# Pakistan's way to Clean Development?

Case Study of Biomass CDM Projects in Pakistan

By

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## Abstract

Pakistan has ratified the Kyoto Protocol in 2005 as a host country. Hence it has recognized a share in the responsibility of mitigating climate change. Up till now, Pakistan has 49 projects at different stages in the CDM project cycle. The Biomass CDM projects make a significant portion of the overall CDM projects in Pakistan. It is being argued in this research work that though Biomass CDM projects are popularly credited with achieving the dual objectives of CDM projects, i.e. both in climate mitigation and sustainable development but Biomass CDM projects seems to fall short in the both the goals. This research work is based on 1) making the profile of Biomass CDM projects in Pakistan; 2) studying additionality of the Biomass CDM projects and 3) how sustainable development aspects are represented in Biomass CDM projects and what environmental problems are found in these projects. It has been found that the problems associated with the CDM projects are not adequately recognized in the PDDs. Though Biomass has been commercialized under the framework of climate trading and it is supposed to provide the reasonable Sustainable Development benefits to a larger community. However, it has been found that the larger community is not involved and engaged in the process as needed by a genuine development program.

# Dedication

*Dedicated to my Parents*

# Acknowledgements

By the name of ALLAH the most compassionate and bountiful, who gave me the wisdom and knowledge to perform this challenging task. The more I ponder over my existence and limitations, and countless blessings bestowed upon me by the Almighty ALLAH, the more I submit before Him in absolute humility and thank Him for giving me the courage and fortitude to complete this task.

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| | |
|---|---|
| CDM | Clean Development Mechanism |
| CERs | Certified Emission Reductions in tons of $CO_2$ |
| $CH_4$ | Methane |
| $CO_2$ | Carbon Dioxide |
| DNA | Designated National Authorities |
| DOEs | Designated Operational Entities |
| EIA | Environmental Impact Assessment |
| FAR | First Assessment Report of the IPCC |
| GHGs | Greenhouse Gas (es) |
| HFO | Heavy Furnace oil |
| IEE | Initial Environmental Examination |
| IPCC | Intergovernmental Panel on Climate Change |
| kCERs | One thousand tons of CERs |
| LCA | Life Cycle Analysis |
| $^oC$ | Degree Celsius |
| PES | Payment for Ecosystem |
| PDDs | Project Design Document(s) |
| ppm | Parts per million |
| RDF | Refuse Derived Fuel |
| SD | Sustainable Development |
| TEEB | The Economics of Ecosystem and Biodiversity |
| TAR | Third Assessment Report of the IPCC |
| TDF | Tire Derived Fuel |
| UNDP | United Nations Development Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VCM | Voluntary Carbon Market |
| WTP | Water Treatment Plant |

# 1 INTRODUCTION

Since the end of the 20th century, Climate Change is considered to be the single most dangerous threat to the Earth's stability (Rockstrom, 2009). Climate Change means that the Earth has entered a phase of climate instability. History has shown that the climate of Earth has always been under a state of transition and these changes have been taking place earlier in history as well. But, there is a consensus that, the rate of changes happening, now, in this century is extremely rapid. The average increase in the Earth's surface temperature has been reported to be 0.7 $^{o}$C in 20th century (IPCC, 2001). This is expected to rise to1.5 –4.5$^{o}$C if the rate of emissions in the atmosphere remains the same in the coming century (Chivers, 2011).

The consequences of this unstable climate are expected to be widespread and unpredictable. The most important characteristic of climate change is a long term rise in average global temperature over time i.e. global warming (IPCC, 2001). Scientists have reported the shifts in weather patterns, abrupt weather events like rainfall, floods, and hurricanes; rising sea levels, change in habitat of various species etc. Besides, the livelihood of millions of people is at stake due to rapid environmental changes.

In the First Assessment Report (FAR)[1] (1990) of the IPCC, scientists established that the rise in temperature of the Earth is due to the Greenhouse Effect being produced by anthropogenic Greenhouse Gases (GHGs). This report served as a precursor of all the following negotiations about climate change. As the result of this report, United Nations General Assembly launched the formal negotiations to establish a framework convention on climate change. The framework was finally completed in 1992 and named as United Nations Framework Convention on Climate Change (UNFCCC) at the Earth Summit by the endorsement of 154 nations from around the globe, stipulating the principle of "common but differentiated responsibilities", the idea identified in Rio Declaration in 1992. The objective adopted by the UNFCCC was to stabilize the atmospheric emissions of GHGs by reducing the emissions below to their 1990 levels.

The concentration of $CO_2$ has increased from 280 parts per million (ppm) to 379 ppm in the last 150 years. This increased concentration of $CO_2$ has contributed to an enhanced Green house effect leading to the global warming. The IPCC has warned that if the present trends continue unchecked, temperatures could rise by over 6 degrees Celsius and sea levels by up to 60 centimeters globally by 2100. The panel has suggested that there would need to be a rapid 50 to 70 percent global emission reduction if the world were to stand a chance of averting devastating climatic change (IPCC, 1995). If the same

[1] IPCC is an international body who is responsible to collect scientific evidences on climate change and to advise the policy makers about the measures to take. IPCC has published four volumes of reports. All of these reports cover science, impacts, adaptation and mitigation.

development path will be followed by the developing countries as the industrialized countries, it would lead to a serious global environmental crisis. Therefore the developing countries cannot follow the same path of development and should move to an alternative clean development which breaks with the fossil fuel dependent development model.

## 1.1 Common but Differentiated Responsibilities

These enhanced concentrations of GHGs are being produced into the atmosphere due to the burning of fossil fuels and other industrial processes. Largely these fossil fuels are being burnt to run industries and in transportation. The Global North had entered the process of fossil-fuel dependent development much earlier than Global South at the time of industrial revolution (150 years ago) and the Global South remains far behind the Global North in the energy intensity of their economies. In this process of transition from agriculture to industry the Global North has consumed large amounts of fossil fuels and dumped the gases in atmosphere without paying any environmental or social cost. These GHGs tend to stay in the atmosphere for decades or even centuries reduce the capacity of the global ecosystem to absorb the increase in GHGs in the atmosphere. Resultantly, the Earth is growing warmer.

The Earth's Atmosphere has been overused as a dump by putting too much carbon in the atmosphere by the industrialized countries and historically this has created a Climate debt. The climate debt of the North to the South has been created as the

atmosphere has been used as a dump by the North while the South has not used the atmosphere to any similar extent; hence North owes a climate debt to South. UNFCCC recognized the issue by stating that "the largest share of historical and current global emissions of greenhouse gases has originated in developed countries' (UNFCCC, 1992). This concern recognized in the Kyoto Protocol by the principle of "common but differentiated responsibilities". Having a very small share historically in polluting the atmosphere, the developing countries do not bear the same responsibility to mitigate the climate crisis. The responsibility to reduce emissions in the atmosphere basically lies on the industrialized countries although climate change is a shared and common concern to all the countries.

## 1.2 Kyoto Protocol and the Birth of CDM

The response to this climate crisis was the Kyoto Protocol. For this Nations gathered in Kyoto in 1997 under the UNFCCC to formulate a feasible solution to the global climate deterioration and reached an agreement on the steps to mitigate the climate. The purpose of this international treaty was to device a means that could bring reductions in the net emissions of greenhouse gases and thereby achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. It created legal bindings for the industrialized nations to reduce their emissions by on average 5.2% below their 1990 levels over the first commitment period of 2008- 2012. The Developing countries did not

have any mandatory emission reduction targets. This was because the common but differentiated principle recognized the very unequal contributions of the Global North and the Global South to the creation of the preset day climate instability.

Kyoto Protocol was expected to come up with something like a Climate Fund as was proposed by Brazil in 1997 that was a 'Clean Development Fund'. This Climate fund would be financed by the penalties paid by industrialized countries that had exceeded their emissions targets this climate fund be given to the South. It was intended as reparations to be paid to the South by the North in lieu of the historical overuse of the atmosphere as dump for carbon emissions by the North. This idea was accepted initially by number of nations involved in negotiations but ended up with the fund transformed into a trading mechanism that has become "Carbon Trading". Carbon Trading allows industrialized countries to buy rights to pollute from countries with no emissions limits. Developing countries were made to earn carbon offset credits rather than giving them climate reparations.

## 1.3 Carbon Trading

Carbon trading under the Kyoto protocol takes place in two forms: Carbon Offsetting and Cap and Trade.

Offsetting means instead of cutting emissions at the source, companies and sometimes international financial institutions, governments and individuals can finance 'emissions-saving projects' outside the capped area (in the Global South) and buy carbon

credits to offset their emissions in the Global North. The mechanisms for GHG reductions are flexible and include the financing of projects in non-Annex I countries (developing countries). These projects will reduce GHG emissions in these countries and create carbon credits. The Clean Development Mechanism (CDM) projects are an example of such Carbon offset projects. In other words, by financing such projects, the number of emissions being reduced in each project will earn carbon credits which can be traded on carbon markets.

Emissions trading or cap-and-trade is a market-based approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants. Cap and trade is project based mechanism that simply allows the sale and purchase of $CO_2$ emissions permits in the atmosphere. This mechanism works by putting a cap or limit on a country, industry or enterprise within the country. This Cap is the emission target providing maximum allowable level of emissions that an industry/ enterprise within a country can emit. Some enterprises will have to reduce their emissions in order to meet the cap while some other enterprises that had not exceeded their cap have the right to emit more. This right of emissions they can then sell in the form of Carbon Permits to those who have exceeded their caps and need the extra emission permits.

Carbon trading is being strongly criticized by the Climate justice movements. They have raised the concern that the carbon offsetting programs can only help the

industrialized countries to avoid taking any genuine climate action that is required by their overuse of the atmosphere as a carbon dump.

## 1.4 Clean Development

Clean development is proposed as a new paradigm of development and is being suggested as a solution to climate change. The historical development the industrialized nations have made is said to be the dirty development based on using cheap sources of Energy (Coal, oil and Natural Gas). This cheap mode of development has associated costs of Environmental degradation with it and hence has caused the crisis of Environment that has accentuated over time. Clean development means to enter a development path using less fossil fuel energy. Hence clean development is found to be a new way by which the developmental goals can be accomplished along with the environmental goals but in a clean way. Clean Development Mechanism (CDM) Projects are the means by steps towards clean development can be taken. The incentives for clean development are being created through carbon trading mechanism.

