon Credits in the market now.

Table 5.62

Descriptive Statistics of Facilities for Earning Carbon Credits

Sl No.	Item No.	Items	N	Mean	Median	SD
1	5	There was no breakdown of the equipment	113	3.22	3	1.132
2	2	The actual revenue expense to run the plant was approximately the budgeted amount.	113	3.33	3	0.891
3	3	Trained and skilled employees were available for regular operations and maintenance of the plant	113	3.47	4	1.01

Sl No.	Item No.	Items	N	Mean	Median	SD
4	6	There were cordial relationships between the employer and the employee	113	3.58	4	0.873
5	1	Favourable weather conditions for renewable energy generation throughout the year	113	2.5	2	1.062
6	4	A long period for shutdown maintenance was not required on a regular basis.	113	3.08	3	0.898
7	12	There was a demand for Carbon Credits in the international market	113	2.27	2	1.029

Source: Primary data

The above table shows that the means of items no. 5, 2, 1, and 3 lie between 2.5 and 3.4, and their median is 3 which represents neutrality. Hence it can be inferred that the respondents had some problems concerning fluctuating weather, equipment failure and maintenance, and high revenue expense for running the plant but they remain neutral as they could manage such problems through planning in advance. Concerning the availability of trained and skilled employees as well as the employer-employee relationships, the respondents had a positive reply with a median of 4 and a mean above 3.4, as they didn't encounter such problems in their projects. Whereas, concerning the demand for Carbon Credits in the international market, all the respondents agreed that it is one of the major factors which are affecting carbon credit generation hence the mean is 2.27 whereas the median is 2.

From Tables 5.61 and 5.62, it is deduced that the facilities for earning carbon credits are there but it is highly hindered by the lack of demand for carbon credits in the international market.

A. **Procedure for Earning Carbon Credits**

Table 5.63

Frequency Distribution of Procedure for Earning Carbon Credits

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Procedures for verification of emission reductions are easy	N	23	33	34	13	10	
	%	20	29	30	12	9	113
	C%	20	50	80	91	100	
Measuring and recording renewable energy generated/energy saved is easy	N	24	40	34	13	2	
	%	21	35	30	12	2	113
	C%	21	57	87	98	100	
Procedures for certification of emission reductions are easy	N	15	37	39	13	9	
	%	13	33	35	12	8	113
	C%	13	46	81	92	100	

Source: Primary data
Note: C% represents cumulative percentage

Table 5.63 depicts that a cumulative, 50% of the respondents feel that the procedures for verification of emission are easy, 30% are neutral and 20% do not agree. The majority of respondents (57%) agree that measuring and recording renewable energy generated/saved is easy, whereas 30% are neutral and 13% do not agree. 46% of the respondents agree with the statement that ‘Procedures for certification of emission reductions are easy’ and 35% are neutral whereas 19% do not agree. From the above discussion, it can be inferred that the majority of the project participants feel that the procedure for earning carbon credits is relatively easy.

Table 5.64

Descriptive Statistics of Procedure for Earning Carbon Credits

Sl No.	Item No.	Items	N	Mean	Median	SD
1	8	Procedures for verification of emission reductions are easy	113	3.41	3	1.193
2	7	Measuring and recording renewable energy generated/energy saved is easy	113	3.63	4	1.002
3	9	Procedures for certification of emission reductions are easy	113	3.32	3	1.096

Source: Primary Data

*T*able 5.64 shows that the means of item no. 9 lie between 2.5 and 3.4 and the median is 3 which represents neutrality, the mean of item no.9 is 3.41 which is just more than 3.4 and hence it is a positive response, whereas for item 7, the mean is 3.63 which lies in the category 3.5-5 which means agreement. Hence it can be inferred that the respondents are either neutral or in agreement about the ease of procedures for earning carbon credits.

B. **Other Incentives supporting Earning of Carbon Credits**

Table 5.65

Frequency Distribution of Other Incentives Supporting Earning of Carbon Credits

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Tax holiday and other incentives from the government was helpful.	N	20	31	33	22	7	113
	%	18	27	29	19	6	
	C%	18	45	74	94	100	
Carbon Credits are issued by the CDM	N	16	30	34	24	9	113
	%	14	27	30	21	8	

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Executive Board promptly.	C%	14	41	71	92	100	
The price of Carbon Credits in the international market is stable	N	3	10	24	36	40	113
	%	3	9	21	32	35	
	C%	3	12	33	65	100	

Source: Primary data
Note: C% represents cumulative percentage

As per Table 5.65, it is evident that the Tax holiday and other incentives from the government were not up to the expectations of the project participants. Only 45% of the respondents are positive about the incentives received, 29% are neutral and 25% (19+6) do not agree that it was helpful.

For the statement 'Carbon Credits are issued by the CDM Executive Board promptly', 41% were in agreement, 30% were neutral and 29% did not agree.

Only 12% of the respondents agreed that 'No fluctuations in the price of Carbon Credits in the international market', whereas 21% were neutral and 67% had not agreed.

Hence from the above analysis, it can be concluded that the project participants are unhappy about the withdrawal of the tax incentives which was given in the initial period, and the fluctuation in prices of carbon credits is a great impediment in motivating the units to go for verification, measuring and certification of CERs. In the statement relating to the issue of CERs by the CDM Executive Board, many were either agreed or neutral.

Table 5.66

Descriptive Statistics of Other Incentives Supporting Earning of Carbon Credits

Sl No.	Item No.	Items	N	Mean	Median	SD
1	10	Tax holiday and other incentives from the government was helpful.	113	3.31	3.00	1.158
2	13	Carbon Credits are issued by the CDM Executive Board promptly.	113	3.18	3.00	1.159
3	11	The price of Carbon Credits in the international market is stable	113	2.12	2.00	1.075

Source: Primary data

The table showing the descriptive statistics of the statements relating to Tax holiday and delay in getting carbon credits depicts that the mean lies in category 2.49-3.5 and hence the respondents are neutral. Whereas item no.11 has a low mean score of 2.12 and a median of 2 which means, there is a more negative response to the statement that there are no price fluctuations of Carbon Credits in international markets.

From the above discussions, in Table 5.61 to Table 5.66, it can be concluded that there are three dimensions to Earning Carbon Credits and the biggest barriers in the generation of carbon credits were the weather conditions, fluctuating demand for carbon credits and uncertainties in the price of CERs in the carbon market.

5.5.1.3 Earning Carbon Credits and States

To investigate if, Earning Carbon Credits are different in each state where the CDM projects are situated, the Kruskal Wallis H test was conducted. The hypothesis formulated is as follows:

Hypothesis

H_0: There is no significant difference in Earning Carbon Credits among different States.

H_1: There is significant difference in Earning Carbon Credits among different States.

Table 5.67

Earning Carbon Credits Based on States

Construct	States	N	Mean Ranks	Test Statistic	Df	*p-value*	Effect Size
Earning Carbon Credits	Rajasthan	15	54.53	4.71	5	0.453	-
	Gujarat	17	48.82				
	Maharashtra	22	60.50				
	Andhra Pradesh	15	50.33				
	Tamil Nadu	24	55.42				
	Karnataka	20	68.85				

Source: Primary data

From Table 5.67 above, it is found that there are differences in the mean ranks for Earning Carbon Credits based on States where the projects are situated. For investigating whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted. The test statistic is 4.71 and *p-value* = 0.453. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in Earning Carbon Credit among States.

Hence it can be concluded that the Earning Carbon Credits do not differ according to the States where the CDM projects are situated.

5.5.1.4 Earning Carbon Credits and Types of Companies

It will be beneficial to understand if there is a significant difference experienced in Earning Carbon Credits among the different types of companies, so the Kruskal-Wallis H test was conducted and the hypothesis is as follows: -

Hypothesis:

H_0: There is no significant difference in Earning Carbon Credits among different Types of Companies thatown the projects.

H_1: There is significant difference in Earning Carbon Credits among different Types of Companies thatown the projects.

Table 5.68

Earning Carbon Credits Based on Types of Companies

Construct	Type of Company	N	Mean Ranks	Test Statistic	Df	*p-value*	Effect Size
Earning Carbon Credits	Public Company	38	40.34	37.117	2	**0.000****	.319
	Private Company	60	56.53				
	HUF	15	101.07				

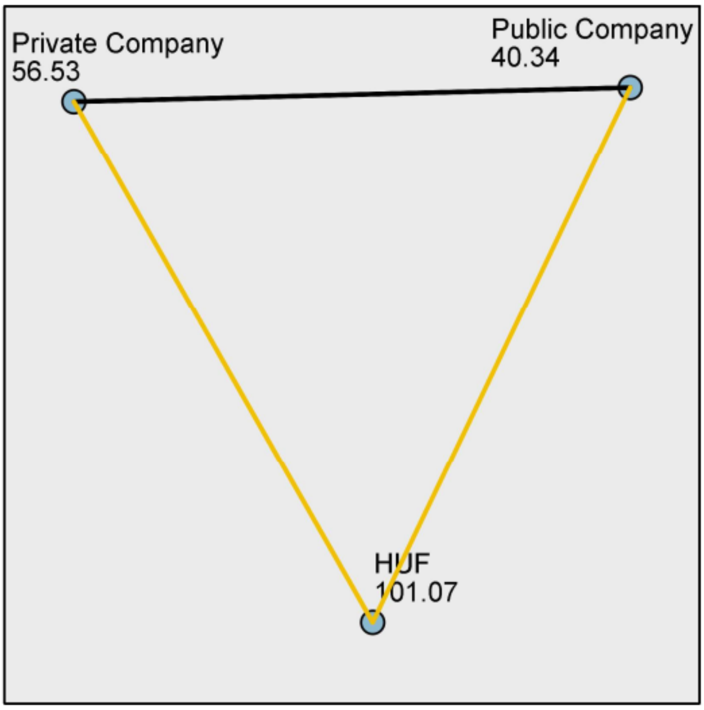
*Source: Primary data, **the mean ranks are significantly different at 1% level*

By analysing the observed data from Table 5.68, it is found that there is a significant difference in the mean ranks of different types of companies which own the CDM projects in the sample, and for further examining whether the difference is statistically significant or not, the Kruskal-Wallis H test was conducted. The test statistic is 37.117 and ***p-value =0.000***** which points to the fact that the test statistic is highly significant at a 1% level of significance. The effect size is .319 which is >.14 and hence has a **large effect**. Hence, the null hypothesis is rejected, so there is a significant difference in Earning Carbon Credits among different types of Companies.

Hence it can be concluded that Earning from Carbon Credits differ based on the Type of Company which owns the CDM projects. Hence, further analysis was done by Multiple Pairwise Comparisons of States and the results are shown in Figure 5.9 and Table 5.69.

Figure 5.9

Pairwise Comparison of Earning Carbon Credits Based on Type of Company



Source: Primary data

Table 5.69

Multiple Pairwise Comparison of Earning Carbon Credits Based on Type of Company

Type of Companies	Test Statistic	*p*-value
Public Company-HUF	-60.725	0.000**
Private Company-HUF	-44.533	0.000**

*Source: Primary data, **Significant at 1% level*

The Multiple Pairwise Comparison shows that the Barriers to Earning Carbon Credits are significantly different with respect to Public Companies and HUF type of ownership. In the same manner, Earning Carbon Credits significantly differ in the case of Private Companies and HUF type of ownership. From Figure 5.9 and Table 5.69, it can be observed that the p-value is .000 for each of the pairs. There is no significant difference between Public Companies and Private Companies.

5.5.1.5 Earning Carbon Credits and the Sources of Renewable Energy

Knowing whether the sources of renewable energy used by the companies is a factor that determines the ease of Earning Carbon Credits will be valuable. It can help the policymakers to take decisions regarding what type of projects have to be promoted. Hence, to test whether there is a significant difference in ease of Earning Carbon Credits among CDM Projects based on the Sources of Renewable Energy used by them, the Kruskal-Wallis H test was used. The hypothesis formulated was as follows:-

Hypothesis

H_0: There is no significant difference in Earning Carbon Credits among CDM projects based on the Sources of Renewable Energy used by them.

H_1: There is significant difference in Earning Carbon Credits among CDM projects based on the Sources of Renewable Energy used by them.

Table 5.70

Earning Carbon Credits Based on Sources of Renewable Energy

Construct	Sources of Renewable Energy	N	Mean Ranks	Test Statistic	Df	*p-value*	Effect Size
Earning Carbon Credits	Biomass	5	58.3	8.9	9	.45	-
	Solar Power	14	51.96				
	Wind Power	66	59.05				
	Natural Gas	13	43.31				
	Thermal Oxidation	1	96				
	Hydropower	8	73.06				
	Methane	1	88.5				
	Waste Hydrogen gas	1	27				
	Coal reduction	1	39.5				
	Waste Heat	3	42.17				

Source: Primary data

From Table 5.70, it is inferred that there are differences in the mean ranks for Earning Carbon Credits among CDM projects based on the Sources of Renewable Energy used by them. For testing whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted. The test statistic is 8.90 and *p-value* is .45. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Earning Carbon Credit among CDM projects based on the Sources of Renewable Energy used by them.

Hence it can be concluded that Earning Carbon Credits do not differ according to the Sources of Renewable Energy used by the CDM project.

5.5.1.6 Earning Carbon Credits and Period of Registration

The researcher would like to know if the Earning Carbon Credits were different for the two periods of commitment periods. Based on the commitment periods the period of registration of the CDM project was divided for analysis (2000-2012 & 2013-2020). Mann-Whitney U Test was conducted to understand if there is a significant difference in Earning Carbon Credits among different Periods of Registration of the CDM projects. The hypothesis formulated was as follows: -

Hypothesis

H_0: There is no significant difference in Earning Carbon Credits with respect to the period of Registration of the CDM project.

H_1: There is significant difference in Earning Carbon Credits with respect to the period of Registration of the CDM project.

Table 5.71

Earning Carbon Credits Based on Period of Registration

Construct	Period of Registration	N	Mean Ranks (Median)	Mann-Whitney U Test Statistic	*p*-value
Earning Carbon Credits	2000 - 2012	93	57.80	856	0.577
	2013 - 2020	20	53.30		

Source: Primary data

The mean ranks of Earning Carbon Credits in the two Periods of Registration were 57.80 and 53.30 for the period 2000-2012 and 2013-2020 respectively which are different so the Mann-Whitney U Test was conducted.

From the above table, the test revealed that there is no significant difference in Earning Carbon Credits based on the Period of Registration. The test statistics are U = 856 and *p-value* = 0.577 are insignificant as the p-value is more than 0.05. Hence, the test accepts the null hypothesis.

Mann-Whitney U test results show that there is no significant difference in Earning Carbon Credits based on the Period of Registration for the sample projects.

Hence it can be summarised that there is a significant correlation between Earning Carbon Credits and Government Support. Earning Carbon Credits do not have any significant correlation with Stakeholders' Awareness and Carbon Credit Development. The type of company which owns the CDM project has a significant bearing on the barriers to earning carbon credits. It is seen that the HUF has a better chance of overcoming the barriers to earning carbon credits, followed by Private Companies and Public Companies. It can be inferred that the management of HUF is better at implementing the procedures of earning carbon credits than Private and Public Companies.

For understanding of the strength of the relationship between Stakeholders' Awareness as well as Government Support with Earning Carbon Credits, Spearman's Rank Correlation and Kendal Theil Regression was used and the results are as follows

5.5.1.7 Influence of Stakeholders' Awareness, Government Support, and CDM Project Development on Earning of Carbon Credits

To determine the relationship and impact of Stakeholders' Awareness, Government Support and CDM Project Development on Earning Carbon Credits, correlation analysis was done followed by regression. To investigate the correlation between Earning Carbon Credits with Stakeholders' Awareness, Government Support, and CDM Project Development, Spearman's Rank Correlation test was conducted. The hypotheses framed were as follows: -

Hypotheses:

1. H_0: There is no correlation between Stakeholders' Awareness and Earning Carbon Credits

   H_1: There is a correlation between Stakeholders' Awareness and Earning Carbon Credits

2. H_0: There is no correlation between Government Support and Earning Carbon Credits

   H_1: There is a correlation between Government Support and Earning Carbon Credits

3. H_0: There is no correlation between CDM Project Development and Earning Carbon Credits

   H_1: There is a correlation between CDM Project Development and Earning Carbon Credits

Table 5.72

Correlation between Earning Carbon Credits and Stakeholders' Awareness, Government Support, CDM Project Development

Dependent Variable	Independent Variable	Spearman's rho	p-value	N	Results
Earning Carbon Credits	Stakeholders' Awareness	0.115	0.226	113	Not Significant
	Government Support	0.244	**0.009****	113	Significant
	CDM Project Development	0.039	0.68	113	Not Significant

*Source: Primary data, **correlation is significant at the 0.01 level (2-tailed)*

The above table shows Spearman's Rank Correlation between the independent variables' Stakeholders' Awareness, Government Support, and CDM Project Development with the dependent variable construct, Earning Carbon Credits. The table shows that Spearman's rho is 0.115 with a p-value of 0.226 for Stakeholders' Awareness with Earning Carbon Credits. As the p-value is greater than .05, it is not significant and hence we accept the null hypothesis that there is no significant correlation between the two. In the case of correlation with Government Support, Spearman's rho is 0.244 and the ***p-value =0.009**** which is less than 0.01 and highly significant at 1%, hence the null hypothesis is rejected and it is inferred that there is a significant correlation between Earning Carbon Credits and Government Support. The Spearman's rho is .039 with a p-value of .68 for the correlation between CDM Project Development with Earning Carbon Credits. As the p-value is greater than .05, it is not significant and hence we accept the null hypothesis that there is no significant correlation between the CDM Project Development and Earning Carbon Credits.

Hence, it can be inferred that there is a positive correlation between all three independent constructs and Earning Carbon Credits, but as per this study, only Government Support has a significant impact on Earning Carbon Credits. Earning of Carbon Credits increases together with the level of Government Support, and barriers either get reduced or are removed with government assistance. It brings into perspective the importance of Government Support for further reduction in emissions through the CDM projects.

For further analysis, **Kendall-Theil Regression**, the non-parametric test equivalent to regression analysis was used to understand the strength of the relationship between Government Support and Earning Carbon Credits. The Kendell Theil Robust Line Version 1.0 was used to get the regression line.

a) The Kendall-Theil Regression equation obtained was

Y= 28.33333 + 0.6666667*X+ ei

Where, X = Government Support

Y= Earning of Carbon Credit

Median of Slopes = 0.6666667

Intercept = 28.33333

From the above, it can be inferred that when Government Support increases, there is a positive effect on the Earning Carbon Credit by 0.6666667. Hence it is once again proved that the amount of Carbon Credits earned greatly influenced by the extent of Government Support.

