CHAPTER III

RESEARCH METHODOLOGY
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3.1 INTRODUCTION TO THE CHAPTER

The Clean Development Mechanism (CDM) under the Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC) enables industrialized countries to meet a part of their emission reduction requirements through purchase of emission reduction credits from projects in developing countries. Global warming is one of the most difficult challenges facing the world today and Kyoto Protocol and the market based trading mechanism (CDM) that it created, have been one of the most substantial ways to address the problem. Efforts to curb global warming will require motivating the necessary expenditures and policies to achieve a stable climate which are both environmentally sound and cost-effective. Recognizing these facts this research focuses on “financial feasibility of Clean Development Mechanism (CDM) projects in India”.

Chapter I outlined the underlying concepts and global mechanism facilitating CDM and Chapter II has discussed the various literature available on the subject which comprehensively covers the research done on the topic. Based on these, this chapter charts out the methodology adopted for the research work. The chapter begins with identifying research questions that need to be addressed for CDM to be a sustainable solution for adopting a strategy that is pro-development as well as pro-environment. Subsequently problem statement, objectives and hypotheses are defined. The researcher then goes on to lay down the methodology facilitating the conduct of the research in terms of design framework, sampling plan, sources of data, testing of the instrument and research model. The chapter concludes with the stating the limitations within which the researcher has to work to achieve the researcher objectives.
3.2 Need for the Study

The Clean Development Mechanism (CDM) under the Kyoto Protocol to the UN framework Convention on Climate Change (UNFCCC) enables industrialized countries to meet a part of their emission reduction requirements through purchase of emission reduction credits from projects in developing countries. Various studies have concluded that India is likely to be one of the major countries supplying such projects. However, in order that a large number of high-quality CDM projects is developed and result in Certified Emission Reductions as specified by the international CDM Executive Board, the institutional set up in the Indian finance sector has to be suitably geared up. So far, banks and financial institutions have not developed set procedures for efficient financing of CDM projects. A necessary condition for an in-depth involvement of the financial sector is the development of transparent and effective approval rules by regulators both on the central and state level as well as improved project development capacity of the private sector. The conventional and novel financing instruments such as project finance for large projects, Special Purpose Vehicles, CDM funds or CDM bonds could become attractive to banks. Such a set up helps in reducing the permit credit risks and political risks considerably.

The proposed study is to analyze the current status of the CDM stakeholders in India, assesses risk perspectives of CDM projects and provides suggestions for approaches these stakeholders may adopt in order that projects from Indian promoters are able to capture a sizeable share of emerging competitive CDM market.
3.3 Statement of the Problem and its description

The statement of the research problem is –

“A study of the financial feasibility of select Clean Development Mechanism (CDM) projects in India.”

Definitions of key concepts used to study the problem through this research work have been extensively discussed in the first chapter of this thesis. As detailed, the study focuses on financial feasibility of selected CDM projects in India. Based on the chapter discussion financial feasibility is simplistically understood to know whether a project is viable after taking into consideration its total costs and revenues. CDM projects have been identified to conduct a financial feasibility analysis using the IRR technique, particulars of which appear in Chapter IV. A primary data analysis on specific parameters further enables a descriptive analysis of the research problem.

3.4 Objectives of the Research

Based on the research problem and extensive literature review the study progressed with the following research objectives –

1. To study the global perspective and Indian scenario of the CDM projects along with the current regulatory authority and the government policies.
2. Examining the current financial scenario of the CDM projects and the specific schemes implemented by banks/external agencies for financing the projects and the challenges faced.
3. Analyzing the profitability of select projects using suitable tools of financial analysis.
4. Improvisation in the current system and challenges in the future.
3.5 Hypotheses

Hypotheses are understood as a tentative solution to a problem. In simplest of words, it is a general idea of the researcher that this may be perhaps the answer to a problem. In the words of Van Dalen, (1956) “A hypotheses serves as a powerful beacon that lights the way for the research worker.” So, we can analyze the meaning of Hypotheses as a tool of research which tells the researcher what he has to do, how he has to do and what kind of results be expected thereon, in context of the problem.