## 1.5 Clean Development Mechanism (CDM)

Clean Development Mechanism is a part of pollution trading and provides incentives for developing countries to participate in the GHG abatement efforts without any commitments, thus apparently leaving the main responsibility for emissions reduction on the industrialized countries. It allows developed countries to undertake GHG emission reduction projects in developing countries to offset their own domestic

emissions. Under the Kyoto Protocol, a CDM project must provide real, measurable and long-term benefits relating to the mitigation of climate change. It must produce a reduction in emissions that would not occur in the absence of the particular project undertaken. Emission reductions are calculated as a difference between the baseline emissions (without CDM project) and the project emissions (with CDM project).The CDM's declared aims are, to accomplish the overarching goals of the UNFCCC – namely to prevent dangerous human interference with the climate system, to encourage sustainable development in developing nations, and to reduce the cost of complying with the provisions of the Kyoto Protocol for developed nations. In 1997, the partner countries in the developed world agreed to the legal bindings and targeted reductions in GHG emissions.

CDM projects are the "emissions-saving projects", being financed by the International companies, industries or governments of the developed countries (Global North) in the developing countries (Global South) so that they can earn carbon credits from such projects to offset their emissions in the North. Apparently it seems as if CDM has been designed to show the developed countries are addressing the climate debt and enables them to reduce the cost of climate change mitigation domestically providing a cheap and cost-effective way through CDM. This also helps the developing countries to go for a development that is sustainable.

Each carbon credit is equal to one ton of $CO_2$ equivalent emissions being reduced through the project, and is called a unit of Certified Emission Reductions (CER's). CERs hold a certain market value and they can be bought and sold in the carbon trading market. Therefore, the industries and enterprises in the North who cannot meet their emission targets buy these carbon credits, and try to fulfill their obligatory bindings. These two broad objectives are also stated clearly in the official definition of the CDM as given under Article 12 (4) of the Kyoto Protocol;

"*The purposes of the Clean Development Mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3".* (UNFCCC, 2002).

For the developing countries, it is claimed that besides financial revenues, CDM brings some additional benefits as well like advanced technology transfer. Since the Global North has access to better and cleaner technologies and the Global South has been using dirty, less efficient and cheaper technologies over the course of their development. Therefore CDM enables the developed countries to undertake financial investments that provide cleaner and environmental friendly technologies to the developing countries.

The CDM does not reduce the GHG emissions in the atmosphere but it helps just to offset the emissions being released in the atmosphere by the developed countries which they find it difficult to achieve but are requirements of the Kyoto emission caps. CDM

serves this Kyoto compliance market and the Voluntary Carbon Market which exists independently of Kyoto and is based on voluntary contributions to climate mitigation efforts in the North.

## 1.6 Biomass CDM Projects

Biomass has historically been used for various purposes in the world. Traditional fuels like firewood, dung and crop residues have always been contributing a major share in meeting the everyday energy requirements of rural and low-income urban households in Pakistan (Ghulam and Bhattacharya, 1999). The use of biomass for energy is deemed to be one of the most promising renewable energy alternatives.

In recent decades, Biomass has been looked up as a source of energy alternative to that of fossil fuels that is considered not only clean but also renewable. It seems as if it requires a new historical energy transition in order to address climate change. It is linked to its historical significance. Historically, there has been one transition that involves a transition from a biomass economy to one based on fossil fuels. In the context of Climate Change, Peak Oil and to meet the requirements of continuous development the question is that can a new transition be adopted in the reverse direction from fossil fuels to a biomass based economy.

The first transition (from biomass to fossil fuels) led to the environmental crisis with issues of climate change and biodiversity loss was started to develop from the time of the industrial revolution. Therefore, need of the time is to take the second shift i.e. to

switch back from using fossil fuels to biomass. Hence under CDM framework, Biomass has assumed a renewed commercial significance. And it has been used in the CDM projects in order to take steps towards the clean development.

This transition towards a low carbon economy based on biomass engages with the development of biofuels and the genetic engineering of biomass. Its first steps are CDM biomass projects and Reducing Emissions due to Deforestation and Forest Degradation (REDD) projects within CDM.

### 1.6.1 Global Distribution of Biomass CDM Projects:

The three types of renewable energy projects are popular worldwide in terms of being CDM projects. Following is given a regional distribution of the hydro, wind and biomass CDM projects in the World. The Table 1 below shows the regional distribution of CDM projects in the Non-Annex-1 countries. This table shows the number of Biomass, Hydro and wind projects distributed region-wise that have got registered or validated up till 2012 along with the expected kCERs generated in each region by these projects. The Biomass CDM projects are largely concentrated in Asia globally as shown in the table below.

**Table 1: Global Distribution of the three largest types of CDM projects**

| Region | Biomass projects | | Hydro Projects | | Wind projects | |
|---|---|---|---|---|---|---|
| | Number | Estimated kCERs | Number | Estimated kCERs | Number | Estimated kCERs |
| Latin America | 150 | 33615 | 301 | 50400 | 171 | 18962 |
| Asia & Pacific | 683 | 126170 | 1797 | 371345 | 1948 | 303868 |
| Europe and | 3 | 47 | 17 | 1114 | 13 | 1449 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Central Asia | | | | | | |
| Africa | 28 | 4178 | 19 | 8179 | 37 | 5821 |
| Middle-East | 3 | 303 | 1 | 26 | 3 | 249 |
| **Total** | 867 | 5,0760 | 2,135 | 4,31,064 | 2,172 | 3,30,349 |

**[Source: UNEP Risoe Database (2012)[2]]**

## 1.7 Why to choose Biomass CDM Projects?

Biomass has always been playing a significant role in human societies. It has been used as a source of fuel for cooking, heating, shelter etc at household level. It has also been used at small commercial levels like tandoors, brick kilns etc. At industrial level, it has been used for meeting both Energy needs and the non-energy needs.

In this thesis we have considered sustainable development benefits those which contribute to the basic needs of the poorer segments (equity) and environmental benefits other than climate mitigation. This perspective focuses on two of the three pillars of sustainable development. As the three pillars of the sustainable development are economic, environment and equity.

Biomass CDM projects are considered to have the potential to improve the economic livelihood of the people most dependent on environmental resources like biomass resources. Poverty alleviation, rural development, creation of employment opportunities, and growth of local industries are the sustainable development benefits most frequently associated to Payment for Ecosystem (PES) (Farley and Costanza, 2010)

[2] www.cdmpipeline.org/publications/CDMPipeline.xlsx (Accessed on 10th April, 2012)

and The Economics of Ecosystems and Biodiversity (TEEB) policies (Sukhdev, 2011) However controversies over the idea of "The Economics of Ecosystems and Biodiversity" (TEEB) (Ref) and payment for ecosystem (PES) (Kosoy and Corbera) and their impact on the growth of economic and social inequalities are common in the research literature.

### 1.8 Research Questions

The objective of this research work is to study the contributions of Biomass CDM projects in emission reductions and environmental benefits and in taking Pakistan really towards a clean development paradigm. The particular Research Questions are as follows.

1. **What are the various characteristics of Biomass CDM projects in Pakistan?**

   PDDs will be studied in order to learn various features of Biomass CDM projects like the categories of these projects, the industries involve in Biomass CDM projects, the type of biomass being used in these projects, the magnitudes of CER's expected to be generated by biomass energy production in Pakistan.

2. **Are Biomass CDM projects in Pakistan additional?**

   Additionality is important to study in order to find out whether Biomass CDM projects in Pakistan really help in achieving the emission reductions targets of the Kyoto protocol. This question is explored by a theoretical investigation of the carbon neutrality of

biomass found in all the CDM biomass projects. Are the biomass CDM projects likely to occur in the absence of CDM finance? What are the uncertainties of additionality frequently controversial? Which particular biomass projects are motivated by objectives other than climate mitigation. Do any of these projects seem to have questioned additionality? PDDs are the main documents referred to in order to find out how this additionality is represented and discussed in official documents to get approval. Interviews will be done additional to this finding how additionality is perceived generally. In addition the assumption of carbon neutrality will also be discussed in this chapter. The carbon neutrality assumption is important in terms of real emission reductions hence it will help to find out whether biomass burning leads to $CO_2$emissions or not?

3. **How are CDM projects geared towards sustainable development in terms of their design and implementation?**

Literature on CDM is incomplete without the mention of Sustainable development along with climate mitigation. Sustainable development has three pillars i.e. of equity, environment and economic. In this study, it is being tried to find out what contributions Biomass CDM project do make other than that of climate mitigation. In this study, it is being tried to find out the significance of having sustainable development the way it is mentioned in the PDDs and how it is being perceived by the carbon consultants, DNA and project developers. PDDs are like promotional documents in order to get a CDM

project approved. Literature shows that there are a lot of environmental problems with Biomass Burning. So one of the questions will be to study whether these known environmental impacts have adequately been represented in PDDs? In this study the known environmental impacts of an industrial process will be compared with the impacts identified in PDD.

## 1.9 Thesis organization

The thesis has been divided into chapters as described below with a short description for each chapter.

Chapter 1 is the introductory section that talks about the CDM, its role, the institutional bodies involved in designing the instrument of achieving climate mitigation.

Chapter 2 is about the research methodology employed to carry out the study. Both Primary and Secondary sources have been discussed in detail.

Chapter 3 is about the literature related to this study. It includes both the critical and mainstream articles related to the research in this particular area.

Chapter 4 comprises of the characteristics of the Biomass CDM projects in Pakistan. Types of Biomass projects, Types of crop residues, nature of industries involved, methodologies being used in these projects to calculate their contributions to climate mitigation.

Chapter 5 is about the significance of additionality and how the Biomass CDM projects in Pakistan have determined their additionality. What type of additionality determination have been used in these projects i.e. Barrier analysis or financial analysis and their significance.

Chapter 6 is about the how successful have Biomass CDM projects Pakistan been in achieving two objectives of sustainable development and climate mitigation.