5.5.1.8 Earning Carbon Credits as per the Level of Stakeholders' Awareness

To assess whether there is a difference in Earning Carbon Credits depending on the level of awareness among stakeholders, Kruskal Walis H test was conducted with Earning Carbon Credits as the test variable and Stakeholders' Awareness as the grouping variable. To see if the difference among the mean scores is significant, the following hypothesis was formed.

Hypothesis:

1. H_0: There is no significant difference in the Earning Carbon Credits based on the Stakeholders' Awareness categories.

H_1: There is significant difference in the Earning Carbon Credits based on the Stakeholders' Awareness categories.

Table 5.73

Earning Carbon Credits Based on Level of Stakeholders' Awareness

Construct	Stakeholders' Awareness Category	N	Mean Ranks	Test Statistic	Df	*p-value*	Effect Size
Earning Carbon Credits	Low Stakeholders' Awareness	41	54.33	0.468	2	.791	-
	Moderate Stakeholders' Awareness	57	58.13				
	High Stakeholders' Awareness	15	60.00				

Source: Primary data

From the above table, it can be seen that the category of stakeholders with High Awareness has a mean score of 60, with Moderate Awareness has a mean score of 58.13, and for Low Stakeholders' Awareness, the mean score is 54.33. The distribution of mean scores reveals that as Stakeholders' Awareness increases, Earning of Carbon Credit also increases. However, the test statistic is .468 and *p-value* = .791 and since the p-value is more than 0.05, the null hypothesis is rejected and it is inferred that there is no significant difference in the Earning Carbon Credits for different categories of Stakeholders' Awareness levels.

5.5.1.9 Earning Carbon Credits as per the Level of Government Support

It was seen in Table 5.72 that there is a high level of correlation between Government Support and Earning Carbon Credits. Hence, in order to understand if there is a significant difference in Earning Carbon Credits among the projects receiving different levels of Government Support, Kruskal Wallis H test was conducted. Government Support was divided into three different levels based on its score. The total score of Government Support (4 x 5=20) was divided into three categories, where

Category 1 with a score of 4 to 9 is Low Government Support, Category 2 with a score of 10 to 14 is Moderate Government Support, and Category 3 with score 15 to 20 is High Government Support. Earning Carbon Credit is taken as the test variable and Government Support as the grouping variable to see if the difference among the mean scores is significant. The following hypothesis was formed.

Hypothesis:

H_0: There is no significant difference in the Earning Carbon Credit based on the level of Government Support.

H_1: There is significant difference in the Earning Carbon Credit based on the level of Government Support.

Table 5.74

Earning Carbon Credits Based on Level of Government Support

Construct	Type of Company	N	Mean Ranks	Test Statistic	Df	p-value	Effect Size
Earning Carbon Credits	Low Government Support	17	34.41	9.987	2	**0.007****	0.073
	Moderate Government Support	56	59.13				
	High Government Support	40	63.61				

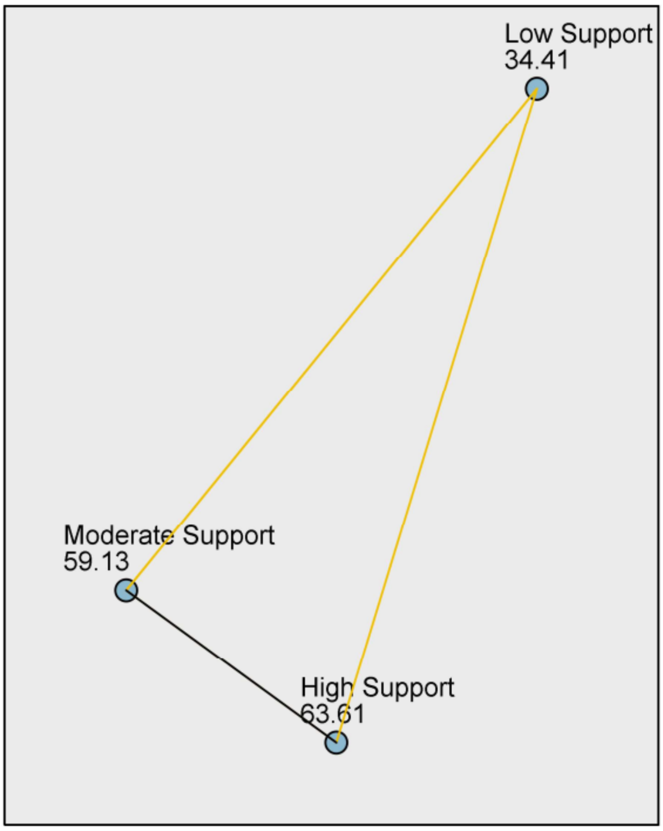
Source: Primary data,

From the above table, it can be seen that the different category of Government Support has different mean scores. The test statistic is 9.987 and ***p-value is 0.007***** and the effect size is 0.073 which is **moderate**. Since the p-value is less than 0.01, it is significant at a 1% level of significance. Hence, the null hypothesis is rejected and it is inferred that there is a significant difference in the **Earning Carbon Credits** for different categories of project promoters who got different levels of Government

Support. For further analysis, a pairwise comparison was conducted and the results are shown in Figure 5.10 and Table 5.75

Figure 5.10

Pairwise Comparisons of Earning Carbon Credits Based on Level of Government Support



Source: Primary data

Table 5.75

Multiple Pairwise Comparisons of Earning Carbon Credits Based on Levels of Government Support

Government Support Category	Test Statistic	P-value
Low Government Support – Moderate Government Support	-24.722	**0.019***
Low Government Support- High Government Support	-29.201	**0.006****

*Source: Primary data, *Significant at 5% level, **Significant at 1% level*

The Multiple Pairwise Comparison shows that the ***p-value*** is **.019*** which is significant at 5% level of significance for the pair Low Government Support & Moderate Government Support Category. Hence, the Earnings of Carbon Credits are significantly different for project promoters who received Low Government Support and those who got Moderate Government Support. The ***p-value is 0.006***** for the Low Government Support & High Government Support Categories which is also highly significant at a 1% level of significance. Hence, the Earning of Carbon Credit is significantly different for projects that received Low Government Support and High Government Support.

From the above, it can be inferred that Government Support has a high influence on the Earning of Carbon Credits.

5.6 *Part 4 - Compliance with ICAI Guidelines for Accounting & Disclosure of Self-generated CERs*

Certified Emission Reductions (CERs) are generated under the Kyoto Protocol for the mitigation of emissions and can be sold in international markets. There are no specific national or international accounting standards for accounting CERs held by a company. There is only a guidance note issued by the Accounting Standard Board of the Institute of Indian Chartered Accountants of India in 2012. If there is proper disclosure and accounting of CERs, it will lead to identifying companies that are taking action to reduce their carbon footprint per unit of product/service delivered. This will help various stakeholders like the government, customers, investors, the general public, and employees to assuage their concerns and make informed decisions. Secondly, sound pollution prevention strategies make strong economic sense for the country as it helps to reduce social and economic costs by reduction of effluents and waste discharges.

Part 4 of this chapter aims to examine the responses from Financial/General Managers of such projects, regarding the method of accounting followed by their companies with respect to CERs held by them. The accounting and disclosure compliance of the companies owing CDM projects in the sample is illustrated below.

5.6.1 Accounting Guidelines Issued by ICAI

The compliance by Indian companies with the accounting standards guidelines is presented in the form of a table showing figures for different types of companies like Public Companies, Private Companies, and Hindu Undivided Families (HUFs), who have invested in carbon emission reduction projects and have registered with the UNFCCC. As per Table 5.4, there was a total of 38 projects by public companies, 60 projects by private companies, and 15 projects by Hindu Undivided Families. The compliance with respect to guidelines for all transactions relating to carbon credit right from the purchase of fixed assets for CER generation and approval of CERs to the sale of CERs is discussed below.

5.6.1.1Valuation of CERs as per AS 2 Valuation of Inventories

CERs are non-monetary assets without a physical form but they do not strictly fall under the meaning of "intangible assets" as per AS 26. The reason is that CERs are not held for use in the production and supply of services and neither are CERs used for administrative purposes nor are they used to rent to others. Instead, CERs generated by the generating entity are held for the purpose of sale. According to AS 26 (paragraph 2), intangible assets held for the purpose of sale in the ordinary course of business are excluded from it and are to be accounted for as per AS2 Valuation of Inventories. This guideline state that, CERs should be measured at cost or net realizable value, whichever is less. (Accounting Standards Board of Institute of Chartered Accountants of India, 2012).

Table 5.76

Valuation of CERs as per AS 2 Valuation of Inventories

Valuation of CERs as per AS 2	Public Company		Private Company		HUFs		Total	
	N	%	N	%	N	%	N	%
Yes	0	0	12	21	0	0	12	12
No	26	100	45	79	15	100	86	88
Total	26	100	57	100	15	100	98	100

Source: Primary data

Regarding the accounting of self-generated CERs as per AS 2, **Table 5.76** indicates that 100% of public companies and HUFs, and 79% of private companies do not record the CERs generated in the project as per AS 2 Valuation of Inventories. Only 21% (12 numbers) of private companies account for their CERs as per AS 2. Hence the compliance of the public and other companies with respect to these guidelines is very less.

5.6.1.2 Revenue Recognition as per AS 9 Revenue Recognition

The CERs are recognized as inventories so the entities should apply AS 9 to recognize revenue in respect of the sale of CERs. (Accounting Standards Board of Institute of Chartered Accountants of India, 2012).

Table 5.77

Revenue Recognition as per AS 9 Revenue Recognition

Revenue Recognition as per AS 9	**Public Company**		**Private Company**		**HUFs**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Yes	26	100	57	100	15	100	98	100
No	0	0	0	0	0	0	0	0
Total	26	100	57	100	15	100	98	100

Source: Primary data

As for the recognition of revenue as per AS 9 on the sale of CERs, **Table 5.77** shows that 100% of the public, private, and HUF companies which are CER-generating entities recognize revenues in respect of the sale of CERs as per AS 9. Hence there is full compliance with the accounting guidance for revenue recognition. When, **Tables 5.76 and 5.77**, are compared, it is seen that they recognize only the revenue received from CERs and do not show the value of CERs in inventories as stock in hand, when CERs are credited to their account by the UNFCCC.

5.6.1.3 Intangible Assets Created during R&D as per AS 26 Intangible Assets

The standard for accounting of intangible assets created during research and development for the projects to reduce emissions states that the expenditure involved has to be accounted for as per AS 26, Intangible assets.

Table 5.78

Intangible Assets Created during R & D Accounted for per AS 26 Intangible Assets

Intangible assets accounted as per AS 26	Public Company		Private Company		HUF		Total	
	N	%	N	%	N	%	N	%
Yes	0	0	6	11	0	0	6	6
No	0	0	0	0	0	0	0	0
N/A	26	100	51	89	15	100	92	94
Total	26	100	57	100	15	100	98	100

Source: Primary data

Regarding the creation of intangible assets and its accounting by Indian companies, **Table 5.78** indicates that only 11% (6 numbers) of the CER-generating P**rivate Company** projects have shown intangible assets created during R&D. 57 % of private companies, and 100% of public and HUFs have not been able to create intangible assets from R&D for CER generation. It shows that the generation of CERs is not leading to innovations in intangible assets in the country in a big way.

5.6.1.4 Accounting of Tangible Assets as per AS 10 Fixed Assets.

An entity may use a tangible asset like equipment or devices to reduce carbon emissions. Such tangible assets come under the provisions of AS 10 Fixed Assets. (Accounting Standards Board of Institute of Chartered Accountants of India, 2012)**.**

Table 5.79

Accounting of Tangible Assets as per AS 10 Fixed Assets

Accounting of tangible assets as per AS 10	Public Company		Private Company		HUF		Total	
	N	%	N	%	N	%	N	%
Yes	26	100	57	100	15	100	98	100
No	0	0	0	0	0	0	0	0
Total	26	100	57	100	15	100	98	100

Source: Primary data

As for compliance with recording tangible assets used in reducing emissions and creating CERs by Indian companies, **Table 5.79** indicates that all the CER-generating entities which include projects under Public, Private, and HUFs have accounted for the assets used for CER generation under AS 10 Fixed assets. Hence, there is full compliance with respect to the accounting of tangible assets under AS 10 among Indian companies.

5.6.1.5 Disclosure of CERs in Financial Statements

An entity should present CERs certified by UNFCCC as part of Inventories in the balance sheet separately from other categories of inventories like raw materials, work-in-progress, and finished products. (Accounting Standards Board of Institute of Chartered Accountants of India, 2012).

Table 5.80

Disclosure of CERs in Financial Statements

CERs Disclosed Separately in Inventories	Public Company		Private Company		HUF		Total	
	N	%	N	%	N	%	N	%
Yes	0	0	11	19	0	0	11	11
No	26	100	46	81	15	15	87	89
Total	26	100	57	100	15	15	98	100

Source: Primary data

It can be inferred from **Table 5.80** that 100% of the projects under Public companies and HUFs do not show CERs separately in inventories. 19% (11 out of 57 projects) of the private companies show CERs separately in inventories. When **Table 5.80** is read along with **Table 5.76**, it can be inferred that almost all private companies which show the value of CERs in their books under inventories do show it separately from raw materials, work-in-progress, and finished goods.

5.6.1.6 Disclosure of the 'Number of CER held as inventory and Basis of Valuation'.

This disclosure guideline says that CERs held by a company as inventory has to be declared in the financial statements and also the basis of valuation has to be mentioned. (Accounting Standards Board of Institute of Chartered Accountants of India, 2012).

Table 5.81

Disclosure of 'Number of CER held as Inventory and Basis of Valuation

Disclosure of number of CERs held as inventory and basis of valuation	Public Company		Private Company		HUF		Total	
	N	%	N	%	N	%	N	%
Yes	0	0	11	19	0	0	11	11
No	26	100	46	81	15	100	87	89
Total	26	100	57	100	15	15	98	100

Source: Primary data

Regarding the disclosure of the number of CERs held as inventory and the basis of its valuation, **Table 5.81** shows that only 19% of private companies, or 11% of the total sample, have disclosed the number of CERs held as inventory and the basis of valuation is disclosed in the financial statements. When Table 5.81 is read with Table 5.82, it can be inferred that only those companies which show the CERs held as inventory show also the number of CERs and their valuation in the financial statements. The majority of the companies do not disclose the CERs held in inventories and only show them directly as revenue earned when they sell the CERs.

5.6.1.7 Disclosure of 'Depreciation and Operating Maintenance Costs of Emission Reduction Equipment Expensed During the Year'.

As per the disclosure norms in guidelines on self-generated CERs, the depreciation and operating maintenance costs of **Emission Reduction Equipment** expensed during the year have to be disclosed separately in the financial statements. (Accounting Standards Board of Institute of Chartered Accountants of India, 2012).

Table 5.82

Disclosure of 'Depreciation and Operating Maintenance Costs of Emission Reduction Equipment Expensed During the Year

Disclosure of depreciation and operating maintenance cost of emission reduction equipment	Public Company		Private Company		HUF		Total	
	N	%	N	%	N	%	N	%
Yes	22	85	29	51	15	100	66	67
No	4	15	28	49	0	0	32	33
Total	26	100	57	100	15	100	98	100

Source: Primary data

With respect to the disclosure of depreciation and operating maintenance costs of emission reduction equipment expensed during the year, **Table 5.82** shows that 85% (22 numbers) of Public Company projects, 51% (29 numbers) of Private Company projects, and 100% (15 numbers) of HUF projects have been shown separately during the year it is expensed.

Reading **Table 5.82** with **Table 5.79,** we can infer that though all the entities are recording the tangible assets used for generating CERs as per AS 10 Fixed Assets, not all are complying with the guideline to disclose the amount of depreciation, operating, and maintenance expense incurred on CER generating assets separately.

As illustrated in **Tables 5.76** to **5.82**, it is seen that public companies are lagging behind private companies in following most of the guidelines. They also hesitate to disclose the CERs under certification and assets used for generating CERs separate from other assets The private companies and HUFs have to be lauded for the effort taken to disclose the number of CERs under certification, valuation, and sale. The majority of the companies mention CERs in their financial statements only when they are sure of sale. Otherwise, there is no mention of the CERs in hand or their value realizable as per market price or cost whichever is less. Hence, it can be concluded that there is an urgent requirement for an accounting standard for all types of CERs held by a company and all transactions relating to CERs. Just guidance notes and the lack of specific standards have led to inconsistencies in recording the generation of CERs.

5.7 Part 5 - Sustainable Development Outcomes of CDM Projects

This part of the chapter examines what are the contributions of the CDM projects, and how it helps to have sustainable development. So, the concepts of sustainable development of CDM projects are measured through the benefits derived from its functioning. The benefits are Economic Benefits, Technological benefits, Social Benefits, and Environmental Benefits. An attempt is made to examine what are the benefits derived from the CDM projects and with respect to each benefit, which are the most important components that contribute to that benefit. Altogether, these benefits lead to the sustainable developmental outcomes of CDM projects.

The Exploratory Factor Analysis of each of the benefits is examined in the following tables.

5.7.1 Economic Benefits

Economic benefits expected from CDM projects are revenue from carbon credits, lower operating costs, improved access to financing, job creation, enhanced reputation, and profitable international collaboration.

5.7.1.1 EFA of Economic Benefits

Table 5.83

KMO and Bartlett's Test of Economic Benefits

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.854**
Bartlett's Test of Sphericity	Approx. Chi-Square	197.344
	df	10
	Sig.	**.000****

*Source: Primary data, **Significant at 1% level*

The KMO of 'Economic Benefits' is 0.854 and Bartlett's Test is significant at a 1% level of significance and it shows that there is a substantial correlation in data.

Table 5.84

Communalities of Economic Benefits

Item No.	Items	Initial	Extraction
1	Financial Benefits received	1	0.58
2	Profit from CDM project more than expected	1	0.597
3	Employment generated	1	0.601
4	Goodwill of the Company increased	1	0.591
5	Increased the prospects of international collaboration	1	0.681

Extraction Method: Principal Component Analysis.
Source: Primary data

From the above table, it is evident that all the variables have communalities above 0.5. Therefore, all the variables were taken for extracting the components.

Table 5.85

Total Variance Explained of Economic Benefits

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.050	61.003	61.003	3.050	61.003	61.003
2	.579	11.577	72.580			
3	.523	10.456	83.036			
4	.458	9.170	92.206			
5	.390	7.794	100.000			

Extraction Method: Principal Component Analysis.
Source: Primary data

The above table explains that 61.003 % of the total variance in the Economic Benefits is explained by one component.