The following hypotheses form the foundation of this research -

1. Inadequate financing and delays in financing are the biggest bottlenecks for implementation of CDM projects.
2. Implementation of CDM project does not lead to losses.
3. The banks are reluctant in financing the CDM projects because of lack of technical knowledge.

3.6 Research Methodology

When starting a research study it is of paramount importance to define the methodology, strategies and its parameters. The methodology guides all other work related to the research, like collection of data, analysis of data, reporting the findings and drawing conclusions. The reliability of findings and validity of the study depends upon how robust and rigorous the applied methodology is and hence, research methodology takes a prominent place in a research project.

In this research the primary reason for deciding on the research methodology is so that the researcher could map out the way to conduct research. Once the researcher selected research questions to find answers, he was able to decide in what manner he must find the solutions and what devices and methods to be used. The clearly ordered list explaining the way the researcher plans to use collection of methods and tools is the research methodology for this research work.
The following sections discuss the research methodology adopted in this research work, in detail.

**Research Design**

The research problem is titled as “A study of the financial feasibility of select Clean Development Mechanism (CDM) projects in India”. The research design is as follows -

**STEP 1 – Define the Information Needed**

The research seeks to gather the following information based on the research problem and objectives -

1. Global and Indian perspective of the CDM projects
2. Current regulatory authority and government policies
3. Financial scenario of the CDM projects
4. Challenges faced in financing
5. Profitability of select projects using suitable tools of financial analysis.
6. Challenges and opportunities in the future.

**STEP 2 – Identifying Qualitative Approach**

A research adopts a qualitative or a quantitative approach depending on the research focus as described in the following figure. In simple words, if the researcher is seeking to prove or disprove a theory or is trying to generalize findings to a population then the research approach will be a deductive approach that is a quantitative approach. Alternatively if the researcher is hoping to elicit some understandings on what people think or feel about an issue or is the topic an area that there is little information and one must undertake an initial, exploratory study then the approach will be induction that is a qualitative approach. For this research, a qualitative approach is being finalized.
The process can be described in the following diagram –

![Diagram showing qualitative approach to research design](Fig 3.1 - Qualitative approach to research design)

**STEP 3 – Choosing Exploratory/Descriptive/Experimental Research Design**

This research has utilised Descriptive Research Design. A descriptive design describes data and characteristics about the population or phenomenon being studied. It answers the questions who, what, where, when, why and how.
The descriptive methods used for data collection is as follows –

![Diagram showing descriptive methods]

**Fig 3.2 - Descriptive method in data collection**

**STEP 4 – Construct a Questionnaire**

In order to construct the questionnaire we need to identify dependent and independent variables. Variables used in this research are shown in the following figure.
Fig 3.3 - Dependent and independent variables

Based on the variable description the research questionnaire measured the following variables -

1. Total Number of Respondent Organizations
2. Total Number of Respondent Projects
3. Abnormal delays in project cycle
4. Primary reason (s) for abnormal delay
5. Role of majority respondents
6. CDM projects have been financed/implemented/consultancy rendered by your organization
7. Dedicated team working on CDM related projects
8. Organization support the following activities related to CDM
9. Challenges in CDM
10. Organization’s resource support to CDM activities
11. Organization taken/provided external support from/to others for CDM related activities
12. Significant barriers in CDM projects in India
13. Major/minor barriers for financial institutions’
14. Organization’s perspective on CDM projects
15. Pace of CDM projects in India is adequate

The Questionnaire is given in Annexure II.