# 2 LITERATURE REVIEW

Biomass combustion for energy purposes has been a common practice in Pakistan. But there is a difference between the historical use of biomass that was for the subsistence needs of the people and the current pattern of biomass i.e. industrial consumption. Biomass has been used historically to meet the subsistence needs of the people meeting both energy and non energy needs. In rural and semi urban areas people use biomass for cooking and in winter for heating homes. At household level, biomass has been used as a raw material in traditional crafts. Though it has also been used as a fuel on small commercial levels like tandoors, small hotels etc. However under CDM, Biomass has assumed a new commercial significance (E. net Magazine, 2011)

The Biomass CDM projects are increasingly growing in number worldwide particularly in South East Asia as already mentioned in first Chapter. Same trend we can find in case of Pakistan as we can found significant number of Biomass based CDM projects. There are basically three types of industries, textile, sugar and cement industries, particularly found to be engaged in the Biomass CDM projects from the study of Project Design Documents (PDDs). Though the Clean development and CDM are being highly appreciated globally in the mainstream literature (Streck, 2004; Huang and Barker, 2011) but it is interesting to note that the industries being engaged with the CDM projects are themselves very polluting industries.

For example, Textile industries are considered to be highly inefficient in water consumption. These industries cause air and water pollution and use heavy metals and chemicals the discharge of which in air and water cause serious environmental problems. (Ren, 2000). Sugar industries are also water intensive industries. Besides being water intensive there are harmful impacts of sugar both levels of cultivation and consumption (WWF, 2005). Cement manufacturing is not only energy intensive process but also a major contributor in putting a lot of emissions into the atmosphere (Mehta, 2001).

Biomass based CDM projects in Pakistan are being using rice husk, bagasse, Tire Derived Fuel (TDF) or Refuse Derived Fuel (RDF) either separately or in combination of each other in the projects. Tire burning of biomass in industries is being promoted as a dire solution to dispose of the expired and used tires however it is a matter of common knowledge that burning of tires in the open is extremely harmful to human health and the natural environment. The fumes emitted are packed with the many toxic chemicals that tires contain. Additionally, the chlorine content in tires leads to the creation of dioxins and furans which are again extremely toxic chemicals when tires are burned (Energy Justice Network, 2010).

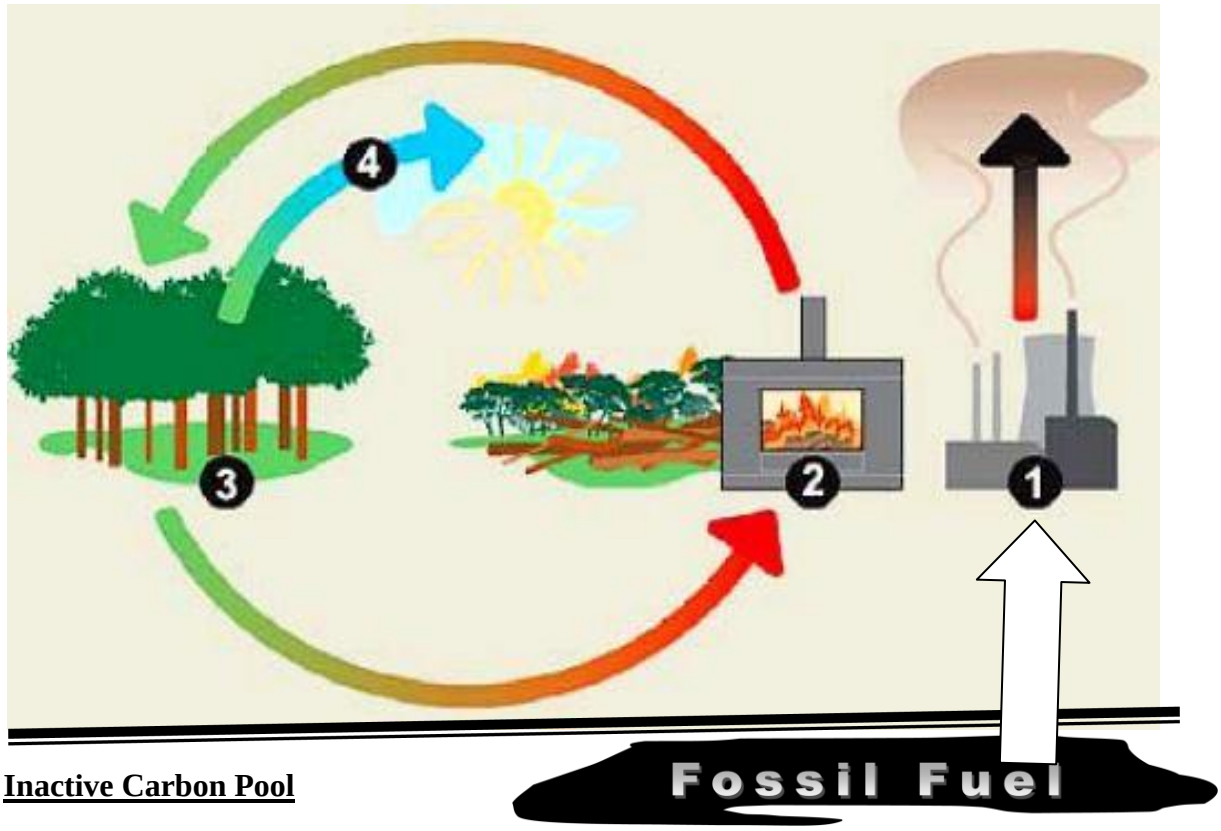
What has been taught and read in the Science is that the properties of all $CO_2$ molecules are similar. But in climate science, $CO_2$ molecules have different climatic effects. At one level, it is being argued that all $CO_2$ molecules are similar and it is not important how and where it is reduced. This is how the phenomenon of carbon trading

works. Carbon trading would like to treat all $CO_2$ as equivalent. Emission reductions by burning fossil fuels are the same as emission reductions by the process of forest destruction. We can reduce emissions by burning less fossil fuel and by planting more trees. So important is the reduction of carbon not its particular process how it is reduced or otherwise we can say that it is important that how much quantity of $CO_2$ is going into the atmosphere not how it is produced and went into the atmosphere. However, Climate scientists recognize the difference between fossil carbon and biotic carbon, at the other level, and argue to keep the fossil fuels underground and reduce the massive consumption of fossil fuel burning. Therefore the climate scientists emphasize that the sources of $CO_2$ emissions do matter in terms of climate mitigation and hence history as well. Similarly the idea of commodity fetishism is that the historical origins of $CO_2$ molecules are more important than the properties of $CO_2$ molecules. So this is a contradiction that exists between the climate science and the carbon trading phenomenon (Lohmann, 2010)

Climate scientists require a distinction between fossil carbon (part of an inactive pool) and biospheric carbon (part of an active pool of atmospheric, oceanic and terrestrial carbon) i.e. the history of $CO_2$ is important. Whereas the social scientists requires a distinction be made between different processes of carbon emissions. Are carbon emissions for the subsistence needs of people (commons) or are carbon emissions for the needs of capital to grow (industrial) (Lohmann, 2010)

Biomass CDM projects are considered to be carbon neutral since it is being assumed that the carbon emissions being released from burning of biomass are offset by the plants when they regrow. Therefore the emissions being produced do not increase the net amount of Carbon present in the atmosphere.

**Active Carbon Pool**




**Inactive Carbon Pool**

**Figure 1: Diagrammatic Representation of the Phenomenon of Carbon Neutrality [Source: www.janderson99.hubpages.com (Accessed on 16th March, 2013)]**

The concept of carbon neutrality can be understood with the help of the Fig.1 above. This figure is showing four processes that are described with the respective numbers. It is being shown how the active and inactive carbon pools are related and how biomass

becomes carbon neutral. Scenario one (1) is depicting the situation when fossil fuels are being burnt in the industries as a result of which GHGs are being emitted in the atmosphere. These fossil fuels have been drawn from beneath the Earth hence the carbon being released in the atmosphere as a result of its burning will be the Carbon from inactive pool increasing the net amount of $CO_2$ in atmosphere. Situation two (2) reflects that rather than burning of the fossil fuels, industries are now burning Biomass (3) in order to meet their energy requirements. The emissions being emitted by the burning of biomass in the industries will go into the atmosphere but will get resequester by the plants when they will regrow. Therefore there is no net increase in $CO_2$ in the atmosphere. Arrows in the diagram represent the $CO_2$ flows.

In Literature, there are many studies that highlight the significance of biomass in ecosystem. Like Smil (1999) has observed that the agricultural residues make the largest quantities of agricultural production. Though produced in largest quantities, biomass residues have been utilized for various purposes in agroecosystem. It has been consumed as household fuel, building material, feed and bedding, mushroom cultivation and pulp chemicals. Therefore considering their services they should not be considered as waste.

Biomass residues have been recycled in traditional agriculture, either they are left on the fields after cultivation or incorporated into the soil during ploughing. Recycling of agricultural residues actually helped against soil erosion by wind or water and improves water retention capacity of the soil. Papong *et al*. (2004) has identified multiple uses of biomass that have been practiced for quite a long time in history and are still being

practiced stating that globally about 30.8% of the rice husk is not used and the remaining 69.2% is used for many purposes such as fuel, fertilizer, soil conditioner, animal feed, etc.

Gilbertson (2009) is of the view that CDM provides money to expand power projects insensitive to the concern of the local people. She has further described that in agricultural societies, wastes and resources are taken together. The wastes being produced by one process is being utilized as a raw material of another process hence leads to a closed cycle. Rice husk is being heavily burnt by factories to produce power. But in traditional societies rice husk was being used for various purposes e.g. rice husk has been used in chicken pins to absorb chicken droppings; this rice husk mixed with chicken droppings was then used as fertilizer in the fields to fertilize the soils. Hence traditional societies consumed resources in closed cycle. The commercial burning of rice husk in the factories has caused the prices of biomass to increase and people can't use it for fertility purpose any more. The burning of biomass has caused increased air pollution and water consumption.

Increased emissions of dust and particulate matter in the air have caused the silicosis's among people working and living near-by (Gilbertson, 2009). Silicosis is the respiratory problems caused by silica being emitted into the air through emissions. It has been reported that when rice husk is burnt silica ashes flies off in the atmosphere and

inhalation of these ashes leads to the occurrence of a respiratory problems like silicosis (LIU, 1996).

There are some studies on Biomass CDM projects also done from different perspectives. For example in the paper by Parnphumeesup and Kerr (2011), the authors have studied the preferences of stakeholders engaged in rice husk based CDM projects in Thailand, employing both quantitative and qualitative methods. In quantitative analysis they found that to increase the usage of renewable energy was the highest priority of stakeholders. However this study finds out that rice husk based biomass CDM projects have significant negative impacts on the air quality and have serious problems in terms of noise, waste disposal and dust.