Table 5.86

Component Matrix[a] of Economic Benefits

Sl. No.	Item No.	Items	Component 1
1	5	Increased the prospects of international collaboration	0.825
2	3	Employment generated	0.776
3	2	Profit from CDM project more than expected	0.773
4	4	Goodwill of the Company increased	0.769
5	1	Financial Benefits received	0.761

Extraction Method: Principal Component Analysis.
a. 1 component extracted.
Source: Primary data

The component matrix shows that there is only one dimension of the Economic Benefits construct. The component is measured by Item 5 and is followed by Items 3,2,4 and 1.

5.7.1.2 Analysis of Economic Benefits

The amount of Economic Benefits received by the companies from CDM projects can be gauged from the response to the statements viz. financial benefits received, profit from the CDM projects was more than expected, Employment Generated, Goodwill of the company increased, increase in the prospects of international Collaboration. The frequency distribution is as follows.

Table 5.87

Frequency Distribution of Economic Benefits

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Financial Benefits received	N	27	43	28	5	10	113
	%	24	38	25	4	9	
	C%	24	62	87	91	100	
Profit from CDM project more than expected	N	8	16	53	29	7	113
	%	7	14	47	26	6	
	C%	7	21	68	94	100	

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Employment generated	N	20	46	34	11	2	113
	%	18	41	30	10	2	
	C%	18	58	88	98	100	
Goodwill of the Company increased	N	18	45	38	9	3	113
	%	16	40	34	8	3	
	C%	16	56	89	97	100	
Increased the prospects of international collaboration	N	0	33	38	34	8	113
	%	0	29	34	30	7	
	C%	0	29	63	93	100	

Source: Primary data
Note: C% represents cumulative percentage

The result depicted in **Table 5.87** revealed that a cumulative of 62% of the respondents Strongly Agree or Agree to the statement that Financial Benefit was received from CDM project and 25% are neutral, where as 13% (4+9) disagree to the statement.

To the statement that profits from CDM projects were more than expected, 47% are neutral in their response. A cumulative of 32% (26+6) disagree or strongly disagree respectively to the statement and only a cumulative 21 % agree with the statement. There is a cumulative of 58% of the respondents agree that employment was generated due to the CDM project, 30% were neutral, and a cumulative 12% disagree with the statement. A cumulative 56% of the respondents felt that the CDM project has increased their company's goodwill, 34% were neutral and 11% disagreed with the statement. Only 29% agreed with the statement that there is an increased chance for international collaboration with CDM Project, 34% were neutral and 37% disagreed.

It can be inferred from above that the majority of respondents felt that there was financial benefit, employment was generated, and the company's goodwill increased but they somewhat agree that they got more profit than expected and do not think that there is scope for international collaboration due to the CDM project.

Table 5.88

Descriptive Statistics of Economic Benefits

Item No.	Items	N	Mean	Median	SD
1	Financial Benefits Received	113	3.64	4	1.158
2	Profit from CDM project was more than expected	113	2.9	3	0.963
3	Employment Generated	113	3.63	4	0.947
4	Goodwill of the company increased	113	3.58	4	0.942
5	Increased the prospects of international collaboration	113	2.85	3	0.928

Source: Primary data

Table 5.88 reveals that the two statements have a mean score between 2.5-3.49 that is they are neutral to the statements that profit from the CDM project was more than expected and there is increased prospects of international collaboration. On the other hand, the mean scores are more than 3.5 for the statements, financial benefits received, employment generated, and goodwill of the company increased, hence they agree to these statements.

It can be concluded that the descriptive statistics and frequency distribution, both show that there have been financial benefits, employment generation, and increased goodwill due to implementing CDM projects.

5.7.2 Technological Benefits

Technological benefits expected from CDM projects are the promotion of sustainable technologies, technology transfer, and innovation.

5.7.2.1 EFA of Technological Benefits

Table 5.89

KMO and Bartlett's Test of Technological Benefits

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.819**
Bartlett's Test of Sphericity	Approx. Chi-Square	208.228
	df	10
	Sig.	**.000****

*Source: Primary data, **Significant at 1% level*

The KMO of 'Technological Benefits' is 0.819 and Bartlett's Test is significant at a 1% level of significance and it shows that there is a substantial correlation in data.

Table 5.90

Communalities of Technological Benefits

Item No.	Items	Initial	Extraction
1	Introduced new technology for renewable energy generation / efficient distribution / efficient use of energy / efficient reduction of emission.	1.000	0.558
2	Technology for CDM project was transferred from foreign participants	1.000	0.721
3	Technology transfer involved import of equipment.	1.000	0.628
4	Technology transfer involved import of knowledge.	1.000	0.613
5	New technology requirement pushed the company in investing in research and development.	1.000	0.516

Extraction Method: Principal Component Analysis.
Source: Primary data

From the above table, it is evident that all the variables have communalities above 0.5. Therefore, all the variables were taken for extracting the components.

Table 5.91

Total Variance Explained of Technological Benefits

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.036	60.721	60.721	3.036	60.721	60.721
2	.703	14.064	74.785			
3	.487	9.749	84.534			
4	.464	9.283	93.817			
5	.309	6.183	100.000			

Extraction Method: Principal Component Analysis.
Source: Primary data

The above table explains that 60.721 % of the total variance in the Economic Benefits is explained by one component.

Table 5.92

Component Matrixa of Technological Benefits

Sl. No.	**Item No.**	**Items**	**Component**
			1
1	2	Technology for CDM project was transferred from foreign participants	.849
2	3	Technology transfer involved import of equipment.	.793
3	4	Technology transfer involved import of knowledge.	.783
4	1	Introduced new technology for renewable energy generation / efficient distribution / efficient use of energy / efficient reduction of emission.	.747
5	5	New technology requirement pushed the company in investing in research and development.	.718

Extraction Method: Principal Component Analysis.
a. 1 component extracted.
Source: Primary data

The component matrix shows that there is only one dimension of the Technological Benefits construct. The component is measured by Item 2 and is followed by Items 3,4,1, and 5.

5.7.2.2 Analysis of Technological Benefits

The extent of Technological Benefits received by the companies from CDM projects can be understood from the response to the statements viz. introduced new technology for renewable energy generation, technology for CDM project was transferred from foreign participants, technology transfer involved import of equipment, technology transfer involved import of knowledge, new technology requirement pushed the company is investing in research and development. The frequency distribution is as follows.

Table 5.93

Frequency Distribution of Technological Benefits

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Introduced new technology	N	25	34	30	17	7	113
	%	22	30	27	15	6	
	C%	22	52	79	94	100	
Technology was transferred from foreign participants	N	16	30	34	19	14	113
	%	14	27	30	17	12	
	C%	14	41	71	88	100	
Technology transfer involved import of equipment.	N	20	29	34	18	12	113
	%	18	26	30	16	11	
	C%	18	43	73	89	100	
Technology transfer involved import of knowledge.	N	13	27	40	20	13	113
	%	12	24	35	18	12	
	C%	12	35	71	88	100	
CDM project led investments in R&D	N	6	27	47	22	11	113
	%	5	24	42	19	10	
	C%	5	29	71	90	100	

Source: Primary data
Note: C% represents cumulative percentage

Table 5.93 shows that a cumulative of 52% of the respondents Strongly Agree or Agree to the statement that Introduced new technology for renewable energy generation and 27% are neutral, where as 21% (15+6) disagree to the statement.

To the statement that Technology for CDM projects were transferred from foreign participants, 41% agreed, 30% are neutral and 29% disagree with the statement. A cumulative of 32% (26+6) disagree or strongly disagree respectively to the statement and only a cumulative 21 % agree with the statement.

There is a cumulative of 43% of the respondents who agree that technology transfer involved import of equipment, 30% were neutral and cumulative 27% disagree with the statement.

A cumulative 35% of the respondents agreed and 35% were neutral to the statement that technology transfer involved import of knowledge and a cumulative 30% disagreed with the statement.

Only 29% agreed to the statement that new technology requirement pushed the company into investing in research and development, 42% were neutral and 29% disagreed.

Based on the information provided, it can be deduced that most respondents acknowledged the introduction of new technology in the CDM project. However, they expressed a neutral stance towards other statements concerning the import of technology from foreign participants, import of equipment, knowledge, and investment in research and development for the CDM project.

Table 5.94

Descriptive Statistics of Technological Benefits

Item No.	Items	N	Mean	Median	SD
1	Introduced new technology for renewable energy generation	113	3.47	4.00	1.173
2	Technology for CDM project was transferred from foreign participants	113	3.13	3.00	1.221
3	Technology transfer involved import of equipment.	113	3.24	3.00	1.227
4	Technology transfer involved import of knowledge.	113	3.06	3.00	1.159
5	New technology requirement pushed the company in investing in research and development.	113	2.96	3.00	1.021

Source: Primary data

Table 5.94 reveals that the statement regarding introduced new technology for renewable energy generation has a Median score of 4 and all other statements have a median of 3. But the mean scores of all statements is between 2.5-3.49 that is they are neutral to the statements relating to Technological Benefits.

It can be concluded that the frequency distribution and descriptive statistics show that the expected technological benefits were not received from CDM projects by the energy companies in India.

5.7.3 Social Benefits

Social benefits expected from a CDM project are improved health, better standard of living, improved education, upliftment of weaker sections of the society,

5.7.3.1 EFA of Social Benefits

Table 5.95

KMO and Bartlett's Test of Social Benefits

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.718**
Bartlett's Test of Sphericity	Approx. Chi-Square	178.140
	df	15
	Sig.	**.000****

*Source: Primary data, **Significant at 1% level*

The KMO of 'Social Benefits' is 0.718 and Bartlett's Test is significant at a 1% level of significance and it shows that there is a substantial correlation in data.

Table 5.96

Communalities of Social Benefits

Item No.	Items	Initial	Extraction
1	Engagement of local population with the company increased	1.000	0.824
2	Social Benefits like improvement in educational resources	1.000	0.688
3	Increased the basic amenities in the area	1.000	0.679
4	Contributed to the social upliftment of weaker sections through empowerment of women, care of children and the old.	1.000	0.575
5	Workshops and training for skill development	1.000	0.658
6	Positive impact on quality of life of local community	1.000	0.502

Extraction Method: Principal Component Analysis.
Source: Primary data

From the above table, it is evident that all the variables have communalities above 0.5. Therefore, all the variables were taken for extracting the components.

Table 5.97

Total Variance Explained of Social Benefits

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.762	46.030	46.030	2.762	46.030	46.030	2.383	39.713	39.713
2	1.163	19.385	65.415	1.163	19.385	65.415	1.542	25.701	65.415
3	.767	12.788	78.203						
4	.542	9.030	87.233						
5	.399	6.645	93.878						
6	.367	6.122	100.000						

Extraction Method: Principal Component Analysis.
Source: Primary data

The above table explains that 65.415 % of the total variance in the Economic Benefits is explained by two components.

Table 5.98

Rotated Component Matrix of Social Benefits

Sl. No.	Item No.	Items	Component	
			1	2
1	4	Increased the basic amenities in the area	.824	
2	6	Workshops and training for skill development	.804	
3	5	Contributed to the social upliftment of weaker sections through the empowerment of women, care of children, and the old.	.734	
4	1	Positive impact on quality of life of local community	.651	
5	2	Engagement of local population with the company increased		.907
6	3	Social Benefits like improvement in educational resources		.770

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.
Source: Primary data

The component matrix shows that there are two dimensions of the Social Benefits construct. The first component is measured by Item 4 and is followed by Items 6,5 and 1. The second component is measured by Item 2 and is followed by 3.

5.7.3.2 Analysis of Dimensions of Social Benefits

As per Table 5.100, there are two dimensions of Social Benefits. The Social Benefits received by the companies from CDM projects can be evaluated by the responses to the two dimensions of "Community Development" and "Community Empowerment". The frequency distribution and Descriptive statistics of each of the dimensions are analysed as follows: -

A. The first dimension of 'Social Benefits' has been named **"Community Development"**. It contains statements that are related to increased basic amenities, workshops for skill development, social upliftment of the weaker section, and positive impact on quality of life. The frequency distribution is as follows.

Table 5.99

Frequency Distribution of Community Development

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Increased the basic amenities in the area	N	8	59	39	7	0	113
	%	7	52	35	6	0	
	C%	7	59	94	100	100	
Social upliftment of weaker sections by empowerment of women, care of children & old	N	16	46	38	12	1	113
	%	14	41	34	11	1	
	C%	14	55	88	99	100	
Workshops and training for skill development	N	1	31	46	31	4	113
	%	1	27	41	27	4	
	C%	1	28	69	96	100	

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Positive impact on quality of life of local community	N	2	62	42	7	0	113
	%	2	55	37	6	0	
	C%	2	57	94	100	100	

Source: Primary data
Note: C% represents cumulative percentage

The above table reveals that, there is a cumulative of 59% of the respondents who agree that the CDM project increased the basic amenities in the area, 35% were neutral and 6% disagreed with the statement.

A cumulative 55% of the respondents agreed and 34% were neutral and 12% disagreed to the statement that the project contributed to social upliftment of weaker sections through empowerment of women, care of children and the old.

Only 28% cumulatively agreed to the statement that workshops were conducted for skill development and 41% were neutral and 31% disagreed.

A cumulative of 57% of the respondents Strongly Agree or Agree to the statement that the project has been successful in generating a positive impact on quality of life of local community and 37% are neutral, where as 6% disagree to the statement.

It can be inferred from the above that the majority of respondents agreed to all the statements related to community development under the social benefits except for workshops conducted for skill development.

Table 5.100

Descriptive Statistics of Community Development

Item No.	Items	N	Mean	Median	SD
1	Social Benefits like improvement in educational resources	113	3.71	4	0.873
2	Increased the basic amenities in the area	113	3.6	4	0.714
3	Contributed to the social upliftment of weaker sections through the empowerment of women, care of children, and the old.	113	3.57	4	0.895
4	Workshops and training for skill development	113	2.95	3	0.854

Source: Primary data

Table 5.101 reveals that the first three statements regarding Community Development have a Median score of 4 and mean scores are above 3.5 showing a general agreement with the statements. Only one statement related to workshops and training for skill development has a median of 3 and mean scores between 2.5 and 3.49 which means they are neutral.

It can be inferred that there has been a fair amount of Social Benefit through community development from CDM projects in the energy sector in India.

B. The second dimension of 'Social Benefits' is "**Community Empowerment**". It contains statements related to the engagement of the local population with the company and improvement in educational resources. The frequency distribution is as follows.

Table 5.101

Frequency Distribution of Community Empowerment

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Engagement of local population with the company increased	N	19	45	37	10	2	113
	%	17	40	33	9	2	
	C%	17	57	89	98	100	
Improvement in educational resources	N	23	42	40	8	0	113
	%	20	37	35	7	0	
	C%	20	58	93	100	100	

Source: Primary data
Note: C% represents cumulative percentage

Table 5.101 shows that a cumulative of 57% of the respondents agreed to the statement that the engagement of the local population with the company increased, 33% were neutral and 11% disagreed with the statement.

58% agreed to the statement that there was Community Empowerment through improvement in the educational resources, 35% were neutral and 7% disagreed.

It can be inferred that approximately 57 to 58% were positive that there was social benefit through community empowerment due to CDM projects.

Table 5.102

Descriptive Statistics of Community Empowerment

Item No.	Items	N	Mean	Median	SD
1	Positive impact on the quality of life of the local community	113	3.52	4.00	0.642
2	Engagement of the local population with the company increased	113	3.61	4.00	0.930

Source: Primary data

Both statements have a Median of 4 and the Mean is more than 3.49. The descriptive statistics of Community Empowerment statements show that the respondents are highly appreciative of the positive impact on the quality of life of the local community and the engagement of the local population with the company.

5.7.4 Environmental Benefits

Environmental benefits expected from CDM projects are the reduction of greenhouse gas emissions, promotion of renewable energy, conservation of natural resources, and reduction of air, soil, and water pollution.

5.7.4.1 EFA of Environmental Benefits

Table 5.103

KMO and Bartlett's Test of Environmental Benefits

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.787**
Bartlett's Test of Sphericity	Approx. Chi-Square	181.558
	df	6
	Sig.	**.000****

*Source: Primary data, **Significant at 1% level*

The KMO of 'Environmental Benefits' is 0.787 and Bartlett's Test is significant at a 1% level of significance and it shows that there is a substantial correlation in data

Table 5.104

Communalities of Environmental Benefits

Item No.	Items	Initial	Extraction
1	Reduce greenhouse gas emissions, improved air, soil, water quality	1.000	0.729
2	Waste Management measures taken	1.000	0.747
3	Environment Diversity is protected	1.000	0.702
4	The health of people around the project has improved	1.000	0.522

Extraction Method: Principal Component Analysis.
Source: Primary data

From the above table, it is evident that all the variables have communalities above 0.5. Therefore, all the variables were taken for extracting the components.

Table 5.105

Total Variance Explained of Environmental Benefits

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.701	67.525	67.525	2.701	67.525	67.525
2	.601	15.017	82.542			
3	.412	10.291	92.833			
4	.287	7.167	100.000			

Extraction Method: Principal Component Analysis.
Source: Primary data

The above table explains that 67.525 % of the total variance in the Environmental Benefits is explained by one component.

Table 5.106

Component Matrix[a] of Environmental Benefits

Sl. No.	Item No.	Items	Component
			1
1	2	Waste Management measures taken	.865
2	1	Reduce greenhouse gas emissions, improved air, soil, water quality	.854
3	3	Environment Diversity is protected	.838
4	4	The health of people around the project has improved	.722

Extraction Method: Principal Component Analysis.
a. 1 components extracted.
Source: Primary data

The component matrix shows that there is only one dimension of the Environmental Benefits construct. The component is measured by Item 2 and is followed by Items 1,3 and 4.

5.7.4.2 Analysis of Environmental Benefits

The Environmental Benefits received by the companies from CDM projects can be evaluated by the responses from the statements viz., Reduced GHG emissions. Improved air, soil, water quality, waste management measures are taken, environment diversity is protected, and the health of people around the project has improved. The frequency distribution is as follows.

Table 5.107

Frequency Distribution of Environmental Benefits

Particulars		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Reduce greenhouse gas emissions, improved air, soil, and water quality	N	20	66	18	9	0	113
	%	18	58	16	8	0	
	C%	18	76	92	100	100	
Waste Management measures taken	N	28	63	15	7	0	113
	%	25	56	13	6	0	
	C%	25	81	94	100	100	
Environment Diversity is protected	N	27	54	26	6	0	113
	%	24	48	23	5	0	
	C%	24	72	95	100	100	
The health of people around the project has improved	N	17	32	51	11	2	113
	%	15	28	45	10	2	
	C%	15	43	88	98	100	

Source: Primary data
Note: C% represents cumulative percentage

Table 5.107 shows that a cumulative of 76% of the respondents Strongly Agree or Agree to the statement that the project has been able to reduce the GHG emissions and improve the quality of air, water, soil whereas 16% are neutral, and 8% disagree to the statement.