**STEP 5 – Sampling Process**

*For the financial analysis of select CDM process (Secondary Data)*

As a part of the research, the researcher has conducted financial analysis of some selected registered CDM projects with an intention of studying the financial feasibility of the projects. The analysis was done based on the secondary data available on the site-[http://cdm.unfccc.int/index.html](http://cdm.unfccc.int/index.html). As of March 2012 about 832 projects were registered in India, of this the wind-mill and the biomass projects were about 356. For analysis, about 20 projects were selected from the windmill sector and bio mass sector, for an in-depth analysis. The list of the projects studied is as follows:
<table>
<thead>
<tr>
<th>#</th>
<th>Project No.</th>
<th>Type</th>
<th>Name of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0796</td>
<td>Wind power</td>
<td>12MW Bundled Wind Power Project in Tenkasi, Tamilnadu</td>
</tr>
<tr>
<td>2</td>
<td>2770</td>
<td>Wind power</td>
<td>1.5 MW Grid connected Wind Electricity Generation at Tirunelveli District, Tamilnadu, India by Kallam Agro Products and Oils Private Limited</td>
</tr>
<tr>
<td>3</td>
<td>3642</td>
<td>Wind power</td>
<td>Wind Power based electricity generation project in India by DLF Home Developers Limited</td>
</tr>
<tr>
<td>4</td>
<td>3700</td>
<td>Wind power</td>
<td>13.75 MW wind power project in Davangere, Karnataka,</td>
</tr>
<tr>
<td>5</td>
<td>3710</td>
<td>Wind power</td>
<td>6 MW Wind Power Project in Tamil Nadu by REI Agro Limited</td>
</tr>
<tr>
<td>6</td>
<td>3920</td>
<td>Wind power</td>
<td>1.25 MW Wind Power Project at Rajasthan, India</td>
</tr>
<tr>
<td>7</td>
<td>3940</td>
<td>Wind power</td>
<td>1.2 MW wind power project of Matrix Clothing at Gujarat,</td>
</tr>
<tr>
<td>8</td>
<td>3977</td>
<td>Wind power</td>
<td>1.2 MW Wind Power Project in Maharashtra</td>
</tr>
<tr>
<td>9</td>
<td>3981</td>
<td>Wind power</td>
<td>1.5 MW Grid connected Wind Electricity Generation at Tirunelveli District, Tamil Nadu,</td>
</tr>
<tr>
<td>10</td>
<td>3996</td>
<td>Wind power</td>
<td>22.5 MW Wind Power Project by Ruchi Soya Industries Limited at Palsodi, District-Ratlam, Madhya Pradesh</td>
</tr>
<tr>
<td>11</td>
<td>4026</td>
<td>Wind power</td>
<td>30 MW wind power project at Surajbari, Gujarat</td>
</tr>
<tr>
<td>12</td>
<td>4197</td>
<td>Wind power</td>
<td>Bundled Wind Power Project in Maharashtra</td>
</tr>
<tr>
<td>13</td>
<td>4209</td>
<td>Wind power</td>
<td>Grid connected wind energy project in Tamil Nadu by Simran Wind Project Private Ltd.</td>
</tr>
<tr>
<td>14</td>
<td>1110</td>
<td>Biomass</td>
<td>10 MW biomass based renewable energy generation for the grid in Parbhani District of Maharashtra</td>
</tr>
<tr>
<td>15</td>
<td>1239</td>
<td>Biomass</td>
<td>1.25 MW biomass based captive power plant by UP Asbestos Limited at Lucknow</td>
</tr>
<tr>
<td>16</td>
<td>1541</td>
<td>Biomass</td>
<td>10 MW Biomass Based Renewable Energy Generation for the Grid at Saradambika Power Plant Private Limited at Chandrapur District, Maharashtra</td>
</tr>
<tr>
<td>17</td>
<td>3148</td>
<td>Biomass</td>
<td>Shree Nakoda Ispat Ltd 12 MW Biomass power generation project</td>
</tr>
<tr>
<td>18</td>
<td>3441</td>
<td>Biomass</td>
<td>Biomass power project by Sri Jyoti Renewable Energy Pvt Ltd</td>
</tr>
<tr>
<td>19</td>
<td>4078</td>
<td>Biomass</td>
<td>Biomass based power generation project in Maharashtra</td>
</tr>
<tr>
<td>20</td>
<td>3232</td>
<td>Biomass</td>
<td>Biomass based power project in Punjab, India</td>
</tr>
</tbody>
</table>
For the questionnaire (Primary Data)

Since the topic is technical one and also requires a good amount of expertise in the related area; the researcher chose to have a non probability judgmental sampling technique.