It is being thought that the environment can be protected if the ecological and social costs are also incorporated in the economic costs. Therefore, it is being argued that putting a price on nature is probably the best way to protect the nature. This is how the polluters will be made to pay the monetary penalties for environmental degradation and this money will be given to the communities who got affected by this degradation. Hence this idea of Payment for Ecosystem (PES) is being taken as a win-win but it has been contested by many people. People argue that this is not a win-win situation as the money usually does not reach the affected communities and they are at loss (Kinzig *et al*, 2011). CDM projects also apply the principle of PES in certain ways. Particularly in the case of Biomass CDM projects one way of addressing social inequalities is, that through pricing crop residues and biomass, the rural people would earn extra money and hence in this

way the Biomass CDM projects will address equity. However, Parnphumeesup and Kerr (2011) have shown in their studies that this is not the case.

Biomass burning in the industries is being promoted in the name of clean energy and energy shortages. However, it has also been reported in the literature that biomass burning is more polluting method of acquiring energy to fossil fuels (Mida, 2009). Therefore the process of burning biomass is being presented as a solution to one problem that is climate mitigation while creating other environmental issues. This nature of producing environmental or economic rifts is inherent character of the technical or market solutions to problems which are actually socially or politically driven like climate change. This method of addressing the issues will do nothing in resolving the problems as such but replace one problem with the other problem. This idea of metabolic rift has been discussed in the literature quite well (York, 2005) and seems to be valid in the case of Biomass CDM projects where the focus to reduce CO2 in the atmosphere will create environmental problems like dust pollution, inefficient water consumption, soil carbon depletion etc.

Additionality is one of the problems faced by CDM is to measure the emission reductions made by a single project i.e. to achieve "*the real, long-term and measurable reductions in emissions*". For this they need a reference level which is called baseline in order to calculate the emission reductions. It is a very important issue in the CDM and yet quite controversial as well. Since the emissions being reduced by the CDM project should

really e additional because the emissions will be offsetting the emissions being emitted in the North. If the CDM project is not going to deliver real emission reductions then the overall emissions will be going to increase and only the CERs transactions will be made without any emission offsetting. It has also been reported in the literature that most of these projects are either energy efficiency projects or any way projects and they could have been implemented without CDM credits (Schneider, 2007).

McNish *et al* (2009) has studied the bagasse power generation under the framework of CDM. The author has analyzed 204 bagasse power projects which have been producing electricity. The authors are very positive about the health of the bagasse power CDM projects and they think of these projects as they could bring change in climate mitigation. Besides the authors are of the view that there are two aspects that need attention. First is additionality test of the bagasse power projects. As bagasse power projects usually go for barrier additionality test rather than financial additionalty test. Secondly authors have pointed out that the time delays involved in registration and verification processes of CDM projects is very lengthy and it should be considered by Executive Board.

The Third Assessment Report (TAR) of IPCC has suggested that sustainable development may be the most effective way to frame the mitigation question (Banuri *et al*., 2001).It has been argued that in the face of climate change the future need is to focus on low carbon economy. They are of the view that the low carbon economy can only be possible if the sustainable development and climate change are addressed together rather

separately (Banuri and Opschoor, 2007). For which the authors have suggested huge public investment in renewable energy technologies in the developing countries.

It has been described quite well in the literature that Climate Change and Sustainable Development has always been addressed in separately large circles. Climate change had been considered as pure scientific and environmental issue till 1980s whereas Sustainable Development has always been related to social and economic dimensions (Olsen, 2007). There is a long history of development gone through different phases and current phase is Clean Development.

This divide was ignored for the first time in around 2001-2002., when the International Panel on Climate Change (IPCC) in the Third Assessment Report and delegates at the World Summit on Sustainable Development crafted a platform to address climate change and sustainable development together (Olsen, 2007). Third assessment report of IPCC has identified Sustainable development as the most effective way to frame the efforts of GHG mitigation.

Since Sustainable development was incorporated at the last moment and hence no method was devised that how it would be implemented. So there is no tool to describe or to use that how the SD benefits will be ensured in a particular CDM project. This is the matter left totally on the discretion of the national governments. Unlike the assessment and monitoring of GHG emissions, the measurement of SD contributions for approving the projects is difficult and not clearly defined.

It is emphasized in the Marrakesh Accords (UNFCCC, 2001) that the host country herself is responsible for setting their national sustainable development goals taking into consideration their local environmental, social and economical aspects. The Marrakech Accords affirm that "it is the host Party's prerogative to confirm whether a clean development mechanism project activity assists it in achieving sustainable development" (UNFCCC, 2002). For this, national government of each host country is made to establish a body called Designated National Authority (DNA) who is responsible for determining whether particular CDM project contributes in SD aspects. DNAs from Host countries use their national SD criteria to assess the PDDs. Once DNA gets satisfied with the PDDs, they can issue a letter of approval (LoA) or reject the project otherwise. This letter of approval is important to commence the project further. Sustainable Development must include at least three dimensions: the social, the economic and environment (Najam *et al*., 2003). PDDs, in their Sustainable Development section, discuss the three dimensions along with the technological benefits of the CDM Project.

Several publications have evaluated the contribution of the CDM to sustainable development; some of them have been discussed below. They all arrive at a similar conclusion: the CDM does not sufficiently fulfill its objective of assisting host countries in achieving sustainable development. There is a lot of literature stating that there is no synergy between the two goals. One of the reasons for this contradiction could be that GHG emission reductions are measureable and verifiable in the form of CERs produced, there is no straightforward method to measure or verify contributions delivered in the

form sustainable development (Kolshus *et al*., 2001, Sutter, 2003). Though there are some studies criticizing the market based approach to mitigate climate change but also reject the framework of Kyoto Protocol altogether (Paulsson, 2009).

There is a lot of literature showing this tradeoff between the emission reduction and SD benefits provided in CDM projects. Olsen and Fenhann (2008) have suggested that development of an international standard to define and measure sustainability in addition to the local parameters of SD can help to solve the problem. In this paper they have analyzed the SD benefits through a text analysis of the PDDs. They have studied the PDDs of 744 projects submitted till 3 May 2006 and develop taxonomy to study the assessment of sustainability.

Similarly, Alexeew *et al* (2010) analysed 40 registered CDM projects in India. In this paper the authors have assessed the likelihood of additionality these projects by studying the impact of CERs on IRR of the individual projects. They have also analyzed the SD benefits being delivered by the projects with additionality. In the end they established that there is an inherent conflict between the two goals of CDM.

Sutter and Parreno (2007) used Multi-Attributive Assessment and assessed 16 registered CDM projects to find out the whether the CDM projects were successful in achieving its twofold objectives or not and they found that 72% of the projects assessed represented the mission reduction but only 1% of the projects contributed in the achievement of SD benefits in host country.

It is also being argued that all the host countries do not have set their Sustainable development goals and it has been found that only 15 countries have designed their SD criteria for assessing CDM projects (Sterk *et al*; 2009). Again, several studies have now concluded that the SD objectives of CDM project are not clearly interpreted by many host countries (Schneider, 2007; Sterk *et al*., 2009). Therefore, it has been found that several projects with negative ecological or social impacts have been approved by host country DNAs (Burian, 2006). This implies that host countries cannot guarantee the SD benefits of CDM projects. UNDP (2006) has identified two aspects to a CDM project's contribution to Sustainable development.

- CDM projects must reduce GHG emissions without causing any social, economic or environmental harm.
- CDM projects must provide positive economic, environmental and social benefits, not just GHGs reduction.

People have argued that by assigning the host countries with the responsibility of assessing CDM projects creates an incentive to set low sustainability standards in order to attract CDM investments (Sutter, 2003). If countries have relatively strict SD criteria, this will lower their CDM market share, as the developers will choose to run projects with low SD benefits in other countries (Schneider, 2007). Ultimately this may lead to the weakening of environmental legislation in the host country in order to attract CDM finances what has been described as ''a race to the bottom'' in terms of SD standards (Sutter, 2003). Even if host countries develop their own SD criteria for assessing CDM

projects, they may simply be ignored because the objective is to have more revenues in the form of CERs.

In a study by Boyd *et al* (2009), it was found out that issuance of letter of approval do not ensure that the sustainable development would be achieved in the host countries. Since countries are being attracted by more foreign investment in the form of CER's so they do not care for the other environmental aspects being affected. The authors have also criticized the process of stakeholder meeting which does not take into account of all the relevant aspects that should be taken under consideration. May be because of language barrier, and also because NGOs do not take part in this process. They concluded that the existing framework of CDM working is insufficient in terms of delivering the Sustainable development aspects to the host countries.

CDM has been considered to be a win- win solution in view that it provides the twofold objectives. Smita Sirohi (2007) studied if CDM projects in India could help in poverty alleviation or not. She analysed all types of CDM projects that made 65 projects in total and found that CDM did not contribute to rural poverty alleviation to any notable extent.

Barbara Haya (2009) has studied the CDM projects in the Indian Power sector. She finds out that though India is actively participating in CDM but there are various associated uncertainties. In her research she finds out that there are various non-additional projects getting registered rapidly in India and therefore do not represent the

real emission reductions. She points out various regulatory uncertainties in the Indian CDM program particularly in the Indian Power sector that can lead to failure to support new projects in the program. In order to screen out the non additional projects she has also study the prospects of having a more rigorous additionality test. She has also studied the history of support for bagasse cogeneration in India and it reveals that a range of shifting barriers have impeded the development of this cost effective technology. In order to overcome this barrier of technology a carbon price alone would not be sufficient but also needs parallel support efforts to encourage bagasse energy generation.

# 3 METHODOLOGY

This section includes the data sources and methods used in order to carry out the research. In this particular study, both primary data and secondary data have been employed.

- The secondary sources of information were the Project Design Documents (PDDs). The PDDs of all the registered and validated CDM projects are available on UNFCCC website. In order to carry out the analysis these PDD documents of Biomass CDM projects were accessed from the website. PDDs were chosen to be analyzed because this is the document being used by the Designated Operational Entities {DOEs (auditors)} to validate the project. Again, this document is used by DNA of the host country before issuing a Letter of Approval (LoA) to find out if the Sustainable development aspects of the project mentioned in the PDD is in coherence with the national sustainable development criteria.
- The primary data has been gathered through site visits to Biomass CDM projects and semi-structured interviews. Both the methodologies have been described in detail below in the sections 2.2 and 2.3.