To the statement that Waste Management measures were taken, a cumulative 81% agreed, 13% are neutral and 6% disagreed with the statement.

72% agreed to the statement that Environment Diversity was protected, 23% were neutral and 5% disagreed.

There is a cumulative of 43% of the respondents who agree that the CDM project improved the health of people around the project area, 45% were neutral, 10% disagreed and 2% strongly disagreed with the statement.

It can be inferred from above that majority respondents agreed to all the statements related to Environmental benefits of CDM projects and only in the case of improvement of the health of people around the project, there was less than 50% agreement.

Table 5.108

Descriptive Statistics of Environmental Benefits

Item No.	Items	N	Mean	Median	SD
1	Reduced greenhouse gas emissions, and improved air, soil, and water quality	113	3.86	4.00	.800
2	Waste Management measures taken	113	3.99	4.00	.796
3	Environment Diversity is protected	113	3.90	4.00	.823
4	The health of people around the project has improved	113	3.45	3.00	.926

Source: Primary data

Table 5.108 reveals that the first three statements regarding Environmental Benefits have a Median score of 4 and mean scores are above 3.5 showing a general agreement with the statements. Only one statement related to the improvement of the health of people around the project has a median of 3 and mean scores between 2.5 and 3.49 which means they are neutral.

It can be inferred that there has been a good level of improvement in the Environment due to the implementation of CDM projects.

Kruskal Wallis H test and Mann-Whitney U test are used to know whether the sustainable development outcomes of CDM projects differ with respect to independent variables like, state where the projects are situated, the type of company owning them, the sources of renewable energy used in the project, and the period of registration.

5.7.5 Sustainable Development Outcomes and State

Sustainable Development Outcomes can be different in different states depending on the enforcement of state policies, support of government, attitude of companies towards corporate social responsibility. Hence, it is essential to know whether there is a significant difference in the mean ranks of Sustainable outcomes with respect to the states where the projects are situated and so, the hypotheses formulated were as follows: -

Hypotheses:

1. H_0: There is no significant difference in Economic Benefits with respect to the State in which the CDM projects are situated.

   H_1: There is significant difference in Economic Benefits with respect to the State in which the CDM projects are situated.

2. H_0: There is no significant difference in Technological Benefits with respect to the State in which the CDM projects are situated.

   H_1: There is significant difference in Technological Benefits with respect to the State in which the CDM projects are situated.

3. H_0: There is no significant difference in Social Benefits with respect to the State in which the CDM projects are situated.

   H_1: There is significant difference in Social Benefits with respect to the State in which the CDM projects are situated.

4. H_0: There is no significant difference in Environmental Benefits with respect to the State in which the CDM projects are situated.

   H_1: There is significant difference in Environmental Benefits with respect to the State in which the CDM projects are situated.

Table 5.109

Sustainable Development Outcomes and States

SDO	States	N	Mean Ranks	Test Statistic	Df	p-value	Effect Size
Economic Benefits	Rajasthan	15	66.33	7.704	5	0.173	-
	Gujarat	17	42.97				
	Maharashtra	22	52.45				
	Andhra Pradesh	15	68.20				
	Tamil Nadu	24	52.94				
	Karnataka	20	63.40				
Technological Benefits	Rajasthan	15	54.50	3.54	5	0.617	-
	Gujarat	17	47.03				
	Maharashtra	22	65.39				
	Andhra Pradesh	15	60.47				
	Tamil Nadu	24	61.42				
	Karnataka	20	50.23				
Social Benefits	Rajasthan	15	52.10	13.017	5	**0.023***	0.075
	Gujarat	17	57.71				
	Maharashtra	22	58.75				
	Andhra Pradesh	15	59.90				
	Tamil Nadu	24	40.71				
	Karnataka	20	75.53				
Environmental Benefits	Rajasthan	15	65.57	13.829	5	**0.017***	0.083
	Gujarat	17	41.35				
	Maharashtra	22	43.59				
	Andhra Pradesh	15	66.10				
	Tamil Nadu	24	70.08				
	Karnataka	20	56.10				

*Source: Primary data, *the mean ranks are significantly different at 5% level*

Table 5.109 illustrates that there are differences in the mean ranks for Sustainable Development Outcomes with respect to the states where they are situated. For analysing whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted.

1. The test statistics is 7.704 and *p-value* = 0.173 for Economic Benefits. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Economic Benefits with respect to the State in which the CDM projects are situated. So it can be inferred that the Economic Benefits do not differ as per the States in which the projects are set up.

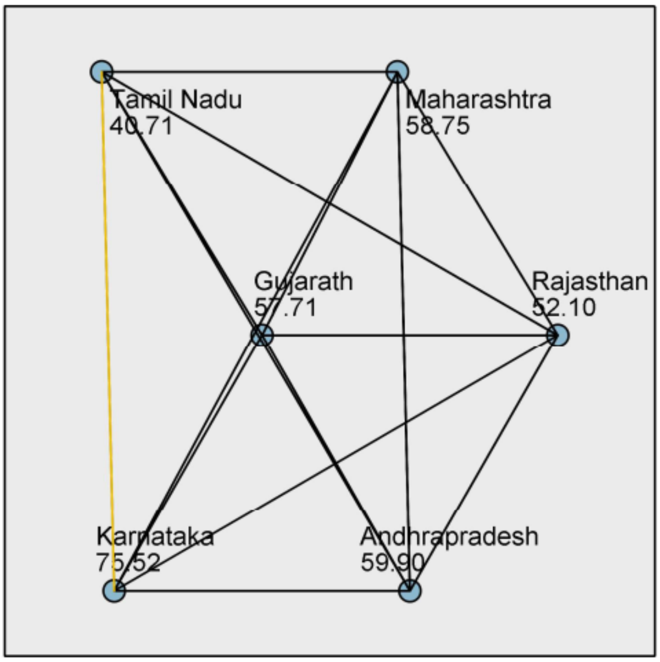
2. The test statistic is 3.54 and *p-value* = 0.617 for Technological Benefits. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Technological Benefits with respect to the State in which the CDM projects are situated. So it can be inferred that the Technological Benefits do not differ as per the States in which the projects are set up.

3. The test statistic is 13.017 and ***p-value is 0.023**** for Social Benefits. Since the p-value is less than 0.05, the test statistic is significant at a 5% level of significance. Hence, the null hypothesis is rejected, so there is a significant difference in the Social Benefits with respect to the State in which the CDM projects are situated. Since the effect is 0.075 which is between 0.06 and 0.14, there is a **moderate** difference between the Social Benefits received by the States where the CDM projects are set up.

Further analysis was done by Multiple Pairwise Comparisons of States based on Social Benefits and the results are shown in Figure 5.11 and Table 5.110.

Figure 5.11

Pairwise Comparison of Social Benefits based on States



Source: Primary data

Table 5.110

Multiple Pairwise Comparison of Social Benefits Based on States

Pairs of States	Test Statistic	P-value
Tamil Nadu-Karnataka	-34.817	**0.006****

*Source: Primary data, **Significant at 1% level*

The Multiple Pairwise Comparison shows that the Social Benefits received from CDM projects based on the States where they are situated, are significantly different from each other. For the pair, Tamil Nadu-Karnataka, the ***p-value is 0.006***** which is highly significant at 1% level of significance. There is no significant difference between other states based on Social Benefits received.

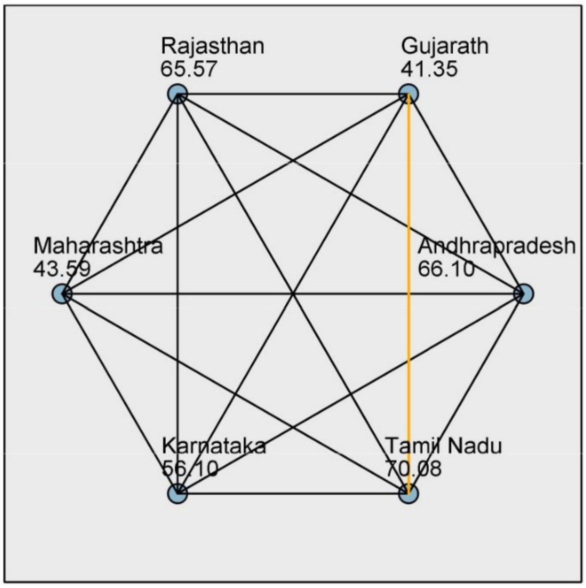
4. The test statistic is 13.829 and ***p-value is 0.017**** for Environmental Benefits. Since the p-value is less than 0.05, the test statistic is significant at a 5% level of significance. Hence, the null hypothesis is rejected, so there is a significant difference in the Environmental Benefits with respect to the State in which the CDM projects are situated. As the effect size is 0.083 which is between 0.06 and

.014, there is a **moderate** difference between the Environmental Benefits received by the States in which the CDM projects are set up.

Further analysis was done by Multiple Pairwise Comparisons of States based on Environmental Benefits and the results are shown in Figure 5.12 and Table 5.111.

Figure 5.12

Pairwise Comparison of Environmental Benefits Based on States



Source: Primary data

Table 5.111

Multiple Pairwise Comparison of of Environmental Benefits Based on States

Pairs of States	Test Statistic	p-value
Gujarat-Tamil Nadu	-28.730	**0.017***

*Source: Primary data, *Significant at 5% level*

The Multiple Pairwise Comparison shows that the Environmental Benefits received from CDM projects based on the States where they are situated, are significantly different from each other. For the pair, Tamil Nadu-Karnataka, the ***p-value is 0.017**** which is significant at 5% level of significance. There is no significant difference between other states based on Environmental Benefits received.

Based on the above results it can be inferred that Social and Environmental Benefits are not equally distributed among the states.

5.7.6 Sustainable Development Outcomes and the Type of Company

The success of CDM project can be evaluated based on the sustainable development outcomes and one of the factors which contributes to sustainable development is the type of company which owns the CDM project. Hence, to estimate whether there is a significant difference in the mean ranks of Sustainable outcomes with respect to the types of companies owning the CDM projects, the following hypotheses were formulated: -

Hypotheses:

1. H_0: There is no significant difference in Economic Benefits based on the Type of Company that owns the CDM projects.

   H_1: There is significant difference in Economic Benefits based on the Type of Company which owns the CDM projects.

2. H_0: There is no significant difference in Technological Benefits based on the Type of Company that owns the CDM projects.

   H_1: There is significant difference in Technological Benefits based on the Type of Company which owns the CDM projects.

3. H_0: There is no significant difference in Social Benefits based on the Type of Company that owns the CDM projects.

   H_1: There is significant difference in Social Benefits based on the Type of Company which owns the CDM projects.

4. H_0: There is no significant difference in Environmental Benefits based on the Type of Company that owns the CDM projects.

   H_1: There is significant difference in Environmental Benefits based on the Type of Company which owns the CDM projects.

Table 5.112

Sustainable Development Outcomes and the Type of Company

SDO	Type of Company	N	Mean Ranks	2 Test Statistic	Df	p-value	Effect Size
Economic Benefits	Public Company	38	43.99	12.493	2	**0.002****	.094
	Private Company	60	60.13				
	HUF	15	77.47				
Technological Benefits	Public Company	38	55.14	22.510	2	**0.000****	.183
	Private Company	60	49.04				
	HUF	15	93.53				
Social Benefits	Public Company	38	58.78	.454	2	0.797	-
	Private Company	60	55.10				
	HUF	15	60.10				
Environmental Benefits	Public Company	38	39.91	16.493	2	**0.000****	.129
	Private Company	60	64.17				
	HUF	15	71.63				

*Source: Primary Data, **the mean ranks are significantly different at 1% level*

It is observed from Table 5.112 that there are differences in the mean ranks for Sustainable Development Outcomes based on the Type of Company which owns the CDM project. For analysing whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted.

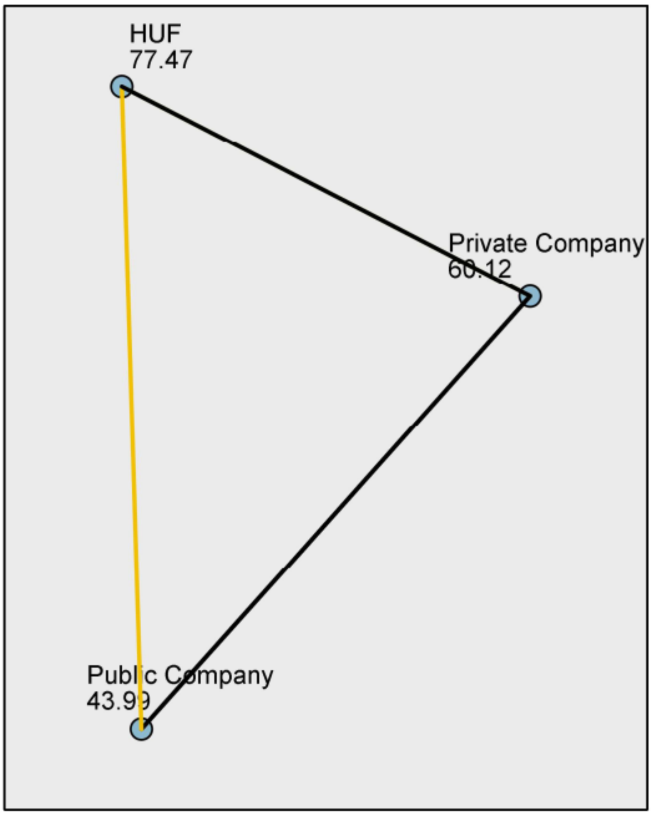
1. The test statistic is 12.493 and ***p-value is 0.002**** for Economic Benefits. Since the p-value is less than 0.05, the test statistic is significant at a 1% level of significance. Hence, the null hypothesis is rejected, and it can be inferred that there is a significant difference in the Economic Benefits based on the type of company which owns the CDM project. Since the effect is 0.094 which is between 0.06 and

0.14, there is a **moderate** difference between the Economic Benefits received by the companies based on their type.

Further analysis was done by Multiple Pairwise Comparisons of Types of Companies based on Economic Benefits, the following results were obtained as in Figure 5.13 and Table 5.113.

Figure 5.13

Pairwise Comparison of Economic Benefits Based on Type of Companies



Source: Primary data

Table 5.113

Multiple Pairwise Comparison of Economic Benefits Based on Type of Companies

Pairs of Types of Companies	Test Statistic	p-value
Public Company-HUF	-33.480	**0.002****

*Source: Primary data, **Significant at 1% level*

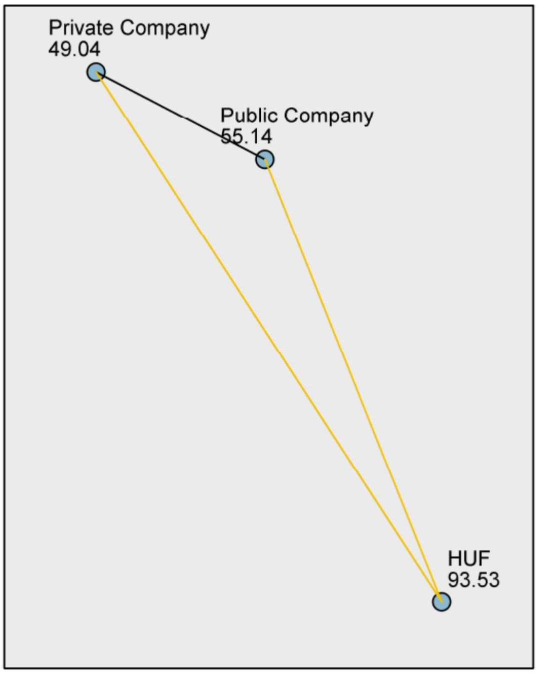
The Multiple Pairwise Comparison shows that the Economic Benefits received from CDM projects based on the Type of Companies, are significantly different from each other. For the pair, Public Company-HUF, the ***p-value is 0.002**** which is highly significant at 1% level of significance. There is no significant difference between other type of companies based on Economic Benefits received.

2. The test statistic is 24.586 and ***p-value is 0.000**** for Technological Benefits. Since the p-value is less than 0.05, the test statistic is significant at a 1% level of significance. Hence, the null hypothesis is rejected, so there is a significant difference in the Technological Benefits based on the Type of Company which owns the CDM project. Since the effect is 0.242 which is more than 0.14, hence, there is a **large** difference between the Technological Benefits received by the companies based on the Type of Company which owns the CDM project.

When further analysis was done by Multiple Pairwise Comparisons of Types of Companies based on Technological Benefits, the following results were obtained as shown in Figure 5.14 and Table 5.114.

Figure 5.14

Pairwise Comparison of Technological Benefits Based on Type of Companies



Source: Primary data

Table 5.114

Multiple Pairwise Comparison of Technological Benefits Based on Type of Companies

Pairs of Types of Companies	Test Statistic	p-value
Private Company-HUF	-44.492	**0.000****
Public Company-HUF	-38.389	**0.000****

*Source: Primary data, **Significant at 1% level*

The Multiple Pairwise Comparison shows that the Technological Benefits received from CDM projects based on the Type of Companies, are highly significantly different from each other. For the pair, Private Company-HUF, the ***p-value is 0.000**** which is highly significant at 1% level of significance, and for the pair Public Company-HUF, the ***p-value is 0.000**** which is also highly significant at 1% level of significance There is no significant difference between Private and Public companies based on Technological Benefits received.

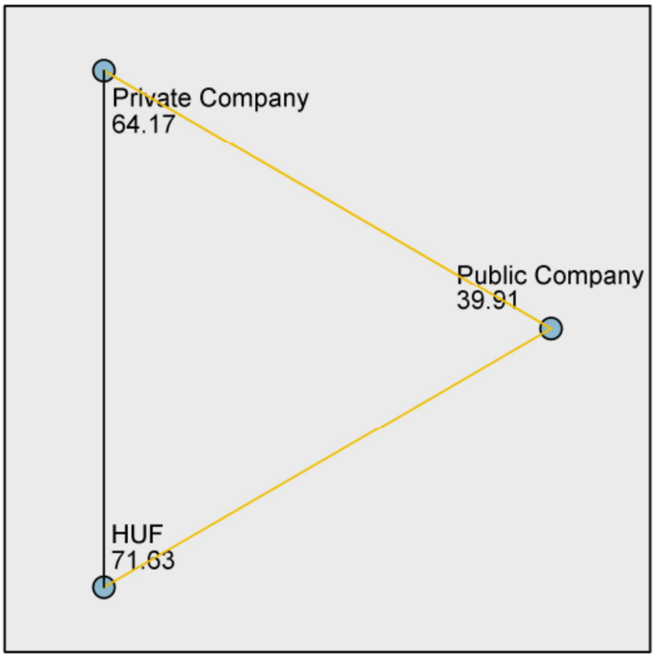
3. In the case of Social Benefits, the test statistic is 0.454 and *p-value* = .797. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Social Benefits with respect to the Type of Company owning the project. Hence, it can be inferred that there is no difference in the Social Benefits received by the companies from CDM projects.