To solicit response for the questionnaire, the respondents were chosen from the following areas:

- Owner of the Project
- Parties involved in financing of the CDM Project
- Consultancy Services of CDM Project
- Third Party independent technology verifier

The questionnaire was circulated to about 100 respondents out of which about 65 respondents replied back with proper responses and the same was used for analysis.

STEP 6 – Data Analysis

For the financial analysis of select CDM process (Secondary Data)

The methodology followed was as follows:

- A particular project was selected wherein the details regarding the financial assumptions were available. It may be mentioned that for many projects only the end figures of financial ratios and some broad numbers like turnover and profitability were mentioned and such projects were not considered.
After analysing the projects wherein financial details/assumptions were available, then the project was studied thoroughly to understand the other aspects like the background of the promoters, the details of the project like location, technology used, the foreign participant from the Annex-1 country, the proposed CER benefits accruing because of the project implementation and other factors.

After noting the assumptions stated about the various aspects of profitability, the detailed financial projections of the project with and without CDM revenue was calculated. The Internal rate of return (IRR) for the project in both the scenario was also computed for all the projects and the same was compared with the cost of capital based on the proposed means of financing, in order to study the financial viability of the project.

For the questionnaire (Primary Data)

A detailed description of the process is presented in the following section.

**STEP 1 – PRIMARY DATA FROM QUESTIONNAIRE**

This research used a structured questionnaire which collected data on various parameters based on research objectives and hypothesis. The parameters include the following –

1. Respondent's Profile
2. Abnormal delays in various stages of CDM project cycle
3. Factors causing abnormal delays
4. Availability of in-house skills for CDM related activities
5. Organization support to CDM activities
6. Challenges in CDM related activities
7. Organization’s resource support for CDM
8. Organization taken/provided external support for CDM
9. Barriers in CDM
10. Barriers for financial institutions to support CDM
11. Organization’s perspective on CDM projects
12. Pace of CDM projects in India

Each of the above parameter when appeared in the questionnaire is measured on a specific scale with an expected Research Output. The details of which have been presented in Chapter V as Data analysis and interpretation.

**STEP II – DESCRIPTIVE ANALYSIS OF DATA**

**Descriptive statistics** is the discipline of quantitatively describing the main features of a collection of data.

Descriptive statistics used in this research provide simple summaries about the sample and about the observations that have been made. Such summaries are quantitative, i.e. summary statistics, and visual, i.e. simple-to-understand graphs. These summaries form the basis of the initial description of the data as part of a more extensive statistical analysis where tests have been used to accept or reject hypothesis.

**STEP III – RELIABILITY TESTING**

The questionnaire measuring the above parameters was run through a reliability test using Cronbach’s Alpha test. Cronbach’s $\alpha$ is a measure of the reliability\(^1\) of the research instrument. The coefficient is also called the internal consistency or the internal consistency reliability of the test.

\(^1\) As a general rule, reliability is established by showing a good level of correlation, concordance, or agreement between multiple assessments of the same measurement.
For conceptual purposes, Cronbach's $\alpha$ is defined as

$$\alpha = \frac{N}{N-1} \left(1 - \frac{\sum_{i=1}^{N} \sigma_{Yi}^2}{\sigma_X^2}\right)$$

where $N$ is the number of components (items or testlets), $\sigma_{X}^2$ is the variance of the observed total test scores, and $\sigma_{Yi}^2$ is the variance of component $i$.

Alternatively, the formula for the standardized Cronbach’s alpha is as follows,

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N - 1) \cdot \bar{c}}$$

Here $N$ is equal to the number of items, $c$-bar is the average inter-item covariance among the items and $v$-bar equals the average variance.

Alpha coefficient ranges in value from 0 to 1. The closer Cronbach’s alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. However, the widely-accepted social science cut-off is that alpha should be 0.70 or higher for a set.