## 3.1 The Assessed Biomass CDM projects

Biomass CDM projects are described as those projects in which biomass have been used as a source of fuel displacing the conventional sources of fuels (coal, natural

gas, Heavy furnace oil, Residual fuel oil, pet coke etc). The term Biomass includes a diverse variety of biomass. According to UNEP Risoe Centre[3], the projects that involve the burning of bagasse, agricultural residues like crop residues or other kinds, poultry waste or industrial wastes are all categorized as Biomass CDM projects. Taking the same description, Eleven CDM projects in Pakistan fall in the category of Biomass CDM projects.

The Biomass CDM projects assessed in this analysis corresponded to the projects registered or validated at UNFCCC as of Ist April, 2012 (UNFCCC, 2012). Since more and more Projects are constantly coming in the CDM pipeline ever month so we had to take a reference date i.e. April 1, 2012. The projects registered or validated after that reference date were not included in the study.

Following is the list of Biomass CDM Projects in the CDM pipeline in Pakistan.

1. Biomass fuelswitch project at Sapphire Finishing mills Ltd, Kasur (Punjab).
2. Biomass based Energy Generation at Kohinoor Mills Ltd, Kasur (Punjab)
3. Biomass based Energy Generation at Master Textile Mills Ltd, Kasur (Punjab)
4. Biomass based high pressure cogeneration project at Shakarganj Mills Ltd. Bhone, Jhang (Punjab).
5. Biomass based cogeneration project for Madina Enterprise Ltd. Chiniot (Punjab).

[3] This website has the CDM/Joint Implementation (JI) Pipeline Analysis and Database that contains all CDM/JI projects that have been sent for validation/determination. It also contains the baseline & monitoring methodologies, a list of DOEs and several analyses.

6. Biomass based cogeneration in Engro foods supply chain Pvt Ltd. Muridke (Punjab).
7. Almoiz bagasse cogeneration project, Dera Ismail Khan (Khyber PakhtunKha (KPK)).
8. Partial substitution of coal with alternate fuels at DG cement, Khofli Sattai, Dera Ghazi Khan Plant (Punjab).
9. Substitutions of coal with alternate fuels at Lucky cement Limited Karachi Plant, Nooriabad; Karachi (Sindh).
10. Attock cement partial substitution of fossil fuels with alternate fuels in cement manufacture project, Hub Chowski, Lasbela (Sindh).
11. Substitution of coal with alternate fuels at DG Khan Cement Company Limited, Khairpur Plant, Chakwal (Punjab).

## 3.2 Project Design Document (PDD)

Project Design Document (PDD) is the key document being officially required for any CDM project to get approved. It is prepared by the project proponents on the format being prescribed by UNFCCC Secretariat. It is a 60 page document (on average) and delineates the basic details required for a project to be considered as a CDM project. It can be called a summary of the CDM project. This document is basically used to get approval from the CDM Executive Board only after passing through various stages of the project cycle. A PDD is based on the following sections.

### 3.2.1 Nature of the industry

This section of the PDD describes the nature of the industry whether it is textile, sugar or cement industry. An industry can have GHG emissions from two types of sources i.e. the direct emissions related to the emissions from the factory process or the indirect emissions related to the energy consumption of the industry. If nature of the industry is known then one can know whether an industry has process emissions or emissions due to fuel consumption. Biomass CDM projects in Pakistan fall in four kinds of factory processes. They include finishing of textile products; sugar manufacturing, cement production and rice processing plant. PDD also gives information about the production capacity of the industry. The production capacity relates to the annual consumption of the biomass and the annual energy needs of the industry.

### *3.2.2* Project Boundary and Leakages

Project boundary means to frame the project in order to simplify the process of calculating GHG emission reductions. Hence the sources included in the project boundary would be accounted for GHG calculations. Leakages are considered as small indirect emissions that are emitted outside the project boundary as a result of the happening of the project.

CDM projects use the concept of boundaries and leakages. However Michel Callon (1998) and Larry Lohmann (2005) have used the terms framing and over-flows instead. He has further described that the ecosystem consists of interconnected linkages and

involves complex systems. However, most physical processes in nature involve the process of framing. Therefore the process of framing a part of the web from a larger system, inevitably leads to the over-flows that could be very large. In CDM overflows are considered small and described as leakages. However according to Callon (1998) overflows can be larger than what is inside the boundary.

Gilbertson (2009) has described how the Biomass CDM projects in Thailand had induced leakages. She described that rice husk mixed with chicken droppings was used as a natural fertilizer by the poor people in the region. But due to the increasing number of Biomass CDM projects in the area led to the prices of Rice husk to increase. Hence the people who were using natural fertilizer in their fields had to switch towards the chemical fertilizers.

### 3.2.3 Additionality

One of the fundamental requirements of CDM project is to prove a CDM project additional. Additionality means to prove that the CDM project is not viable without CDM finance. It explains in detail how its future emissions reductions will be real, additional, and not induce leakage. Possible leakages that could have happened due to the project are also given in the PDD along with the leakages not included in the calculations. Following are the two types of the additionality tests employed in CDM projects.

#### 3.2.3.1 Financial Analysis

A project can only be considered additional if it is not profitable without revenue from carbon offsets. In other words, the revenue from the carbon offsets is a decisive reason for implementing a project. Additionality on the basis of the investment is established if the particular CDM project activity is proved to be economically or financially less attractive than other alternatives without the revenue from the sale of the CERs. Financial analysis is quantitative in character and hence is more reliable than the barrier analysis.

#### *3.2.3.2* Barrier Analysis*:*

A project can only be considered additional if there are barriers, such as local resistance, lack of know-how, institutional barriers, etc, that prevent its being implemented regardless of its profitability. Barrier analysis is qualitative in character and it includes either a Technological barrier or a Common practice barrier.

Technological barrier analysis is done if there is a less technologically advanced alternative to the project activity that involves lower risks and the activity would lead to higher emissions. A project can only be considered additional if it employs technologies or practices that are not already in common use. If the technology or practice is already in common use, then implementation as an offset project it presumed not to be necessary to carry out the activity. Common Practice barrier means that there are certain prevailing practices that can hinder the adoption of CDM project. An existing regulatory or policy

requirements can also be a common practice barrier that would have led to implementation of another activity, and that activity would probably lead to higher emissions.

### 3.2.4 Baseline:

PDD identifies a hypothetical baseline project. As the baseline project is not executed it cannot be measured and is hypothetical. In order to highlight this fact it is sometimes called a counterfactual. In this section different possible baselines are identified and a unique baseline is identified in order to be able to calculate the emission reductions. This is where the possibility of manipulated baselines exists. In the real world a variety of procedures is found in all the industries but the CDM require a unique counterfactual to be identified.

PDD informs about baseline of the project set, its business as usual and CDM project. Each scenario is being discussed under different sections. Besides it also notifies about the Baseline methodologies and Monitoring Methodologies according to the requirements of PDD set by Executive Board. It must also prepare a monitoring methodology that explains in detail how it will monitor emissions reductions made by the project. Project generally utilizes a previously approved monitoring methodology.

### 3.2.5 Details on Biomass:

The particular type of biomass being used in individual projects is also given in a PDD. In the case of Pakistan, this is currently rice husk, bagasse, Refuse Derived Fuel (RDF) and Tire Derived Fuel (TDF). The amount of biomass consumed must be able to provide the energy required in the process and this is provided by the calorific value of the biomass. As frequently biomass is assumed to be carbon neutral the amount of $CO_2$ emitted per unit of energy produced is not provided in the PDD. This factor called the Emission Factor is an important factor required in the case of fossil fuels and indirectly in the case of electricity consumption. PDDs provide an energy balance of the process so that its integrity can be checked by the auditors (DOEs).

### 3.2.6 Crediting period:

The project has a certain crediting period either of seven or ten years. This crediting period means that once a project gets registered, the project developer can claim CER's for that length of time. The crediting period of seven years is renewable and can be extended up to 21 years that can be allocated on request which means that the projects can claim validation once granted approval up to 21 years. In stable economies, this may appear appropriate. However in economies such as Pakistan where conditions of functioning can fluctuate over relatively short times this can result in the project life extending far beyond the period where its validation is justified.

### 3.2.7 Institutional details:

It briefly describes the entities involved in the making and processing of the Project for example it gives information about the project developer, carbon consultant, Designated Operational Entities (DOEs). DOEs are involved at two stages of the project cycle. First is when the PDD is submitted by the carbon consultant to Executive Board. DOEs have to check the integrity of the project and verify the project through doing an energy balance. Secondly, another DOE is engaged after the project gets registered for monitoring of the emissions. They monitor the project according to the description given in PDD. These DOEs are hired by the project developers and like conventional auditors are often accused of being hand in glove with the developers. This means that the climate integrity and independence of the auditors is questionable. This is sometimes described as "he who pays the piper, plays the tune".

### 3.2.8 Sustainable Development

One of the sections writes particularly about the contributions of the project in terms of Sustainable Development which are meant to be verified by the DNA. This section briefly describes the four components of Sustainable development contributions namely economic, equity and environment. In addition technological inputs are also discussed here.

### 3.2.9 Initial Environmental Examination (IEE):

Every CDM project in Pakistan requires an IEE report to be submitted to the Environment Department of the Province. The various major impacts in term of environment are also being listed by the end of the PDD. In some countries, EIA/IEE requirement is waived off, but in Pakistan all the projects have the requirements to have IEE done. This means that in practice environmental problems cannot be swept under the rug but must find a mention in the report even if downplayed.

EIA reports are also funded by the project developers. Consultants who prepare these reports need to have a working relationship with the potential project developers and yet maintain some level of environmental integrity. These contradictory pressures mean that these reports have to trail a thin line.

### 3.2.10 Stakeholder's meeting:

Stakeholder's meeting is basically held to make local people aware of the CDM projects and to take their consent. The concluding remarks are given briefly in this section. Stakeholders' comments, including a brief description of how the meeting was held, summary of the comments received from the stakeholders, and a statement on what response had been given to take care of any comments received. Stakeholder meetings are part of a larger project of public participation in the CDM process. At the local level this takes place through the stakeholder meetings which are frequently seen as a requirement in name only. The other aspect of public participation is making the

documents available online which enables civil society organizations to engage with the development and reform of CDM.