4. The test statistics of Environmental Benefits is 16.493 and ***p-value is 0.000****. Since the p-value is less than 0.05, the test statistic is significant at a 5% level of significance. Hence, the null hypothesis is rejected, so there is a significant difference in the Environmental Benefits received by various Projects based on the Type of Company owning them. As the effect size is 0.129 which is more than .014, hence, it is inferred that there is a **large** difference between the Environmental Benefits received by the companies which own the CDM projects.

When further analysis was done by Multiple Pairwise Comparisons of Types of Companies based on Environmental Benefits, the following results were obtained as shown in Figure 5.15 and Table 5.115.

Figure 5.15

Pairwise Comparison of Environmental Benefits Based on Type of Companies



Source: Primary data

Table 5.115

Multiple Pairwise Comparison of Environmental Benefits based on Type of Companies

Pairs of Types of Companies	Test Statistic	p-value
Public Company-Private Company	-24.259	**0.001****
Public Company-HUF	-31.725	**0.004****

*Source: Primary data, **Significant at 1% level*

The Multiple Pairwise Comparison shows that the Environmental Benefits received from CDM projects based on the Type of Companies, are significantly different from each other. For the pair, Public Company-Private Company, the ***p-value is 0.001**** which is highly significant at 1% level of significance, and for the pair Public

Company-HUF, the ***p-value is 0.004**** which is also highly significant at 1% level of significance There is no significant difference between Private Company and HUF based on Environmental Benefits received.

Based on the above results it can be concluded that Economic, Technological, and Environmental Benefits are not equally distributed among the Companies which own the projects.

5.7.7 Sustainable Development Outcomes and Sources of Renewable Energy

Sources of Renewable Energy that are used for the generation of carbon credits and may be a factor that affects sustainable development outcome. Here, the Sustainable Development Outcomes mean rank as per sources of renewable energy used by CDM projects is compared and analysed to see if there is a significant difference among them, for this the Kruskal-Wallis H test is performed and the result is discussed below. The hypotheses formed are listed below.

Hypotheses:

1. H_0: There is no significant difference in Economic Benefits based on Sources of Renewable Energy used by the CDM projects

   H_1: There is significant difference in Economic Benefits based on Sources of Renewable Energy used by the CDM projects

2. H_0: There is no significant difference in Technological Benefits based on Sources of Renewable Energy used by the CDM projects

   H_1: There is significant difference in Technological Benefits based on Sources of Renewable Energy used by the CDM projects

3. H_0: There is no significant difference in Social Benefits based on Sources of Renewable Energy used by the CDM projects.

   H_1: There is significant difference in Social Benefits based on Sources of Renewable Energy used by the CDM projects

4. H_0: There is no significant difference in Environmental Benefits based on Sources of Renewable Energy used by the CDM projects

H_1: There is significant difference in Environmental Benefits based on Sources of Renewable Energy used by the CDM projects

Table 5.116

Sustainable Development Outcomes and Sources of Renewable Energy

SDO	Source of Renewable Energy	N	Mean Ranks	Test Statistic	Df	p-value	Effect Size
Economic Benefits	Biomass	5	72.60	15.518	9	0.078	-
	Solar Power	14	75.75				
	Wind Power	66	56.19				
	Natural Gas	13	34.62				
	Thermal Oxidation	1	99.50				
	Hydropower	8	54.63				
	Methane	1	25.50				
	Waste Hydrogen gas	1	32.00				
	Coal reduction	1	62.50				
	Waste Heat	3	67.50				
Technological Benefits	Biomass	5	11.60	21.241	9	**0.012***	0.117
	Solar Power	14	70.43				
	Wind Power	66	59.73				
	Natural Gas	13	50.12				
	Thermal Oxidation	1	73.50				
	Hydropower	8	35.19				
	Methane	1	34.00				
	Waste Hydrogen gas	1	60.00				
	Coal reduction	1	94.50				
	Waste Heat	3	86.67				

SDO	Source of Renewable Energy	N	Mean Ranks	Test Statistic	Df	p-value	Effect Size
Social Benefits	Biomass	5	79.90	13.794	9	0.130	-
	Solar Power	14	63.07				
	Wind Power	66	51.23				
	Natural Gas	13	56.88				
	Thermal Oxidation	1	49.50				
	Hydropower	8	83.75				
	Methane	1	64.50				
	Waste Hydrogen gas	1	93.00				
	Coal reduction	1	12.50				
	Waste Heat	3	49.50				
Environmental Benefits	Biomass	5	74.90	19.822	9	**0.019***	0.103
	Solar Power	14	43.18				
	Wind Power	66	60.87				
	Natural Gas	13	32.54				
	Thermal Oxidation	1	108.50				
	Hydropower	8	72.88				
	Methane	1	29.50				
	Waste Hydrogen gas	1	18.00				
	Coal reduction	1	82.00				
	Waste Heat	3	66.83				

*Source: Primary data, *the mean ranks are significantly different at 5% level*

Table 5.116 depicts the fact that there are differences in the mean ranks for Sustainable Development Outcomes based on the Sources of Renewable Energy used in the CDM project. For analysing whether this difference is statistically significant or not, the Kruskal-Wallis H test was conducted.

1. The test statistic is 15.518 and *p-value* is .078 for Economic Benefits. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, hence, there is no significant

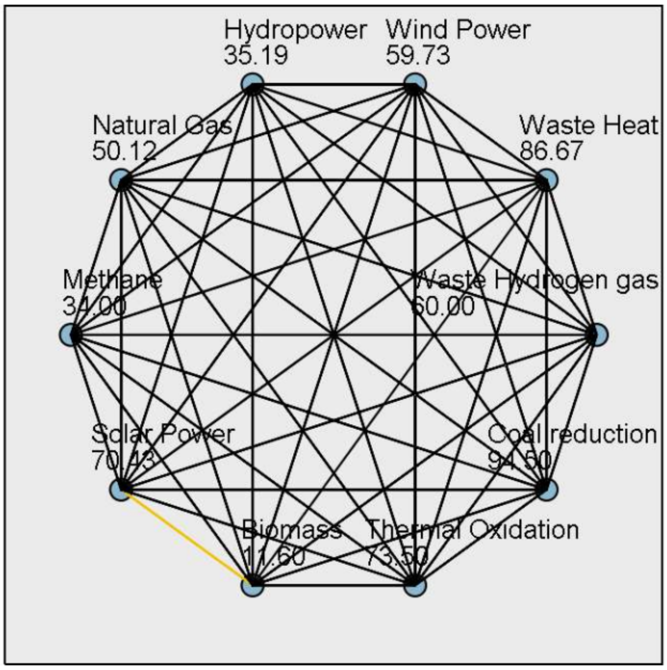
difference in the Economic Benefits based on the Sources of Renewable Energy used in the CDM project.

2. The test statistic is 21.241 and ***p-value is 0.012**** for Technological Benefits. Since the p-value is less than 0.05, the test statistic is significant at a 5% level of significance. Hence, the null hypothesis is rejected, so there is a significant difference in the Technological Benefits based on the Sources of Renewable Energy used in the CDM project. Since the effect is 0.117 which is between 0.06 and 0.14, there is a **moderate** difference between the Technological Benefits received by the companies based on the Sources of Renewable Energy.

Further analysis was done by Multiple Pairwise Comparisons of Sources of Renewable Energy based on Technological Benefits, the following results were obtained as shown in Figure 5.16 and Table 5.117.

Figure 5.16

Pairwise Comparison of Technological Benefits Based on Sources of Renewable Energy



Source: Primary Data

Table 5.117

Multiple Pairwise Comparison of Technological Benefits Based on Sources of Renewable Energy

Sources of Renewable Energy	Test Statistic	p-value
Biomass- Solar Power	-58.829	**0.024***

*Source: Primary data, *Significant at 5% level*

The Multiple Pairwise Comparison shows that the Technological Benefits received from CDM projects based on the Sources of Renewable Energy, are significantly different from each other. For the pair, Biomass and Solar Power, the ***p-value is 0.024**** which is significant at 5% level of significance. But there is no significant difference between other forms of Sources of Renewable Energy based on Technological Benefits received.

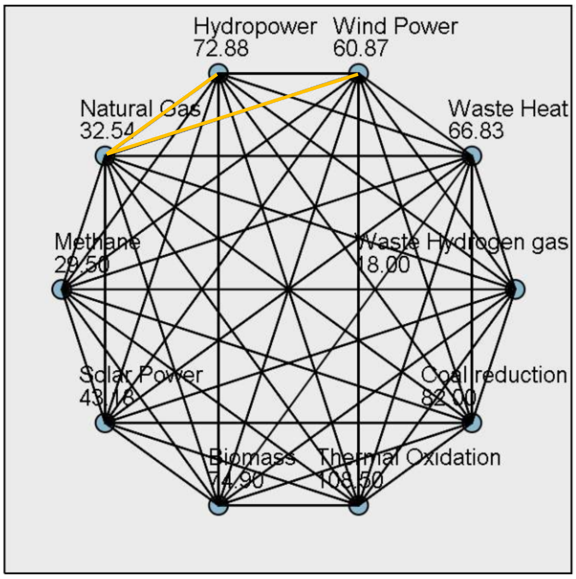
3. In the case of Social Benefits, the test statistics is 19.822 and *p-value* = 0.130. Since the p-value is more than 0.05, the test statistic is not significant at a 5% level of significance. Hence, the null hypothesis is accepted, so there is no significant difference in the Social Benefits based on the Sources of Renewable Energy used in the CDM project. Hence, it can be inferred that there is no difference in the Social Benefits received by the companies from CDM projects based on the Sources of Renewable Energy.

4. The test statistics of Environmental Benefits is 16.493 and ***p-value is 0.019*.*** Since the p-value is less than 0.05, the test statistic is significant at a 5% level of significance. Hence, the null hypothesis is rejected, so there is a significant difference in the Environmental Benefits received by various Projects based on the Sources of Renewable Energy used in the CDM project. As the effect size is 0.103 which is between 0.06 and 0.14, there is a **moderate** difference between the Environmental Benefits received by the companies based on the Sources of Renewable Energy used in the CDM projects.

Further analysis was done by Multiple Pairwise Comparisons of Sources of Renewable Energy based on Environmental Benefits, the following results were obtained as shown in Figure 5.17 and Table 5.119.

Figure 5.17

Pairwise Comparison of Environmental Benefits Based on Sources of Renewable Energy



Source: Primary Data

Table 5.118

Multiple Pairwise Comparison of Environmental Benefits Based on Sources of Renewable Energy

Sources of Renewable Energy	Test Statistic	p-value
Natural Gas- Wind Power	28.333	**0.019***
Natural Gas-Hydro Power	-40337	**0.025***

*Source: Primary data, *Significant at 5% level*

The Multiple Pairwise Comparison shows that the Environmental Benefits received from CDM projects based on the Sources of Renewable Energy, are significantly different from each other. For the pair, Natural Gas and Wind Power, the ***p-value is 0.019**** which is significant at 5% level of significance and for Natural Gas and Hydro

Power, the ***p-value is 0.025**** which is significant at 5% level of significance. There is no significant difference between other forms of Sources of Renewable Energy based on Environmental Benefits received.

Based on the above results it can be inferred that **Technological,** and **Environmental Benefits** are not equally distributed among the Companies when compared on the basis of Sources of Renewable Energy used for the projects.

5.7.8 Sustainable Development Outcomes and Period of Registration.

As sustainable development outcomes depend on the socio-political environments, the situation might change with time. The period of registration is taken as per the Kyoto Protocol commitment period which is 2000-2012 in the first phase and 2013-2020 in the second phase. Hence, in order to know if there is a significant difference in 'Sustainable Development Outcomes' in these two periods of registration, the following hypotheses were formed.

Hypotheses:

1. H_0: There is no significant difference in Economic Benefits based on the Period of Registration

   H_1: There is significant difference in Economic Benefits based on the Period of Registration.

2. H_0: There is no significant difference in Technological Benefits based on the Period of Registration.

   H_1: There is significant difference in Technological Benefits based on the Period of Registration.

3. H_0: There is no significant difference in Social Benefits based on the Period of Registration

   H_1: There is significant difference in Social Benefits based on the Period of Registration.

4. H_0: There is no significant difference in Environmental Benefits based on the Period of Registration.

   H_1: There is significant difference in Environmental Benefits based on the Period of Registration.

The results are shown below:

Table 5.119

Sustainable Development Outcomes Based on the Period of Registration

Construct	Period of Registration	N	Mean Ranks (Median)	Mann-Whitney U Test Statistic	p-value
Economic Benefits	2000 - 2012	93	54.09	659.5	**0.041***
	2013 - 2020	20	70.53		
Technological Benefits	2000 - 2012	93	56.38	872.5	0.664
	2013 - 2020	20	59.88		
Social Benefits	2000 - 2012	93	56.51	884	0.728
	2013 - 2020	20	59.30		
Environmental Benefits	2000 - 2012	93	57.25	907	0.861
	2013 - 2020	20	55.85		

*Source: Primary data, *the mean ranks are significantly different at 5% level*

Mann-Whitney U Test was conducted to evaluate the difference in Sustainable Development Outcomes and Period of Registration for companies registered between the two commitment periods of the Kyoto Protocol.

1. From the above table, the test revealed that there is a significant difference in Economic Benefits from CDM projects based on the year of Registration (Mean Rank = 54.09, n = 93) for the period 2000-2012 and the period 2013-2020 (Mean Rank = 70.53, n = 20). The test statistic is U =659.500 and ***p-value is 0.041*.*** Since the p-value is less than 0.05, the null hypothesis is rejected. Hence it is concluded that the Economic Benefits differ on the basis of the Year of Registration of the Project.

2. In the case of Technological Benefits received by CDM projects registered in two periods, the Mean Rank= 56.38, n=93 for the period 2000-2012, and the Mean

Rank = 59.88, n=20. The test statistic is U = 872.500 and *p-value* = 0.664. Since the p-value is more than 0.05, the null hypothesis is accepted. Hence there is no significant difference in the Technological Benefits received by CDM projects based on the Period of Registration.

3. For Social Benefits received by CDM projects registered in two periods, the Mean Rank= 56.51, n=93 for the period 2000-2012, and the Mean Rank = 59.30, n=20. The test statistic is U = 884 and *p-value* = 0.728. Since the p-value is more than 0.05, the null hypothesis is accepted. Hence there is no significant difference in the Social Benefits received by CDM projects based on the Period of Registration.

4. The Mean Rank= 57.25, n=93 for the period 2000-2012, and the Mean Rank = 55.85, n=20 for Environmental Benefits. The test statistic is U = 907 and *p-value* = .851. Since the p-value is more than 0.05, the null hypothesis is accepted. Hence there is no significant difference in the Environmental Benefits received by CDM projects based on the Period of Registration.

Mann-Whitney U test results show that except in the case of Economic Benefit, all other sustainable development outcomes are not significantly different for CDM projects based on the Year of Registration.

5.7.9 CDM Project Development with Sustainable Development Outcomes

CDM Project Development is the stage where a CDM project is formed, executed, commissioned, and operated to generate energy using clean technology. Hence, it is desirable to know whether the CDM Project Development has a correlation with the achievement of sustainable development goals. Hence, on that basis, the following hypothesis has been formed.

Hypotheses

1. H_0: There is no correlation between CDM Project Development and Economic Benefits.

   H_1: There is a correlation between CDM Project Development and Economic Benefits.

2. H_0: There is no correlation between CDM Project Development and Technological Benefits.

   H_1: There is a correlation between CDM Project Development and Technological Benefits.

3. H_0: There is no correlation between CDM Project Development and Social Benefits.

   H_1: There is a correlation between CDM Project Development and Social Benefits.

4. H_0: There is no correlation between CDM Project Development and Environmental Benefits.

   H_1: There is a correlation between CDM Project Development and Environmental Benefits.

The results are shown below:

Table 5.120

Correlation between CDM Project Development and Sustainable Outcomes

Independent Variables	Dependent Variables	N	Spearman's rho	p-value	Results
CDM Project Development	Economic Benefits	113	0.001	0.993	Not Significant
	Technological Benefits	113	-0.415	**0.000****	Significant
	Social Benefits	113	0.123	0.193	Not Significant
	Environmental Benefits	113	-0.043	0.653	Not Significant

*Source: Primary Data, **correlation is significant at the 0.01 level (2-tailed)*

The Correlation between 'CDM Project Development' and the various Sustainable Development Outcomes are given in **Table 5.120.** The Spearman's rho is 0.001 for Economic Benefits, with a p-value of 0.993 which is not significant as it is more than .05. For Technological Benefits the Spearman's rho is -0.415 and the **p-value is**

0.000** which is highly significant at 1% level of significance. For Social benefits, Spearman's rho is 0.123 with a p-value of .193 which is not significant as it is more than .05. In the case of Environmental Benefits, Spearman's rho is 0.043 with a p-value of .653 which is not significant as it is more than .05.

Hence, it can be inferred that there is a high negative correlation between CDM Project Development and Technological Benefits. The cause for such a negative correlation needs to be studied in depth. Literature shows that as more projects of a particular type are implemented in a host country, the rate of technology transfer often declines indicating the development of broader technology in the country and this has always been the case with India (Seres, Haites, & Murphy, 2009).

When the negative correlation of technological benefits with CDM Project Development is read with existing literature, it can be inferred that though CDM Project Development has positive growth, technological benefits from the transfer of equipment and know-how from foreign countries have declined in India due to the development of indigenous clean technology.

In the case of Environmental Benefits, there is a negative correlation which is not significant. Hence, it can be inferred that CDM Project Development has not improved the Environmental health of the locality but on the contrary, there is a negative effect on the Environment. This has been observed in other countries like Brazil which is the third largest CDM host country after China and India (Jaraitė, Kurtyka, & Ollivie, 2022).

5.7.10 Earning Carbon Credits with Sustainable Development Outcomes

Earning carbon credits is an important phase in Clean Development Mechanism projects as there are many benefits for the company due to carbon credits. So, it is imperative to know whether the Earning of Carbon Credits has a correlation with the achievement of sustainable development outcomes. Hence, on that basis, the following hypothesis has been formed.