**STEP IV - ACCEPTANCE OF DIMENSIONS WITH A MINIMUM CRONBACH ALPHA VALUE**

The alpha score of 0.840 and alpha score based on Standardized Items of 0.780, both indicate high degree of reliability of the research instrument. Reliability is a fundamental concept of test construction. A high alpha score of reliability for the research instrument used in this research is indicative of the instrument's internal consistency.

**STEP V - HYPOTHESIS TESTING**

Hypothesis tests are procedures for making rational decisions about the reality of effects. Hypothesis testing is really a systematic way to test claims or ideas about a group or population. The researcher has used t-test and ANOVA for hypothesis testing in this research work.
The t-test assesses whether the means of two groups are statistically different from each other. The formula for the t-test is a ratio wherein the top part of the ratio is just the difference between the two means or averages. The bottom part is a measure of the variability or dispersion of the scores. This formula is essentially another example of the signal-to-noise metaphor in research: the difference between the means is the signal that, in this case, we think our program or treatment introduced into the data; the bottom part of the formula is a measure of variability that is essentially noise that may make it harder to see the group difference.

\[
\frac{\text{signal}}{\text{noise}} = \frac{\text{difference between group means}}{\text{variability of groups}} = \frac{\bar{x}_T - \bar{x}_C}{SE(\bar{x}_T - \bar{x}_C)} = \text{t-value}
\]

The top part of the formula is easy to compute -- just find the difference between the means. The bottom part is called the standard error of the difference. To compute it, we take the variance for each group and divide it by the number of people in that group. We add these two values and then take their square root. The specific formula is as follows:

\[
SE(\bar{x}_T - \bar{x}_C) = \sqrt{\frac{\text{var}_T}{n_T} + \frac{\text{var}_C}{n_C}}
\]

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The final formula for the t-test is:

\[ t = \frac{\bar{x}_T - \bar{x}_C}{\sqrt{\frac{\text{var}_T}{n_T} + \frac{\text{var}_C}{n_C}}} \]

Analysis of Variance, or ANOVA for short, is a statistical test that looks for significant differences between means. The following assumptions exist when one performs an analysis of variance:

- The expected values of the errors are zero.
- The variances of all errors are equal to each other.
- The errors are independent from one another.
- The errors are normally distributed.

The mean is calculated for each of the groups. The overall mean is then calculated for all of the groups combined. Within each group, the total deviation of each individual’s score from the group mean is calculated. This is called within group variation. Next, the deviation of each group mean from the overall mean is calculated. This is called between group variations. Finally, an F statistic is calculated, which is the ratio of between group variation to the within group variation.

If the between group variation is significantly greater than the within group variation, then it is likely that there is a statistically significant difference between the groups.
3.7 Limiting Factors

The field of banking and finance is constantly changing. At the same time, an ever-increasing financial integration of economies across the globe intertwines the happenings in banking and financial sector in one economy with the others, further obscuring the findings of research in specific geographical areas. As the researcher compiles this report major transformations are happening for CDM projects finance across the world impacting the industry landscape in India. Trends and inferences drawn for the period of research may, hence, be used for future predictions subject to changes occurring in the global CDM and financial environment from time to time.

3.8 Chapter End-note

This chapter commenced with an introduction to the research methodology, briefly highlighting the underlying motivations which provided stimulus to this research. It details out the research plan defining the problem, hypotheses, research questions and objectives. The chapter rationalizes the choice of research design, sources of data and the tools used for data collection. An elaborate sampling and field study plan was also laid out in the chapter. Statistical tools that were used for data analysis were identified and their conceptual underpinnings were cataloged, justifying their suitability to the research data. The chapter also describes the variables and questionnaire design. The chapter also mentions the limitations which should underlie before meaningful conclusions are drawn from the study. The chapter concludes with a description of scheme of chapters compiled in the report and presentation of research output.

In the next chapter, the data analysis and interpretation based on the financial analysis of select CDM projects is presented.