### 3.2.11 Calculation of CER's:

The carbon offsetting of a particular CDM project is measured by the annual estimated CERs generated by the project. This method requires a comparison between the CDM project and the unique counterfactual identified as the baseline projects. Though the baseline cannot be measured as such but the CDM project can be monitored. The amount of biomass consumed annually and its calorific value can be used to calculate the energy production on an annual basis. The assumption of biomass as carbon neutral means that this energy is produced without any $CO_2$ emissions. The baseline project will have emitted more $CO_2$ as it is based directly or indirectly on fossil fuel consumption (fuel switch project). Here the baseline emissions would be calculated by multiplying the biomass energy production by the emission factor of the fossil fuels consumed. This amount would essentially provide the emission reductions which are verified in the form of CERs.

The CERs can then be bought and sold in a carbon market and the sale of CERs provides extra CDM financial revenues which make a CDM project viable. In a counterfactual commodity market the price of a commodity reflects the quality of the commodity. However, the buyers assess the quality of the CERs. Both buyers and sellers

are not concerned with the quality; they only require verification by a recognized authority.

## 3.3 Interviews and Site Visits:

This section describes the primary methodology and primary sources of information.

### 3.3.1 Interviews:

In the early stages of the research, interviewees were identified through a review of the PDDs. As the research progressed, we followed by asking interviewees to identify individuals and organizations that have close relationships with them in terms of CDM activities. An interpretive methodology was used in analyzing data collected from semi-structured interviews. These interviews were conducted with people involved in CDM Project like carbon consultants, industrialists, CDM project managers, people involved in biomass market. Besides, interviews were also held with CDM Project Managers in industries having CDM projects as mentioned in sections 3.3.3.

In total 14 interviews were conducted during the study. A few of them were in two rounds. (Details have been attached in Appendix III).

#### 3.3.1.1 Carbon Consultants:

These carbon consultants were identified from reading PDDs and from the Pakistan's CDM website (www.cdmpakistan.gov.pk). This website has enlisted the carbon consultants, DOE s, stakeholders etc. Lahore based carbon consultants and DOEs were identified, selected and contacted on phone. Following is the list of Carbon consultants who were interviewed.

- Carbon Services
- Global Environmental Lab (GEL)
- Climate Ventures
- National Development Consultants (NDC).

#### 3.3.1.2 Government Officials:

Ministry of Climate Change and Enercon are the government departments involved in CDM process. Some of the officials were identified and contacted from the information given in Pakistan's CDM website. They were from the following entities.

##### 3.3.1.2.1 Designated National Authority (DNA):

Ministry of Climate Change has recently been made the DNA of the country. DNA actually verifies the projects on the basis of Sustainable development criteria of the country. The contact numbers and addresses of the people involved particularly in DNA

were also taken from the Pakistan's CDM website. Deputy Director Technology Transfer was being mentioned as representative of DNA on the Website and was interviewed.

#### 3.3.1.2.2 CDM Cell

CDM Cell was established in August 2005. It is basically responsible to provide technical and policy support in order to advice the Government. It also reviews the CDM projects for grant of approval by DNA. Besides, CDM cell also helps in implementation of CDM strategy, conduct awareness raising activities etc.

### 3.3.1.3 CDM Project Managers:

CDM project managers of the following industries were interviewed during the site visits of the CDM projects.

1 Kohinoor CDM Project

2 Masters CDM Project

3 Sapphire CDM Project

### 3.3.2 Site Visits:

In addition three site visits were also done to in order to learn how a CDM project actually works. The CDM projects of these following industries were visited and their CDM Managers were interviewed on site.

- Kohinoor Textile: The Project is located at: 8th KM Manga Raiwind Road, District Kasur, Punjab.
- Masters Textile: The Project is located at: 3 KM Manga Raiwind Road, District Kasur, Punjab.
- Sapphire Textile: The Project is located at: 3 KM Manga Raiwind Road, District Kasur, Punjab.

### 3.3.3 Themes Explored:

In the interviews mentioned above, questions have been asked according to the following themes.

1. What is the Motivation for Biomass CDM Projects?
2. How "Additionality" is demonstrated in these projects?
3. What contributions of "Sustainable Development" a biomass CDM project is delivering?
4. What "environmental problems" are associated with Biomass CDM projects?
5. How has the "Community Engagement" in these projects been ensured?
6. How have biomass Prices have fluctuated over time since the start of the CDM projects?

## 3.4 Limitations of the study

There were also some limitations of the study mentioned as follows.

Firstly, other organizations and People involved in CDM project cycle were also contacted, particularly the DOEs, for the interviews but unfortunately they could not give us time to talk. Secondly, most of the CDM projects were not easy to access physically therefore only those projects we could visit which were situated around Lahore and for which we could seek permission of visiting them.

# 4 BIOMASS CDM PROJECTS IN PAKISTAN

Pakistan had signed the United Nations Framework Convention on Climate Change (UNFCCC) as a Non Annex- I Party in June 1994 and, subsequently, adopted the Kyoto Protocol in 1997 and acceded to it on 11th January 2005 (CDM Pakistan)[4]. Being a non Annex-I country Pakistan doesn't have any emission reduction targets. It has ratified the CDM in February 2004 as a host country and now adopts CDM projects on voluntarily basis. Hereafter, Government of Pakistan declared Ministry of Environment as the "Designated National Authority" (DNA) fulfilling the requirements of the CDM structure. A body called, Clean Development Mechanism (CDM) Cell in the Ministry of Environment was established in August 2005 in order to provide technical and policy support about CDM projects to the government. In addition, a "National Operation Strategy for CDM" was also prepared and approved by the Prime Minister in February 2006. Besides, various other studies[5] have also been done in the context of Climate Change, mitigation and adaptation in Pakistan.

## 4.1 CDM projects in Pakistan

According to the CDM UNFCCC Website/UNEP Risoe database, there are 49 projects in Pakistan. These projects are at different stages of the project cycle: 13 are

[4] http://www.cdmpakistan.gov.pk/. Accessed on 25th July 2011

[5] For example the Study of Least-Cost Greenhouse Abatement for Asia (*ALGAS*), the UNEP country study on adaptation, the first National Communications on Climate Change (submitted in 199), two reports called the Task Force report on Climate Change (2008 and 2010).

registered. If the projects have been registered that means that the project has got the formal acceptance by the Executive Board after being validated. One project has requested registration (in CDM cycle it is called "requesting registration") and 35 projects are at validation. Validation means to have an independent evaluation of the project by a DOE in order to confirm that project meets the requirements of the CDM and hence is eligible for registration. All of these projects are expected to generate 5,972 thousand Certified Emission Reductions (kCERs) annually as is being shown in table 1 below.

**Table 2: Status of the CDM Projects in Pakistan till 1st April, 2012**

(Adapted from the data available on www.cdmpipeline.com till 1st April, 2012)

| Sr. No. | Status of CDM projects | 2Number | kCERs Annual |
|---|---|---|---|
| 1 | At validation | 35 | 4,134 |
| 2 | Total in the process of registration | 1 | 30 |
| 3 | Total registered | 13 | 1,808 |
| | Total | 49 | 5,972[6] |

### 4.1.1 How can CDM projects be categorized?

All the 49 CDM projects in Pakistan can be classified into following categories. These categories are made by UNFCCC and characterize the different nature of CDM projects.

[6] (5972 k CERs is the exact figure without round off, 5974 kCERs mentioned otherwise in the data represents the round up figure.)

In the table below, we see the largest contribution to CERs came from the few hydro projects followed by the contribution of two nitrous oxide abatement projects. The largest number of projects are energy efficiency projects followed closely by biomass energy projects. The size of the projects is given in estimated annual emission reduction i.e. these emission reductions are measured in tons of carbon dioxide equivalent.

**Table 3: CDM Projects in Pakistan (till Ist April, 2012) according to their types and CERs**

| **Type of CDM project** | **Number** | **Annual kCERs $tCO_2$** |
|---|---|---|
| EE own generation | 12 | 406 |
| **Biomass energy** | **11** | **796** |
| EE households | 6 | 217 |
| Hydro | 4 | 2050 |
| EE supply side | 3 | 166 |
| Methane avoidance | 3 | 138 |
| Landfill gas | 3 | 327 |
| $N_2O$ abatement | 2 | 1496 |
| Fossil fuel switch | 2 | 51 |
| Wind | 2 | 163 |
| Fugitive | 1 | 164 |
| Total | 49 | 5974 |

**Source: (data adapted from UNFCCC website on ist April, 2012)**[7].

### 4.1.2 Renewable Energy Projects in Pakistan:

In Pakistan, Renewable Energy Projects are categorized as Hydro Power Projects, Wind Power Projects and Biomass Power Projects. We don't have any Solar Energy based

[7] http://cdm.unfccc.int/

CDM Project in Pakistan as yet. The distribution of the Renewable Energy Projects is given as follows.

**Table 4: Renewable Energy Projects distribution in Pakistan**

| Types of Renewable Energy Projects | Number | Annual kCERs $tCO_2$ |
|---|---|---|
| Biomass Power Projects | 11 | 796 |
| Hydro Power Projects | 4 | 2,050 |
| Wind Power Projects | 2 | 163 |

**(Source: Pakistan's CDM website)**

As a result we can see that biomass energy projects are the most popular renewable energy projects in the CDM however it is also being reflected from the data in Table 3 that though the number of Biomass CDM projects is large than the rest of the renewable types of projects in the country but the amount of CERs being produced from these projects is quite small as compared to the Hydropower projects which are small in number but significantly large in terms of size.

## 4.2 Characteristics of Biomass CDM Projects

In Pakistan, Biomass CDM projects can be grouped in three categories in terms of types of projects, type of industries engaged in CDM projects, types of agricultural residues and monitoring methodologies. All of these characteristics have been described below in separate sections.

### 4.2.1 Nature of industries involved:

The industries involved in these projects are essentially textile, sugar and cement industries. Each type of the industries has been described below.

#### 4.2.1.1 Textile Industries:

In Textile industries, heat is basically required for steam production in the boilers. The steam is indirectly used in process dryers, steam jackets and directly in the winches. The process has been designed the way that can't be run without steam. The biomass is burnt in the husk chopper where in it is fed by trolleys and manually by workers. This chopper takes them to the ignition chamber where biomass is being burnt. After getting burnt, the heat energy produced is taken to the boilers where the heat is used to boil the water. Water is sprinkled on the flue gases and taken out of the chambers through an outlet chamber. Textile industries do not have process emissions as such but they have emissions due to energy consumption. CDM project will, therefore, tries to offset the fossil fuel emissions.