Hypotheses

1. H_0: There is no correlation between Earning Carbon Credits and Economic Benefits.

H$_1$: There is a correlation between Earning Carbon Credits and Economic Benefits.

2. H$_0$: There is no correlation between Earning Carbon Credits and Technological Benefits.

   H$_1$: There is a correlation between Earning Carbon Credits and Technological Benefits.

3. H$_0$: There is no correlation between Earning Carbon Credits and Social Benefits.

   H$_1$: There is a correlation between Earning Carbon Credits and Social Benefits.

4. H$_0$: There is no correlation between Earning Carbon Credits and Environmental Benefits.

   H$_1$: There is a correlation between Earning Carbon Credits and Environmental Benefits.

The results are shown below:

Table 5.121

Correlation between Earning Carbon Credits and Sustainable Development Outcomes

Independent Variable	Dependent Variables	N	Spearman's rho	p-value	Results
Earning Carbon Credits	Economic Benefits	113	0.238	**0.011***	Significant
	Technological Benefits	113	0.119	0.210	Not Significant
	Social Benefits	113	0.195	**0.038***	Significant
	Environmental Benefits	113	0.197	**0.036***	Significant

*Source: Primary data, *correlation is significant at the 0.05 level (2-tailed)*

The Correlation between 'Earning Carbon Credits' and the various Sustainable Development Outcomes is given in **Table 5.121.** From the above table it can be inferred that there is a significantly high correlation between Earning Carbon Credits and three of the Sustainable Development Outcomes. The Spearman's rho is 0.238 with a ***p-value of 0.011**** which is significant at 5% level of significance for Economic Benefits. For Social benefits, the Spearman's rho is 0.195 with a ***p-value of 0.038**** which is significant at 5% level of significance. For Environmental Benefits, the Spearman's rho is 0.197 with a ***p-value of .036*** which is significant at 5% level of significance. Whereas, Spearman's rho is .119 with a p-value of .210 for Technological Benefits and is not significant as the p-value is more than .05.

Hence, it can be inferred that, there is high correlation between Earning Carbon Credits and Sustainable Development Outcomes except for Technological Benefits. In the case of Economic Benefit, the companies are directly benefitted by the sale of Carbon Credits. The Companies which are issued Carbon Credits are bound to use a part of the sale proceeds for the benefit of the society and environment. Hence, the analysis reflects this in the form of a significant correlation between Earning Carbon Credits and Economic Benefits, Social Benefits, and Environmental Benefits.

On the other hand, Technological Benefits are derived from implementing the CDM project if there is an agreement with the foreign participant to share new technology with the host company. Hence, though there is a positive correlation with the Technological Benefit, it is not significant as Earning Carbon Credit will not lead to Technological Benefits directly.

For further analysis, **Kendall-Theil Regression** was used to understand the strength of the relationship between Earning Carbon Credit and Sustainable Development Outcomes which have high correlation. The Kendell Theil Robust Line Version 1.0 was used to get the regression line.

a) The Kendall-Theil Regression equation for Earning of Carbon Credits and Economic Benefit obtained was

$Y = 12.45 + 0.15*X + ei$

Where, X = Earning of Carbon Credits

Y= Economic Benefits

Median of Slopes = 0.15

Intercept =12.45

It can be inferred that there is a positive relation between the independent construct 'Earning of Carbon Credit' and dependent construct 'Economic Benefit', and for every unit increase in 'Earning of Carbon Credits', there will be 0.15 increase in 'Economic Benefits'.

b) The Kendall-Theil Regression equation for Earning of Carbon Credits and Social Benefit obtained was

$Y = 16.15385 + 0.7692308e^{-02}*X + ei$

Where, X = Earning of Carbon Credits

Y= Social Benefits

Median of Slopes = $0.7692308e^{-02}$

Intercept =16.15385

It can be inferred that there is a positive relationship between the independent construct 'Earning Carbon Credit' and dependent construct 'Social Benefit', and for every increase in 'Earning of Carbon Credits' there is a $0.7692308e^{-02}$ increase in 'Social Benefits'.

c) The Kendall-Theil Regression equation for Earning of Carbon Credits and Environmental Benefit obtained was

$Y = 13.82353 + 5.882353e^{-02} * X + ei$

Where, X = Earning of Carbon Credits

Y= Environmental Benefits

Median of Slopes = $5.882353e^{-02}$

Intercept =13.82353

It can be inferred from above equation that there is a positive relationship between the independent construct 'Earning of Carbon Credit' and dependent variable 'Environmental Benefits', and for every increase in 'Earning of Carbon Credits' there is $5.882353e^{-02}$ increase in 'Environmental Benefits'.

Hence it can be inferred that if earning carbon credits is effortless, it will have a positive effect on the Economic Benefits, Social Benefits, and Environmental Benefits and there is approximately six times more effect on environmental benefits. Hence the government should facilitate the companies to earn more carbon credits.

5.8 Chapter Summary

In this chapter, a detailed analysis of all the demographic variables and constructs has been conducted as per the objectives of the study. As this is an exploratory study, the Exploratory factor analysis has been conducted on all the constructs to discover the factor structure and to examine its internal reliability so that further analysis can be done on the data. The chapter has been divided into five parts. The first part is a description of independent variables related to the study like the states where the projects are situated, the type of companies that have invested in the CDM projects, the source of renewable energy used, the period of registration, and the activity levels of the projects. The second part discusses the relationship between Stakeholders'

Awareness, Government Support, and CDM Project Development. The third part deals with factors facilitating the Earning of Carbon Credits and its relation with the independent variables and constructs like Stakeholders' Awareness, Government Support, and CDM Project Development. The fourth part discusses the compliance of the projects with the ICAI guidelines 2012 for accounting and disclosure of self-generated CERs. The fifth part of the chapter is related to sustainable development outcomes and the influence of independent variables and other constructs on sustainable development outcomes. The summary, findings and conclusions are discussed in Chapter 6.

Chapter 6

Summary, Findings and Conclusions

6.1 Introduction

Climate change is one of the biggest challenges facing humans today. Climate change refers to long-term shifts in global climate patterns, primarily attributed to human activities releasing greenhouse gases into the atmosphere. There has been widespread discussion among scientific and political bodies about the dangerous effects of climate change. In response to this issue, international efforts have been made to mitigate GHG emissions and promote sustainable development. The adoption of the Kyoto Protocol is a milestone in climate change governance. Under the Kyoto Protocol, the Clean Development Mechanism (CDM) was introduced to facilitate emission reductions and sustainable development in developing countries with the help of developed countries. It was designed such that, the developed countries were expected to help the developing countries to set up projects which will reduce emissions by providing technology and funds, in return for a share in the carbon credits generated. These carbon credits will be used by developed countries to write off the compulsory reductions that they are obliged to make under the Kyoto Agreement. But, in India, it is seen that though in the early 2000s, many foreign countries were participating in CDM projects hosted by India, later on, such countries withdrew from the projects, and then the Indian counterparts carried on with the projects, and earned carbon credits on their own. Later on, the new projects were set up by Indian companies on their own with the latest green technology available in India or imported from a foreign country.

India's Designated National Authority (DNA) is the National Clean Development Mechanism Authority (NCDMA) located in New Delhi. It has registered 3053 CDM projects and 3019 projects were given final approval over all 13 sectors, till March 2022. India is second only to China in generating carbon credits from CDM projects. Along with earning carbon credits, the projects are supposed to contribute to the sustainable development of the local area around the project. To achieve that, the projects have to be successfully implemented in the most efficient manner and with the least disturbance to the biodiversity of the area. There are some prominent issues associated with the development of CDM projects. Such a project should be able to prove that it has reduced the emissions that would not have otherwise occurred without the project. An accurate baseline for measuring emission reduction has to be established and approved. It needs to undergo a rigorous verification process to ensure that the claimed emissions reductions are accurate and meet the required standards. Projects often require significant upfront investment which is a problem in countries with limited financial resources. They have to overcome barriers such as intellectual property rights, capacity building, and knowledge transfer while transferring environmentally friendly technologies, last but not least, the CDM projects are expected to contribute to sustainable development in the host country by generating social, economic, and environmental co-benefits. Moreover, since many international agencies are involved at various stages of the project to get approval, it becomes a complex and time-consuming affair to earn carbon credits. Thus, effective governance structures, transparency, and robust monitoring mechanisms are essential for CDM projects' successful implementation and credibility.

To determine if earning carbon credits makes it easier to achieve sustainable development goals, this study was done to assess the extent of stakeholders' awareness of and government support for the CDM project, as well as its impact on the ease of CDM project development. Also, the adherence to the accounting and disclosure guidelines established by the ICAI for documenting CDM project-related transactions is evaluated. Hence, research into CDM initiatives in India can aid future project developers, policymakers, academicians, chartered accountants, and researchers in learning more about the benefits, opportunities, drawbacks, and impacts of these projects. The information can help India achieve its sustainable development objectives and advance global climate action through policy decisions, project development strategies, and international climate change negotiations.

6.2 Research Problem in Brief

This study is an attempt to understand the environment in India faced by the investors in CDM projects in the effective utilization of CDM as a mechanism for promoting sustainable development. The CDM projects usually have complex and lengthy project approval processes like preparing a Project Design Document (PDD) which is to be submitted to the Designated National Authority. Then the PDD has to be validated by a Designated Operational Entity (Approved by the CDM Executive Board) and then registered by the CDM Executive Board after submitting all the required documents and fees. All such registered CDM Projects do not earn carbon credits after commissioning. For earning carbon credits there are more procedures like monitoring the emission reductions and documenting them as per the methodology mentioned in the PDD and approved by the Kyoto Protocol from time to time. Then the DOE has to verify that the said emission reduction has taken place and the monitoring system followed is as per the approved monitoring plan. A certificate is issued by the DOE to the CDM EB stating that the required amount of CERs can be issued to the company. If no further review of the project is requested by any party, then the CDM EB issues CERs after deducting the equivalent value of CERs for the administrative fees and other charges.

To go through all these procedures for earning carbon credits is a big hassle and the value of Carbon Credits in the international market is very volatile. In the early years of the Kyoto Protocol, the price of carbon credits was relatively low and it experienced significant fluctuations. It often ranged from a few cents to a few dollars per ton of carbon dioxide equivalent (CO2e). However, as the Kyoto Protocol progressed and countries sought to meet their emission reduction targets, the demand for carbon credits increased. This resulted in a gradual increase in the price of carbon credits over time, reaching a peak in the late 2000s and early 2010s. After 2010 the price of carbon credits experienced a significant decline in the carbon market and one of the major reasons was the oversupply of CERs. The reason was increasing investments in CDM projects which led to an increase in CERs issued. At the same time decline in demand was due to various reasons like the withdrawal by major emitters of GHG like the US, Canada, and Russia, and also the economic recession, policy uncertainty in some regions, delay in implementing emission reduction targets, lack of global agreement on carbon pricing and the relaxed attitude of various governments regarding the seriousness of the issue contributed to it.

Hence, the research questions framed explore the following issues.

- What is the concept of carbon credit?
- What is the level of Stakeholders' Awareness of Clean Development Mechanism projects?
- What is the level of Government Support received by project developers for Clean Development Mechanism projects?
- What are the factors which affect the formation and implementation of Clean Development Mechanism projects?
- What are the facilitating factors in earning carbon credits in Clean Development Mechanism projects?
- What is the compliance level of accounting and disclosure of carbon credits adopted by Indian companies?
- What are the contributions of CDM projects in terms of economic, technological, social, and environmental benefits?

6.3 Objectives of the Study

1. To measure the influence of Stakeholders' Awareness and Government Support on creating a conducive atmosphere in promoting CDM Projects.
2. To investigate the factors enabling the Indian Companies to form and implement Clean Development Mechanism projects.
3. To analyse the factors facilitating the Earning of Carbon Credits.

4. To examine the compliance of accounting and disclosure of Carbon Credits as per the guidance note issued by ICAI.

5. To evaluate the accomplishment of sustainable development outcomes of CDM Projects.

The study thus, focuses its attention on the environment faced by project participants in India during the formation and execution of CDM (Clean Development Mechanism) Projects. It explores the importance of Stakeholders' Awareness and Government Support in the development of CDM Projects, investigates the factors facilitating and barriers to earning carbon credits, scrutinizes the accounting and disclosure practices of carbon credits by Indian corporations, and aims to assess whether the projects have effectively achieved their sustainability goals.

6.4 Methodological Design at a Glance

The study is both descriptive and exploratory in nature. The first phase of research was exploratory with a literature review, which helped in finding the research gap and forming objectives. The variables were identified after a review of the PDD of many CDM Projects, reports of UNFCCC, DOEs, and journal articles. An interview schedule was drafted and expert opinions were sought from academicians and industrialists working in the renewable energy sector. The necessary corrections were made and the final interview schedule was used for further data collection. The respondents of the study are top-level managers of various Indian Companies working in various positions like Directors, Presidents, Vice Presidents, General Managers, Assistant General Managers, CFOs, and others like finance managers were included. The data collected was cleaned and entered into the SPSS package for further analysis. Since the data was found to be not normal under the Kolmogorov-Smirnov test, descriptive statistics like Percentages, Mean, Median, Standard Deviation, and non-parametric tests like, Mann Whitney U Test, Kruskal Wallis Test, Spearman’s Rank Correlation, Kendell-Theil Regression were used. The factor structure of the constructs was discovered using Exploratory Factor Analysis and internal reliability was established. For Kendell-Theil Regression, the Kendell-Theil Robust Line

Software version 1.0 and for Exploratory Factor analysis, IBM SPSS Statistics version 22.0 were used.

6.5 Summary of the Chapters

The research work is divided into seven chapters, each serving a specific purpose. The first chapter, known as the Introduction, initiates the study by providing background information and discussing the events that led to India's participation in the Kyoto Protocol. It highlights the relevance and scope of the study, presents the statement of the problem, outlines the objectives, and acknowledges the study's limitations.

Moving on to the second chapter, an extensive literature review is conducted, covering various aspects such as the Kyoto Protocol, the Clean Development Mechanism (CDM), the process of earning carbon credits, carbon credit accounting, and the sustainable outcomes of CDM projects.

The third chapter, titled "Clean Development Mechanism -An Overview," delves into the formation and implementation of CDM projects, exploring topics like the National Clean Development Mechanism Authority (NCDMA), the CDM Project Cycle, the United Nations Framework Convention on Climate Change (UNFCCC), the CDM Registry, rules regarding accounting and disclosure of CDM project transactions, carbon credits, carbon markets, registered CDM projects in India, sector-wise CDM projects in India, and the expected outcomes of CDM projects.

The fourth chapter, "Materials and Methods," covers the research approach, process, methodology, and database. It includes information on the type of data collected, the instrument used for data collection, the pilot study conducted, and the tools employed for data analysis, among other relevant aspects.

The fifth chapter, "Results and Discussions," presents the analysis and interpretation of the data collected, aligning with the stated objectives of the study.

Moving on to the sixth chapter, titled "Summary, Findings, and Conclusions," a summary of the report is provided, followed by a concise discussion of the problem.

The chapter further encompasses the objectives, hypothesis, findings, and conclusion derived from the research.

Finally, the seventh chapter, "Recommendations" focuses on providing recommendations based on the study's outcomes and offering suggestions for further research.

6.6 Findings of the Study

The following section presents the findings of the study, which aimed to understand the challenges in the formation and implementation of CDM Projects, the factors that influence the development of CDM projects, the tasks involved in earning carbon credits, compliance with accounting and disclosure norms of ICAI guidelines, achievement of sustainability goals by CDM projects in India. Through a comprehensive analysis of the primary data collected from the top-level managers of various CDM projects, the study sought to explore and understand the ease of setting up CDM Projects in India and the compliance of accounting and disclosure norms as per the guidelines of ICAI (2012). This section presents the key results, shedding light on the contribution of CDM projects in meeting sustainable development goals.

6.6.1 *Profile of the CDM Projects*

a) The sample was taken from six states in India viz. Gujarat, Maharashtra, Rajasthan, Tamil Nadu, Andhra Pradesh, Karnataka. These six states contain 63% of all CDM projects in India and 66% of the CDM projects in the Energy Industry. As 79% of all the projects in India are in the Energy Industries Sector, the sample for this study was taken from the Energy Industries Sector. 113 projects have been taken as samples for the study from the above-mentioned six states.

b) 55.8% of the sample projects are large-scale projects and 44.2% are small-scale projects. 53% of the projects are owned by Private Companies, 34% are owned by Public Companies and 13% are owned by HUFs. Hence, private companies have invested more in CDM projects than public companies.

c) The projects are using nine different sources of energy and major sources are Wind Power (58%), Solar Power (12%), and Natural Gas (12%). Wind Power is the most preferred mode of renewable energy among the project developers. Most (82%) of the projects were registered in the first phase of (2000-2012) the Kyoto Protocol and only 18% were registered in the second phase of 2013-2020. Thus it can be concluded that the Indian companies were more enthusiastic about investing in CDM projects initially, but later on, many foreign participants withdrew their support and the volatility in the carbon credit market led to ebbing their enthusiasm.

d) The majority (63%) of the projects were started by companies that are already in the Energy generation business and they thought that they would have diversified into the renewable energy business even without the CDM facility. Only 37% of the companies invested in the CDM Projects related to renewable energy for earning revenue from carbon credits and saving tax.

e) The CDM Project proponents get their project verified for issuance of CERs only when they get a buyer for the CERs generated. Thus, they are ready to spend money on verification only when they are sure of the returns from CERs.

f) Out of the different types of companies, all 15 projects promoted by HUFs were successful in selling their CERs, whereas only 95% (57 out of 60 projects) of private companies and 68% (26 out of 38 projects) of the public companies were able to sell their CERs. So, a total of 87% (98 out of 113 projects) of the total projects were able to sell their CERs in the international market. It shows that the type of ownership of projects is a key factor in being able to sell the CERs, as projects owned by HUFs were most successful in selling their carbon credits, followed by the projects owned by private companies and public companies.