Textile industries are considered as one of the harmful industries to the environment in terms of water consumption and wastewater discharge. Besides these industries use a lot of heavy metals and chemicals in the dying process and hence release these heavy metals in the water discharge causing pollution (Green Choice, 2012 ).

#### 4.2.1.2 Sugar Industries:

There are three sugar plants having the CDM status. These sugar plants are basically involved in the production of sugar and they need energy in the process of sugar manufacturing. Sugar production requires high pressure steam to boil the extracted juices from sugar cane. Therefore bagasse is mostly burnt in the boilers to generate that steam. Sometimes steam is also run through turbines to produce electricity which is used to power the sugar mill equipment. Bagasse based projects are basically the cogeneration projects. Cogeneration is the process of generating heat along with the electricity together. PDDs of Bagasse CDM projects show that the energy generated in the Sugar Mills is used within the mill to meet their own requirement and in return they displace the fossil fuel based electricity from the grid. All of the bagasse CDM projects are energy efficiency projects.

Sugar itself has been considered as the environmentally most destructive crop that depletes the soil the fastest hence causing infertility in the fields. Sugar crop uses unsustainably huge amounts of water to grow. Considering the harmful impacts of the sugar in terms of environment when it grows and in terms of health when it is consumed in diet, people have argued to stop growing the crop.

#### 4.2.1.3 Cement Industries:

Four Cement industries in Pakistan are engaged in Biomass CDM projects.

In cement industries, Clinker manufacturing, which is a component of cement manufacturing, is a very energy intensive process. The pyro-processing stage is where a large quantity of heat is required to start the chemical reactions: evaporating all moisture, calcining the limestone to produce free calcium oxide; and reacting the calcium oxide with the minor materials (sand, shale, clay, and iron). This stage in the process requires the largest amount of thermal energy in the entire cement manufacturing activity. The cement industry produces process emissions and energy consumption based emissions. Cement industries produces both process emissions during clinker formation as well as the emissions due to energy consumption and in fact are environmentally most polluting industries (Worrel *et al*; 2001).

#### *4.2.1.4* Food Industry:

There is only one food industry actually involves in the CDM Project in Pakistan. It is basically rice processing unit that process rice and involves in de-husking, polishing, shining and packaging etc of the rice.

### 4.2.2 Type of residues:

Under CDM, Renewable Biomass is defined as woody or non-woody biomass from croplands/grasslands or from land areas that are forests. Also includes"….the non-fossil fraction of an industrial or municipal waste."(UNFCCC, 2012). As not specified in the definition, it then includes municipal solid waste (trash), tires, construction/demolition wood waste, crop and animal wastes, energy crops, trees, gas from digestion of sewage

sludge or animal wastes, and landfill gas. Hence biomass can include any non-fossil fuel that is arguably "organic."

Following are basically the types of residues find in the CDM projects found in Pakistan.

#### 4.2.2.1 Rice Husk:

The husk surrounding the kernel of rice accounts for approximately 20% by weight of the harvested grain (paddy). The calorific value of rice husk is given in the PDDs i.e. 12.73 GJ/tons however; we could not find the emission factor for rice husk anywhere in literature.

#### 4.2.2.2 Bagasse:

Bagasse is the fibrous by-product of sugar cane processing in sugar industries during the manufacturing of sugar. Bagasse is generated from sugar manufacturing in large quantities. Generally one ton of sugar cane produces almost 280 kg of bagasse (Sun *et al*; 2004). Bagasse has historically been known for its high heating potential. In general, bagasse has a heating value between 1,600 and 2,200 kcal/kg (3,000 and 4,000 Btu/lb) on a wet, as-fired basis (USEPA, 1993). The calorific value for bagasse given in PDDs is 14 GJ/tons.

It is primarily consisting of carbon (90.22%) and Silica (9.78%) (Hoang, 2001). Mostly bagasse has moisture content between 45 and 55 percent by weight. Calorific value of bagasse dried to half of its initial moisture content is about 10% higher (Anwar,

2010). Since bagasse is being considered as renewable since it is produced from an organic source in sugar season on continuous basis.

Energy efficiency projects form less fuel to generate the same amount of energy. Biomass is considered carbon neutral and yet more efficient burning generates emission reductions. Emission factors for biomass are not provided in the PDDs because of the carbon neutral assumption.

#### 4.2.2.3 Agricultural Residues:

Agricultural residues include a variety of agricultural field leftovers like Rice straw, cotton residues, wheat straw, wood waste, Corn cob, Poultry waste, textile waste, Cotton pods, Cotton shells, Corn stack, etc. These residues are basically collected from the fields and also from the small units like where wood is being cut and wood products are being made.

#### 4.2.2.4 Tire Derived Fuel (TDF) and Refuse Derived Fuel (RDF):

Tire Derived Fuel (TDF) and Refuse Derived Fuel (RDF) are also considered the alternate sources of fossil fuels and according to CDM definition TDF and RDF are also the types of biomass that are carbon neutral. Since they are organic so they are included in the biomass category. The PDDs of the cement CDM projects have given the values for TDF which is 26.77GJ/ton which is quite high and also for RDF it is 13.94 GJ/ton. The types of biomass being utilized in Pakistan's CDM projects are as follows.

**Table 5: Types of Biomass in Biomass CDM projects**

| Types of Biomass | Number of CDM Project |
|---|---|
| Rice Husk | 3 |
| Agricultural residues | 1 |
| Bagasse power | 3 |
| RDF + TDF +Agricultural residues | 4 |
| Total | 11 |

**(Source: PDDs of Biomass CDM projects)**

### 4.2.3 Nature of Biomass CDM Projects:

All the Biomass CDM projects fall in to the following three categories.

#### 4.2.3.1 Fuel switch Projects:

Fuel switch projects are those in which one fossil fuel is being replaced with another fossil fuel. For example, if in an industry coal was being used earlier and now under CDM they will use natural gas or biomass as a source of energy so these projects will be termed as Fossil fuel switch project. Some of the projects have partial fuel switches. Partial fuel switches mean that the biomass will be used as a fuel in combination of another fuel that is fossil fuel in Pakistan's case.

#### 4.2.3.2 Energy Efficiency Projects:

Efficiency projects are basically the energy efficiency projects in which the projects using some improved and more advanced technology improve their energy generation process. These are basically the cogeneration projects (producing both electricity and heat at the same time).

#### 4.2.3.3 Cement projects:

The third category is exclusively for the cement projects in which clinker production is involved. All of these projects are engaged in fuel switch from fossil fuel (that most probably is coal) to a mix of biomass.

### 4.2.4 Monitoring Methodologies:

A monitoring methodology refers to the method used by project participants for the collection and archiving of all relevant data necessary for the implementation of the monitoring plan. The Biomass Projects in this study can be summarized into three categories on the basis of nature of the projects and the type of Methodology they are having. These methodologies have been taken from the CDM website.

#### 4.2.4.1 Type I C:

"Thermal Energy production with or without electricity"

Sapphire textile, Kohinoor textile and Master textile and Engro Foods; all 4 of these projects are engaged in the burning of rice husk and in some case the agricultural residues only for the generation of heat energy in the boilers but are not producing electricity by burning of biomass.

**Baseline scenario:**

Thermal Energy would be produced by using more-carbon intensive technologies based on fossil fuel. Or Biomass residues could partly decay under anaerobic conditions,

bringing about methane emissions. Sapphire project uses natural gas and pet coke in the baseline, Kohinoor uses 100% pet coke, Master textile uses coal in the baseline. Whereas, Engro foods uses natural gas in the baseline.

**Project scenario:**

Generally the Project scenario involves the use of biomass residues for heat generation instead of fossil fuel. Biomass residues are used as fuel and decay of biomass residues is avoided. For example, in the projects we are studying, Sapphire CDM project employs a variety of crop residues besides rice husk which constituted the 50 % of the substitution while the rest is achieved by a mix of rice straw, cotton residues, corn residues, wheat straw, wood waste, bagasse. Kohinoor project is a partial fuel switch project in which up to 60% of rice husk will be used with at least 40 % pet coke. Masters Textile and Engro foods will be using Rice husk only.

#### 4.2.4.2 ACM0006:

"Consolidated methodology for electricity and heat generation from biomass residues"

Bagasse CDM projects in Pakistan have used this methodology. According to this methodology the number of offsets earned depends on the amount of Grid Electricity being displaced by electricity produced from burning bagasse. Madina Enterprises, Almoiz Sugar mill and the Shakarganj Sugar industry are all fall in this category. All three of these projects involve the burning of bagasse as a CDM project.

**Baseline scenario:**

Electricity and heat would be produced by more-carbon intensive technologies based on fossil fuel or less-efficient biomass power and heat plants. Biomass residues could partly decay under anaerobic conditions, bringing about methane emissions. Madina enterprises would have been using low pressure boilers and turbines and need to import grid electricity to run their sister steel mill. Almoiz and Shakarganj sugar projects also uses the low pressure boilers for burning bagasse which leads to inefficient burning of bagasse.

**Project scenario:**

Use of biomass residues for power and heat generation instead of fossil fuel or increase of the efficiency of biomass fuelled power and heat plants. Biomass residues are used as fuel and decay of biomass residues is avoided. Madina enterprises uses a mix of bagasse and rice husk to produce power and heat; and feed a sister steel mill of the same unit by installing high pressure turbines. The CDM project scenario for the other two projects i.e. Almoiz and Shakarganj projects is also the installation of high pressure boilers and turbines.

#### 4.2.4.3 ACM0003:

"Emissions reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement or quicklime manufacture". This monitoring

methodology has particularly been designed for the Cement industries. The four cement CDM projects i.e. Attock cement, DG cement, DG Khan cement and Lucky cement projects are included in this category.

**Baseline scenario:**

Clinker or quicklime is produced using more-carbon-intensive fuel and/or decay or uncontrolled burning of biomass leads to $CH_4$ emissions. In the baseline scenario all the four Cement projects were using Coal.

**Project scenario:**

Clinker or quicklime is produced using less-carbon-intensive fuel and/or alternative fuel and/or biomass is combusted. In the project scenario, Lucky cement will be using RDF, TDF and rice husk only. While Attock cement, DG Khan and DG Cement project will be using agricultural residues such as, rice husk, corn cob, wheat straw, bagasse; textile waste; tire waste; and refused derived fuel (RDF).