6.6.2 *Measure the Stakeholders' Awareness and Government Support for CDM Project Development.*

a) The reading of the frequency table and descriptive statistics of Stakeholders' Awareness brings forth the understanding that project participants, state and central agencies are somewhat aware of the CDM Projects and the local communities have a very low level of awareness. Also, the standard deviation shows that there is wide variation in the opinion of the respondents.

b) Analysis of the Stakeholders' Awareness of the CDM Project based on the state where the project is situated revealed that there was no significant difference. Hence it can be concluded that in all the states of India, the level of awareness is the same.

c) Stakeholders' Awareness of the CDM Project was significantly different based on the type of company. The mean ranks were the highest for HUF followed by Private Companies and Public Companies. Further analysis showed that stakeholders' awareness was significantly different for Public Companies and HUF, as well as Private Companies and HUF.

d) It is seen that the project participants have the same type of experience concerning awareness among stakeholders for the CDM projects in India whether it is the first commitment period (2000-20012) or the second commitment period (2013-2020). It shows that there has not been any effort to increase awareness among the stakeholders regarding the CDM projects and their importance to the community as a whole over the two commitment periods of registration.

e) The majority of the respondents thought that they received moderately good Government Support which helped them in the smooth development of CDM projects. The companies did get some incentives from the government for implementing CDM projects during the first phase of the Kyoto Protocol, but many are unhappy that the incentives have been withdrawn by both central and state governments after the initial years. Though the level of awareness was moderate among the project proponents, state, and central agencies and low among the local communities, the support of the state-central government was an important factor in the implementation of CDM projects.

f) The level of government support based on state showed that it is significantly different in different states. The mean rank of government support was the highest in Karnataka followed by Andhra Pradesh, Tamil Nadu, and Gujarath. It was the least in Maharashtra and Rajasthan in that order. The difference in government support was felt most in Rajasthan and Karnataka as well as Maharashtra and Karnataka.

g) Analysis of the Government Support of the CDM Project based on the type of company disclosed that there was no significant difference. Hence it can be concluded that whatever the type of company, all of them received the same level of government support.

h) The analysis of government support for CDM projects concerning the period of registration shows that it is not significantly different. That means the project participants have the same level of experience concerning government support for the CDM projects in India whether it is the first commitment period (2000-20012) or the second commitment period (2013-2020). It can be concluded that the government has not taken any effort to increase the level of support for CDM projects after the first commitment period.

i) The influence of Stakeholders' Awareness on CDM Project Development was determined using correlation. It was found that there is no significant correlation between Stakeholders' Awareness and CDM Project Development. When the descriptive statistics of Stakeholders' Awareness and CDM Project Development are compared, it can be inferred that there was low Stakeholders' Awareness but still, the CDM Project Development had not encountered many problems and the projects could be developed reasonably well. This means that the companies had overcome the problem of lack of awareness of project stakeholders by utilizing other means to implement the projects satisfactorily. They had taken the help of private agencies who are experts in preparing the PDD, monitoring the emission reductions, and liaisoning with the DOEs, NCDMA, State and Central Government agencies, and the UNFCCC.

j) Correlation between Government Support and various stages of CDM Project Development disclosed that there is a positive correlation between government support and the various stages of CDN Project Development. However, there is a significant correlation between Government Support and the first stage of Project Formation also the Overall CDM Project Development. When further regression analysis was done, to find the extent of influence of Government Support, it was understood that for every increase in Government Support, there would be a 0.25 increase in the Project Formation and a 0.5 increase in the Overall CDM Project Development. Hence, it can be positively stressed that if Government Support is increased, it will help the project participants immensely in project formation and project development.

k) Kruskal Wallis H test showed that there is a significant difference in the mean scores of CDM Project Development concerning the level of Government Support received. The projects which received the highest support had a very high mean score followed by projects which received moderate and low support.

6.6.3 *Prospects and Challenges of CDM Projects*

a) Following an exploratory factor analysis, the CDM Project Development was separated into four dimensions viz Project Formation, Project Execution, Project Operations, and Project Support which can also be considered as four stages of project development. The analysis of the frequency data and the descriptive data for each component led to the following conclusions. The first stage of CDM Project development is **Project Formation** which covers the support of the local people in the area, easy availability of skilled labourers, trouble-free registration of the project with NCDMA, PDD was prepared in a reasonable time, easy availability of initial capital. The analysis of the statements reveals that all the statements had a median of 4 proving that the project formation stage was generally easy for the project participants in India. In the case of the second stage of **Project Execution**, the statements were: Coordination with the state and the central agency was easy, Strong support from banks was received for the project, and Sufficient infrastructure was available at the site. Most of the respondents were neutral and the median of all statements was 3. Hence, there was a neutral response to the statements related to project execution which points to some problems during the execution stage. The questions relating to the third stage of

Project Operations had a mixed response. The Median of the response was 4 to the statement, ‘Monitoring of operations was done without any problem’, which means the respondents agreed that monitoring of operations was easily done. For the statements ‘Cost of CDM project did not exceed the estimated cost’ and ‘CDM project was commissioned on time’, the response showed a median of 3 with a standard deviation of more than 1 which means there was wide variation in the responses and most of the responses were neutral to the statements. It means that there were problems with CDM project cost and timely completion in some cases and some there were no problems. Hence there was a high rate of standard deviation. The dimension **Project Support** had a median score of 4 indicating that there was no problem when new technology was installed and the existing staff supported it.

b) Analysis of CDM Project Development based on States revealed that there is no significant difference in the CDM Project Development based on states where they are situated. Hence, it can be concluded that the project participants got the same type of facilities for the smooth formation and implementation of CDM Projects in all the states.

c) Analysis was conducted using the Kruskal-Wallis H test of the four dimensions of CDM Project development with the type of company owning the projects. The type of company is a significant factor for three out of the four dimensions of CDM Project Development viz., Project Formation, Project Execution, and Project Operations, and also for Overall CDM Project Development. In most cases, the mean score of Private Companies is more than the Public Companies and HUF in that order. It means that Private Companies could complete the activities of formation and implementation more easily than the other two types of companies. Thus, it can be concluded that the type of company is an influencing factor in the formation and implementation of the CDM Project.

d) The CDM Project Development activities based on sources of renewable energy were analysed and found that it does not differ for different sources of renewable energy. The CDM Project Development activities also don’t have a significant difference in terms of the period of registration of projects. It means that the challenges faced by the project investors have not changed in the second phase of the Kyoto Protocol.

e) The analysis of all the dimensions of the CDM Project Development and Activity Scale exposed the fact that only Project Execution was significantly different for different activity scales. The comparison of mean scores revealed that it was much easier for small-scale project participants to coordinate with the authorities, get support from banks/financial institutions, and get sufficient infrastructure for the project. All other stages faced similar challenges and the mean scores were not significantly different for both the activity scales,

6.6.4 Carbon Credits from CDM Projects

a) A project that has been commissioned is not automatically eligible for earning carbon credits. It has to prove that there is a decrease in emissions due to the activities of the project. The monitoring report has to be validated by a DOE who is appointed by the CDM EB. Only after the CDM EB approves the report of the DOE, the CERs are released. Hence in all these procedures, the project participants face many hurdles like weather conditions, equipment breakdown/maintenance, the problem of non-availability of trained staff, employer-employee conflicts, procedures for monitoring, verification, delay in issue of CERs, withdrawal of incentives by the government, lack of demand or fluctuation in the price of CERs.

The exploratory analysis of the construct ‘Earning Carbon Credits’ revealed that it can be divided into three different dimensions. The three dimensions are: -

1. Facilities for Earning Carbon Credits
2. Procedure for Earning Carbon Credits
3. Other Incentives Supporting Earning Carbon Credits

b) The descriptive statistics of ‘Facilities for Earning Carbon Credits’ show that the major worry of the project participants is the low demand for CERs in the international market. Another concern is the weather conditions which are unpredictable and it causes loss of revenue for the projects when enough energy is not produced thereby reducing the carbon credits earned. Other problems that were moderate were the long period of maintenance required for the energy-generating machines due to many factors like old machinery, sabotage, etc. Some of the projects had high revenue expenses for running the plant which is a hurdle for earning carbon credits. There was no shortage of trained and skilled employees for the installation of machinery or regular running of the machines. Most of the projects have appointed contractors for the maintenance and running of the plant. There were also no employer-employee conflicts reported which could have led to the shutting down of the plant or loss of man-days.

c) Analysis of the descriptive statistics of 'Procedure for Earning Carbon Credit' reveals that the measurement and recording of renewable energy generation, the procedure for verification of emission reduction, was not a hurdle as all these steps were easily completed by them. There was only a slight delay in the procedure for the certification of emission reduction as it has to be done by the CDM EB only after the submission of the verification certificate by the DOE.

d) One of the major hurdles in 'Other Incentives Supporting Earning Carbon Credits' is the fluctuation of the market price of carbon credits. Due to many reasons, the prices of carbon credits are volatile in the market and it had been very low. The tax holiday and other incentives from the government were not up to the expectations of the project participants, as they were withdrawn after the initial period. The majority of the participants were in agreement that there is no hurdle in getting the CERs issued by the CDM EB.

e) Analysis of the facilities for Earning Carbon Credits in different states revealed that it does not differ according to state. Hence the facilities are the same in all states as they are commonly facilitated by the Kyoto Protocol mechanism.

f) The comparison of Earning Carbon Credits among the projects owned by different types of companies shows that it is a highly significant factor. The HUFs were most successful in easily going through the steps to earning carbon credits. The fact that only one person is responsible for making decisions in such companies may be a reason for this. There is no significant difference in earning carbon credits between Public and Private companies.

g) Earning Carbon Credits is not different for different sources of renewable energy or the period of registration of the project. Hence both those factors do not have a bearing on successfully earning carbon credits.

h) The influence of Stakeholders’ Awareness, Government Support, and CDM Project Development on Earning Carbon Credits was determined using correlation and regression analysis. The correlation analysis revealed that Stakeholders’ Awareness and CDM Project Development activities had a positive but insignificant correlation with Earning Carbon Credits. At the same time, there was a significant positive correlation between Government Support and Earning Carbon Credits. Regression analysis showed that for every increase in Government Support, there is a .6666667 increase in Earning Carbon Credits. It means that, if government support is increased, there will be a positive effect on earning carbon credits.

i) When the means of Earning Carbon Credits at different levels of Stakeholders’ Awareness was compared, it was seen that there was no significant difference in the mean. Hence the different Stakeholders’ Awareness levels were not a factor that impacted Earning Carbon Credits.

j) The means of Earning Carbon Credits at different levels of Government Support was compared using the Kruskal Wallis H test. It revealed that there is a significant difference among them. The mean ranks are significantly high for a high level of government support followed by moderate and low support. The pairwise comparison shows that there is a significant difference between low and moderate government support as well as low and high government support. Hence it can be inferred that government support is crucial for earning more carbon credits and decreasing our dependence on fossil fuels thereby reducing global warming.

6.6.5 Accounting and Disclosure Compliance by CDM Projects

The accounting and disclosure of CDM project-related transactions gain importance in the backdrop of the non-existence of Accounting Standards for the same. There is only a guideline issued by the Accounting Standard Board of the Institute of Indian Chartered Accountants of India in 2012. If a company reports its carbon credit transactions, external stakeholders like the government, the public, and consumers, and internal stakeholders like employees, and suppliers can make informed decisions. Out of the 113 samples taken for the study, only 98 projects were successful in selling CERs. Hence 98 companies were taken to study the accounting and disclosure compliance. 57 of the projects were by Private Companies, 26 by Public Companies and 15 were by HUFs. Dichotomous questions were asked and the following findings were arrived at to understand the level of compliance with the guidance.

a) Accounting of self-generated CERs should be shown under AS 2 Inventories as they are held for sale as soon as it is issued by the UNFCCC. It was seen that only 21% (12) of the Private Companies had disclosed the number of CERs held as inventory in their financial statements. It was revealed by the project participants that their owners insisted on showing it as inventory to get an idea of how many CERs they had in stock. Others like the Public Companies or HUFs did not show it in inventory or anywhere in the financial statements. This is a violation of the guidelines

b) The accounting guideline states that income generated from the sale of CER should be done as per AS 9 Revenue Recognition. 100% of the companies whether Public, Private, or HUF, complied with this guideline. Hence, it can be inferred that though they do not show the CERs in inventory, it is recognized only when they are sold by them.

c) The expenditure incurred for research and development for the creation of any intangible assets in the company should be accounted as per AS 26, Intangible Assets. It was found that only 11% (6) of the private companies had intangible assets to show as per AS 26. It can be inferred that not much research was done in the clean technology area in India. Most of the technology used was existing in India or abroad.

d) 100% compliance was found for accounting of all tangible assets used for CER generation by the companies as per AS 10 Fixed Assets.

e) The disclosure norms say that CERs issued by UNFCCC should be disclosed under the head Inventories and it should be shown separately from Raw materials, Work-in-Progress, and Finished Goods. They are also supposed to show the number of CERs held and how the value of CERs has been derived. However as per the sample taken only 21% (12)of private companies had disclosed the CERs as inventories and only 19% (11)of the private companies had disclosed it separately from Raw Materials, Work-in-Progress, and Finished Goods and shown the number of CERs held by them as well as the method of valuation of CERs. Also, such CDM projects are supposed to show the CERs under certification. In that case, also, the same, 19% of private companies or 11% of total sample companies have shown the CERs under certification.

f) As per the disclosure guidelines, the companies have to disclose the depreciation and operating maintenance costs of Emission Reduction Equipment expensed during the year separately in the financial statements. 85% (22) of Public Companies, 51% (29) of Private Companies, and 100% (15) of HUFs have disclosed the depreciation and operating maintenance costs of Emission Reduction Equipment separately in their financial statements.

From the above findings, it can be inferred that the Public Companies are lagging behind the Private Companies in confirming to the accounting guidelines. The majority of the companies also do not disclose the number of CERs under certification, or in their hand and their realisable value. Only some of the Private Companies and HUFs have accounted for or disclosed partially as per the guidelines issued by ICAI.

6.6.6 *Sustainable Development Outcomes of CDM Projects.*

One of the primary goals of the Kyoto Protocol is the sustainable development of the locality where the CDM project is implemented. The frequency table and descriptive statistics derived from the data reveal that there has been a positive effect on Economic Benefits, Technological Benefits, Social Benefits, and Environmental Benefits due to the implementation of CDM projects, earning carbon credits from it, and the company spending on the general development activities in the locality.

a) From the economic point of view, the profits from carbon credits and benefits from international collaboration have not been as expected. In the case of the introduction of green technology, there was a good improvement due to CDM Projects but there was not much technology transfer from foreign participants either in the form of knowledge or equipment. There were very few research and development outcomes due to the implementation of these projects. It means that the existing technology that was already available in the country whether imported/assembled or manufactured in India was used. The positive effect was that the use of green technology was given a boost due to the CDM.

b) From the social benefits perspective, it was seen that there has been Community Development and Community Empowerment due to the implementation of CDM projects and earning carbon credits. The environmental benefits have been largely on the expected lines of improvement in the air, soil, water quality, waste management, and improving environment diversity. At the same time, there was not much direct impact on the health of people living in the area.

c) Analysis of Sustainable Development Outcomes and States showed that there is no significant difference in the Economic Benefits and Technological benefits concerning states where the projects are situated. However, there is a significant difference in Social Benefits and Environmental Benefits based on States. It was discovered that there is a significant difference in Social Benefits between Tamil Nadu and Karnataka states, and there is a significant difference in Environmental Benefits between Gujarath and Tamil Nadu.

d) Economic Benefits, Technological Benefits, and Environmental Benefits are significantly different based on the Type of Company. Further analysis shows that Economic Benefit is significantly higher for HUF when compared to Public Company, Technological Benefits is significantly higher for HUF compared to both Public and Private Company, and Environmental Benefits is significantly higher for Private Company and HUF compared to Public Company. Whereas Social benefits do not significantly differ based on the type of company.

e) Technological Benefits and Environmental Benefits are significantly different for projects using different sources of energy for emission reduction. Further analysis revealed that Technological Benefits were more for Solar Power than Biomass. Biomass technology already existed in the country hence there was no need to import technology. In the case of solar power, the latest technology for solar cell cleaning was imported, and also in some cases, the solar cells were imported. It was also found that the Environmental Benefits were more for Wind Power and Hydro Power compared to Natural Gas. Natural Gas is a fossil fuel and hence it has to be mined from underground making it less sustainable than Wind and Hydro. But if Natural Gas is produced along with petroleum, it is better to use it as a source of energy than releasing it into the atmosphere or burning it.

f) The Economic Benefits were found to be significantly different based on the Period of Registration. The Economic Benefit received by the projects registered after 2013 was high compared to those registered before that. The reason is the slight increase in the price of carbon credits in the market, increased international collaboration, increased profits from CDM, and increased goodwill of the companies in the second phase of the Kyoto Protocol.

g) The influence of CDM Project Development on Sustainable Outcomes was checked using correlation analysis. CDM Project Development has a positive non-significant correlation with Economic Benefits and Social Benefits. On the other hand, it has a high negative correlation with Technological Benefits. A literature survey shows that, as more projects of a particular type are implemented in a host country, the rate of technology transfer declines demonstrating the effect of indigenous development technology in the country.(Seres, Haites, & Murphy, 2009). When the correlation between CDM Project Development and Environmental Benefits is studied, there is a negative correlation which is not significant. So it shows that CDM Project Development has not improved the Environmental health of the locality but on the contrary, there is a negative effect on the Environment. Jaraitė, Kurtyka, & Ollivie, (2022) in their article 'Take a ride on the (not so) green side: How do CDM projects affect Indian manufacturing firms' environmental performance?' say that Brazil which is the third largest host country after China and India, have a negative correlation between CDM Projects and Environmental Benefits.

h) The influence of Earning Carbon Credits on Sustainable Outcomes was checked using correlation and regression analysis. Earning Carbon Credits has a high positive and significant correlation with Sustainable Goals like Economic Benefits, Social Benefits, and Environmental Benefits. There is a positive correlation with Technological Benefits but it is not significant. Further regression analysis disclosed that for every increase in Earning Carbon Credits, there is a .15 increase in Economic Benefits, $0.7692308E^{-02}$ increase in Social Benefits, and $5.882353E^{-02}$ increase in Environmental benefits. Hence it is proved that earning more carbon credits will have a huge positive impact on achieving sustainability goals.

6.7 Contributions of the Study

The assessment of Clean Development Mechanism Projects in the Energy Sector contributes to the understanding and improvement of efforts taken by the governments to mitigate climate change. An exhaustive search of the literature reveals that there is no study connected to the difficulties faced by proponents of CDM projects in developing the projects neither in India nor in any other nation. This report is a pioneering study on the CDM projects in the energy sector in India. It helps in understanding the project developer's perspective on the facilities available and challenges faced in CDM project development in India. Some of the problems impeding successful execution of projects under CDM are the lack of stakeholders' awareness, regulatory issues, changing market scenarios. It is also revealed that in India the Government support has been a very significant factor in overcoming these difficulties for CDM Project Development and Earning Carbon Credits.

At the same time accounting and disclosure of transactions involving carbon credits and assets used for CDM Projects by the energy companies show that there is very little compliance to the guidelines issued by ICAI in 2012. Thus the study contributes to the understanding that there is a need for further research on the problems encountered by the project participants while recording and disclosing the transactions relating to CERs under certification and in hand. There are various types of carbon credits earned by companies other than CERs like Verified Carbon Units (VCUs), Renewable Energy Certificates (REC), Gold Standard CERs, etc., which are evolving. Hence it is imperative that the various factors that are involved in earning these different types of carbon credits have to be taken into account by chartered accountants, and ICAI while designing and setting fixed standards for accounting and disclosing them. Hence, this study gives an overview of how energy industries are engaged in the carbon mitigation process in India. It is an inspiration to energy industries in other countries to switch from fossil fuel to renewable energy and help sustain the environment. It will also give an impetus to the foreign collaborators to choose Indian businesses that are carbon-neutral for furthering their zero-carbon business policies.

6.8 Implications of the Study

The study on Clean Development Mechanisms, issues, and challenges in Energy Sectors, has several important implications. Here are some key implications that can arise from such a study:

a) Policy implications: The study will have policy implications as it gives an insight into the specific challenges and barriers faced in implementing the CDM. This information can help policymakers design and implement more effective policies and regulations to address these challenges leading to improvements in the future emission reduction policies of government, making it more efficient, transparent, and accessible for project developers.

b) Operational implications: The study can have operational implications for project developers and participants in the emission reduction drive of government of India. The identification of common challenges faced, can help developers anticipate and address these issues during emission reduction project planning and implementation. This can lead to more successful project outcomes, reduced risks, and enhanced project management practices.

c) Financial implications: This study sheds light on financial challenges associated with the CDM, such as the high transaction costs, limited access to financing, and uncertainties in revenue streams. These insights can inform financial institutions, investors, and project developers about the financial risks and opportunities associated with such emission reduction projects. It can lead to the development of innovative financial mechanisms and instruments to address these challenges and mobilize more private-sector investments.

d) Technological implications: This study highlights technological challenges and opportunities related to the CDM. It identifies areas where technological advancements are needed to enhance the effectiveness and efficiency of CDM projects. This can drive research and development efforts in clean technologies, encouraging the deployment of innovative solutions for emission reduction and sustainable development.

e) Capacity-building implications: The study also highlights capacity-building needs for countries and institutions involved in the CDM. It identifies gaps in knowledge, skills, and resources that hinder effective participation in the CDM. This can lead to targeted capacity-building initiatives to strengthen the capabilities of developing countries and project developers in project identification, development, monitoring, and verification.

f) International cooperation implications: This study promotes international cooperation and collaboration in addressing CDM challenges. It creates opportunities for knowledge sharing, learning from best practices, and joint problem-solving among countries and stakeholders. This cooperation can lead to the development of shared strategies, common standards, and harmonized approaches to overcome CDM challenges at a global scale.

In summary, the study on CDM issues and challenges can have implications for policy, operations, finance, technology, capacity-building, and international cooperation. These implications can drive improvements in the CDM framework, enhance project outcomes, mobilize investments, foster technological advancements, build capacity, and strengthen global collaboration in climate change mitigation efforts

6.9 Conclusions

Drawing upon the previously mentioned findings, the study has reached significant conclusions. Around 69% of all CDM projects are concentrated in the northern states of Gujarat, Rajasthan, and Maharashtra, as well as the southern states of Tamil Nadu, Andhra Pradesh, and Karnataka. In India, 79% of the CDM projects belong to the energy industry sector. The stakeholders exhibit a low level of awareness regarding the Kyoto Protocol, the Clean Development Mechanism (CDM), and the rationale behind the implementation of such projects. The analysis makes it clear that government support is crucial to developing CDM projects to achieve sustainable goals. Private companies demonstrated greater ease in establishing Clean Development Mechanism (CDM) projects, which contrasted the usual expectation where public companies are typically assumed to have an advantage.

The withdrawal of incentives and tax holidays for the CDM project was a blow to the viability of the projects for many small companies who had entered into the energy business due to the Clean Development Mechanism. The Public Companies are lagging behind the Private Companies in confirming the accounting standard guidelines given by the ICAI. The lack of proper Accounting Standards is a major hurdle in following accounting and disclosure norms for all types of companies. Some Private Companies and HUFs have adhered to partial disclosure of CER in hand and sale.

CDM projects have been found to positively impact economic growth, social upliftment, and environmental protection in the localities where they are situated. Though technology transfer and funding from developed countries were expected as per the Kyoto Protocol, there was very little evidence of technological benefit to Indian firms. Thus, the study establishes that though there were various issues in CDM project development in India, the Indian entrepreneurs took advantage of the opportunity right from the beginning. India actively joined the other countries in the fight against climate change and at the same time, benefited from it. With a little more backing from the central government, there can be a huge surge in clean projects if not under CDM than any other scheme devised by the central government to achieve carbon neutrality by 2070.

Chapter 7
Recommendations

The following recommendations are suggested based on the analysis, and findings as per the sixth chapter.

7.1 Recommendations

- There is an immediate requirement to enhance awareness regarding the adoption of clean technology. Educating the general public about their entitlement to demand carbon-neutral products is crucial. This knowledge should be incorporated into the consumer movement. Currently, the consumer movement primarily focuses on product safety and quality, pricing and fair trade, consumer education and awareness, consumer protection laws and regulations, consumer redress and dispute resolution, and food and product labeling, among other things. However, there should be a concerted effort towards sustainable and ethical consumption highlighting the technology utilized in the production of consumer goods.

- It is revealed that many of the project developers themselves had very little knowledge about CDM projects initially and were advised by their chartered accountants to invest in CDM projects to reduce tax. It is suggested that there should be increased efforts by government agencies and the Confederation of Indian Industry (CII), to educate entrepreneurs on carbon-neutral production and thereby produce carbon-neutral products. It will increase their brand value and make their products more attractive in the international markets as well, as the expectations of consumers are shifting fast towards a new global energy economy.

- According to the study, it was observed that there was a lack of awareness among local bodies regarding the significance of Clean Development Mechanism (CDM) Projects, despite entrepreneurs making efforts to invest in them. To address this issue, the company had to arrange meetings with the local bodies to educate them about the societal benefits associated with such projects. It is imperative to ensure that various offices of the central government, state government, and local bodies are well-informed about the evolving policies of international organizations that pertain to mechanisms for meeting India's environmental compliance requirements. This knowledge will enable them to effectively align with the environmental commitments and obligations India has undertaken as a party to these international agreements. Therefore, if there is effective dissemination of information from the central government to the state and local bodies, the process of obtaining various approvals could have been smoother.

- The analysis and findings show that there is a tremendously positive effect of Government Support on the various activities of CDM like the formation of the project, its implementation, stages of earning carbon credits, compliance of accounting and disclosure of CDM transactions, and sustainability outcomes. Hence the governments both at the Centre and the States have a very important role to play in making Vision 2070 happen. The companies should be encouraged to invest back a part of the profits from carbon credits in improving the diversity of the environment, upliftment of the locality, and empowerment of the weak.

- The government and other NGOs have the responsibility to educate the masses about the policy decisions taken by the government relating to emission reduction and the targets for achieving them. This will make the general public more aware of their right and will bring about proper checks and balances in the economy. Only when there is accountability to the masses, the policy decisions can be implemented in its true sense.

- The study discovered an interesting trend where private companies demonstrated greater ease in establishing Clean Development Mechanism (CDM) projects, which contrasted the usual expectation where public companies are typically assumed to have an advantage in this regard. Therefore, it is imperative for the government to actively investigate the reasons why public companies encounter difficulties in navigating the various procedures involved in establishing CDM projects. Special attention should be given to providing additional training to public sector companies on CDM projects, and it is recommended to establish dedicated cells within each company specifically focused on CDM projects. This will enable these companies to develop expertise in the procedures related to CDM projects.

- The withdrawal of tax holidays and other incentives by the central and state governments is identified as one of the significant obstacles to the generation of carbon credits. To attain carbon neutrality, it is crucial to reinstate tax holidays and other incentives that can stimulate investments in clean technology. The survey findings indicated that approximately 37% of the participants had invested in renewable energy projects primarily due to the early-stage tax benefits and additional profits from carbon credits.

- This study has contributed to the understanding that the level of compliance among Indian corporates, especially regarding the disclosure of CERs under certification, or in inventory, and its valuation is very low. The quality of carbon credits can be enhanced and a liquid market created for carbon credits in India, only by having standardized transactions and data transparency. For that accounting and disclosure standards have to be set by ICAI and strictly adhered to.

- The clean technology concept should not be limited to specific industrial sectors like the energy sector, but the emphasis should be to expand to other sectors like the consumer goods industry. With the backing of the government, the private sector should be encouraged to do research in the area leading to the innovation of clean technologies in all sectors. The global market for mass-manufactured clean technologies will increase as major economies are targeting net zero emissions by 2050.

- There should be concerted efforts on the part of the government and industrial undertakings to encourage financial institutions to invest more in clean technology companies. Carbon emission reduction should be a benchmark for the financial support provided by banks and other financial institutions.

- At present carbon tax is charged only on coal produced and imported in India, which can be extended to other industries that pollute the environment like fossil fuel energy industries, automotive industry, consumer goods industry, etc. This will encourage a total shift in technology to reduce emissions in all sectors.

7.2 Limitations of the Study

1. The awareness of stakeholders is studied from the point of view of the project participants taking into consideration the problems faced by them when interacting with each of the stakeholders during the formation, implementation, and monitoring of CDM Projects.

2. As this is a novel study on the different dimensions of CDM projects like Earning Carbon Credit, Disclosure and Accounting of Carbon Credits, and Sustainable Development Outcomes achieved, it may not be free from the limitations of a maiden study.

3. The 2030 agenda for sustainable development, adopted by all UN members in 2015 includes 17 Sustainable Development Goals. But in this study, only the four sustainable outcomes of CDM Projects as envisaged by the Kyoto Protocol and Ministry of Environment, Forest and Climate Change of India, are taken viz economic, technological, social, and environmental benefits.

7.3 **Scope for Further Research**

The following areas are suggested for more research based on the findings of the current study:

Since the study is based on the opinions and experiences of the project participants, there is ample scope for conducting the research with respect to the views of government agencies and the local community. As this study is based on Energy Sector projects which are situated in six states, there is plenty of room for doing research regarding the perspectives of stakeholders on the Manufacturing industry, the Energy Demand Sector, etc. Further research may also be carried out related to the specific problems of Carbon Credit Accounting based on a comprehensive analysis of the Financial Statements of CDM Projects.

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APPENDIX

Interview Schedule

An Assessment of Clean Development Mechanism Projects in theEnergy Sector in India

Dear respondent,

This interview schedule is designed for research on various factors enabling and issues facedin Project formulation and implementation of Clean Development Mechanisms by Indian Companies. Your answers will be an invaluable contribution to the research effort and the feedback provided will be used for academic purposes alone.

1. Name of the Company

   ____

2. Name of the CDM Project

   ____

3. Tick the State where the project is situated.
   a) Andhra Pradesh
   b) Gujarat
   c) Karnataka
   d) Maharashtra
   e) Rajasthan
   f) Tamil Nadu
4. Please tick the activity scale of the project
   a) Large-scale
   b) Small-scale
5. Type of Entity which owns the CDM project. (Tick anyone)
   a) Public Sector
   b) Private Sector
   c) HUF
   d) Others
6. Source of Renewable Energy used in Project: - (tick one if applicable)
   a) Biomass
   b) Solar
   c) Wind
   d) Natural Gas
   e) Hydro Power

f) Waste Heat

g) Thermal Oxidation

h) Waste Hydrogen gas

i) Others- specify__________

7. Period of Registration of the CDM Project

a) 2000-2012

b) 2013-2020

8. Do you think the project could have been viable and implemented withoutthe Clean Development Mechanism?

a) Yes

b) No

9. In what intervals were the verification and certification conducted for theproject?

a) Annually

b) Bi-annually

c) Once in two years

d) As and when necessary

10. Were you able to sell any CERs?

a) Yes

b) No

A. Stakeholders' Awareness

11. Level of awareness among the stakeholders about the benefits of CDM Projects to the society and environment, understanding the required process for the development of CDM projects.

(5-Extremely Aware, 4 – Moderately Aware, 3-Somewhat Aware, 2-Slightly Aware, 1-Not at all Aware)

Sl. No.	Statements	EA (5)	MA (4)	SWA (3)	SA (2)	NA (1)
1.	There was awareness about the CDM Projects among the Project Participants.					
2.	State Government entities were aware of the prerequisites for CDM project development and its benefits.					
3	Central Government entities were aware of the prerequisites for CDM project development and its benefits.					

Sl. No.	Statements	EA (5)	MA (4)	SWA (3)	SA (2)	NA (1)
4	The Local Communities were aware ofthe benefits of the CDM Project to the society and environment.					

B. Government Support

12. Level of support from the Government for CDM Projects

(5-Strongly agree, 4 - Agree, 3-Neutral, 2-Disagree, 1-Strongly disagree)

Sl. No.	Statements	SA (5)	A (4)	N (3)	D (2)	SD (1)
1	Strong economic incentives were provided by Central Government for the production of renewable energy/ reducing energy consumption.					
2	High Coordination between State Governments in Policymaking.					
4	The Central Government Policy Initiatives have helped the formulation of the project.					
5	Special Economic Packages were declared by State Government for CDM Projects					

C. CDM Project Development

13. Experiences during the Project Development Stage

(5-Strongly agree, 4 - Agree, 3-Neutral, 2-Disagree, 1-Strongly disagree)

Sl. No.	Statements	SA (5)	A (4)	N (3)	D (2)	SD (1)
1	Easy availability of Initial Capital					
2	PDD was prepared within a reasonable amount of time					
3	Registration of the project with the NCDMA was easy					
4	There was considerable support fromthe existing staff of the company for the CDM Project					

Sl. No.	Statements	SA (5)	A (4)	N (3)	D (2)	SD (1)
5	There was considerable support fromthe people residing in the project vicinity for the CDM Project.					
6	Sufficient infrastructure was available at the proposed project site					
7	Coordination with the state and central agencies was easy in getting approval for the project					
8	Local skilled labour was available toset up the CDM Project					
9	No opposition from the existing staff and employees when new technology was introduced (eg:-for retrofitting of the existing plant)					
10	Strong support of banks and other financial institutions for the CDM Project					
11	Install Installation of the machinery/new technology was done without any problems					
12	The CDM Project was commissioned on time					
13	Cost of the CDM Project did notexceed the estimated cost.					
14	Monitoring of operations was done without any problem.					

D. Earning Carbon Credits

14. Full capacity could be utilized to generate carbon credits as budgeted in PDD. (5-Strongly agree, 4 - Agree, 3-Neutral, 2-Disagree, 1-Strongly disagree)

Sl. No.	Statements	SA (5)	A (4)	N (3)	D (2)	SD (1)
1	Favourable weather conditions for renewable energy generation existed throughout the year					
2	The actual revenue expense to run the plant was approximately the budgeted amount					

Sl. No.	Statements	SA (5)	A (4)	N (3)	D (2)	SD (1)
3	Trained and skilled employees for regular operation and maintenance of the plant					
4	A Long period for shutdown maintenance was not required on regular basis.					
5	There was no breakdown of equipment					
6	There were cordial relationships between the employer and the employee					
7	Measuring and recording renewableenergy generated/energy saved is easy					
8	Procedures for verification of emission reductions are easy					
9	Procedures for certification of emission reductions are easy					
10	Tax holiday and other incentives from the government was helpful.					
11	The price of Carbon Credits in the international market is stable					
12	There was a demand for Carbon Credits in the international market					
13	Carbon Credits are issued by the CDM Executive Board promptly.					

E. Compliance with ICAI Guidelines for Accounting & Disclosureof Self-generated CERs

15. Please answer the following statements relating to CDM Project and CER expenses and sale as per the accounting and disclosure norms followed byyour company

Sl. No.	Statements	YES	NO
1	Accounting of CERs generated in the project is done as per AS 2 Valuation of Inventories		
2	Income from the sale of CRE is recognized in accordance with the Accounting Standard (AS) 9 Revenue Recognition		
3	Accounting of Intangible assets created during R & D		

Sl. No.	Statements	YES	NO
	for generation of CER was done as per AS 2 Valuation of Inventories		
4	Accounting of all tangible assets created for the generation of CER was done as per AS 10 Fixed Assets		
5	CER certified by UNFCCC is disclosed under the head inventories and shown separately from Raw materials, Work–in–progress, and finished products.		
6	The company has disclosed the 'Number of CER held as inventory and basis of valuation' in the financial statements		
7	The company has disclosed the 'Depreciation and operating maintenance costs of Emission Reduction Equipment expensed during the year' in the financial statements		

F. Sustainable Development Outcomes of CDM Projects

16. Economic Benefits

(5-Strongly agree, 4-Agree, 3-Neutral, 2-Disagree, 1-Strongly disagree)

Sl. No.	Statements	SA (5)	A (4)	N (3)	D (2)	SD (1)
1	The generation of carbon credit from the CDM Project has increased the profits of the company.					
2	The return on the CDM Project was more than expected.					
3	The Company could generate employment through the project					
4	The goodwill of the company hasimproved					
5	It has increased the prospects of collaboration with foreign countries and opened the door to other new opportunities					

17. Technological Benefits

(5-Strongly agree, 4-Agree, 3-Neutral, 2-Disagree, 1-Strongly disagree)

Sl. No.	Statements	SA (5)	A (4)	N (3)	D (2)	SD (1)
1	Introduced new technology for renewable energy generation / efficient distribution / efficient use of energy / efficient reduction of emission.					
2	Technology for CDM project was transferred from foreign participants					
3	Technology transfer involves the import of equipment.					
4	Technology transfer involves import of knowledge.					
5	New technology requirements pushed the company to invest in research and development.					

18. Social Benefits

(5-Strongly agree, 4-Agree, 3-Neutral, 2-Disagree, 1-Strongly disagree)

Sl. No.	Statements	SA (5)	A (4)	N (3)	D (2)	SD (1)
1	Engagement of local population with the company increased					
2	Social Benefits like improvement ineducational resources					
3	Increased the basic amenities in the area					
4	Contributed to the social upliftment of weaker sections through the empowerment of women, care of children, and the old.					
5	Workshops and training for skilldevelopment					
6	Positive impact on quality of life of local community					

19. Environmental Benefits

(5-Strongly agree, 4-Agree, 3-Neutral, 2-Disagree, 1-Strongly disagree)

Sl. No.	Statements	SA (5)	A (4)	N (3)	D (2)	SD (1)
1	Reducegreenhouse gas emissions, improved air, soil, water quality					
2	Waste Management measures taken					
3	Environment Diversity is protected					
4	The health of people around the project has improved					
5	Reducegreenhouse gas emissions, improved air, soil, water quality					

20. State your suggestion to improve the functioning of CDM Projects in India?

____

____

____

____

Thank You