### 4.2.5 Annual Estimated Emission Reductions of Biomass CDM Projects:

Following is the chart showing the annual estimated CERs of each individual CDM project.

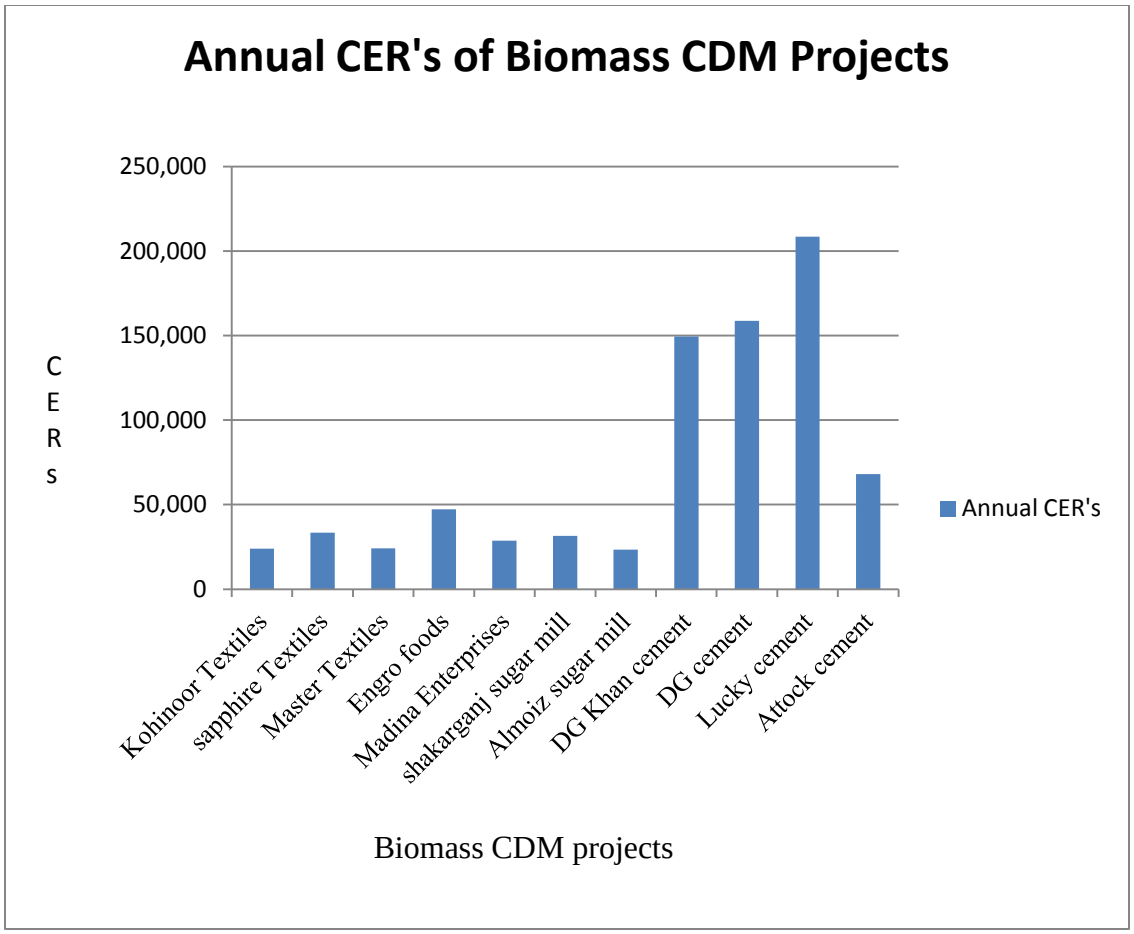



**Figure 2: Annual Estimated Emission Reductions of Biomass CDM Projects**

CERs for the cement projects are excessively higher than the rest of the projects. This chart reflects the amount of energy consumption in the Cement industries which is quite large. The more the number of CERs, the larger the amount of energy consumption in these industries. Also the textile and sugar industries are less energy consumptive industries as compared to cement industries. Therefore, the alternate sources of energy like tire derived fuel (TDF) and refuse derived fuel (RDF) being used in these cement projects that are more energy intensive and hence enable the projects to meet the energy

requirements and earn large number of CERs. The CERs for textile and sugar mills CDM projects are more or less of similar trend which shows that they are not that much energy intensive.

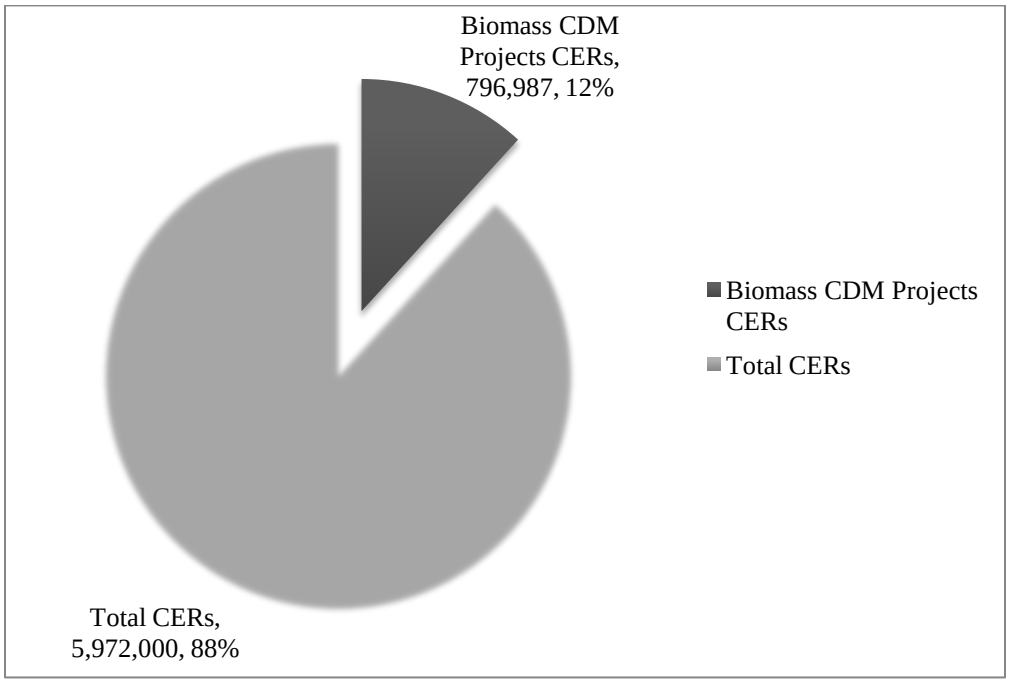



**Figure 3: Percentage CERs of Biomass Projects among total CERs of CDM Projects in Pakistan**

Though the number of Biomass CDM projects is significant but they do not contribute significantly in the total CERs earned by the CDM projects. As it is being shown above in the Fig. 2 that the 11 Biomass CDM projects make only 12 % of the overall CERs in the country showing the Biomass CDM projects do not generate significant amounts of CERs.

**Table 6: Summary of the Biomass CDM projects**

| **Name of the Industry** | **Nature of Industry** | **Type of Biomass** | **Annual CERs $tCO_2$** |
|---|---|---|---|
| Kohinoor Textile | Textile | 60% rice husk+ 40%pet coke | 23,912 |
| Sapphire Textile | Textile | Rice husk 50%<br>Rice straw 5%<br>Cotton residues 15%<br>Corn residues 10%<br>Wheat straw 5%<br>Wood waste 10%<br>Bagasse 5% | 33,502 |
| Masters Textile | Textile | Rice husk | 24,177 |
| Engro foods | Rice processing plant | Rice husk | 24,177 |
| Madina Textile | Sugar and steel mill | Rice husk +bagasse | 28,684 |
| Shakarganj, Bhone | sugar | bagasse | 31,482 |
| Almoiz | Sugar | bagasse | 23,319 |
| DG Khan Cement | cement | rice husk, corn cob, wheat straw, bagasse; textile waste; tyre waste; and refused derived fuel (RDF) from Municipal Solid Waste (MSW) | 149,469 |
| DG Cement | Cement | rice husk, corn cob, wheat straw, poultry waste, agro-waste and refused derived fuel (RDF) from Municipal Solid Waste (MSW) and tyre waste | 158,781 |
| Lucky cement | cement | 50% (TDF+RDF+Rice husk) | 208,484 |
| Attock cement | Cement | rice husk, corn cob, cotton straw, Tyre Derived Fuel (TDF) and Refused Derived Fuel (RDF) | 68,007 |

**(Source: PDDs of Biomass CDM projects)**

# 5 ARE THE BIOMASS CDM PROJECTS IN PAKISTAN REALLY ADDITIONAL?

Additionality is the most important tool in CDM to ensure the environmental integrity of the CDM projects. It is basically done to show that the emission reductions made through the project would not have happened without CDM project. Additionality is defined as follows:

"*A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity*" (UNFCCC, 2002)

The additionality test holds a particular significance because if non additional projects get registered, it would lead to an overall increase in the emissions (Schneider, 2007).It is applied basically to separate the CDM projects from business as usual projects. Also, it is intended to separate out these projects that are executed because they are economically beneficial to the investor and just happen to have incidentally.

## 5.1 How Additionality is demonstrated in Pakistan's Biomass CDM projects:

All the Biomass based CDM projects have been classified into fuel switch projects or energy efficiency projects. Fuel switch projects have used the financial analysis while barrier analyses tests are done in the energy efficiency projects. As already

described, financial analysis is considered to be more rigorous and hence is more reliable in proving the additionality of the CDM projects. Whereas the Barrier analysis is like telling a good story and depends on how better a story has been constructed (Haya *et al*, 2009). Following is the description of the tests being employed in the Biomass CDM projects in Pakistan.

### 5.1.1 Financial Analysis:

The investment analysis is based on the idea that carbon credit revenues improve the financial returns of projects, making CDM projects viable compared to the project without CDM revenues which is seen to be unviable. It assesses the financial returns of the proposed project, most commonly in terms of Internal Rate of Return (IRR). A benchmark is defined that represents the threshold financial returns defining whether the project would go forward. If the expected financial returns are below the benchmark, then it is assumed that the project most likely would not have gone forward without carbon credits and the project is considered additional. The investment analysis is done to find out the difference between the expected returns from the proposed CDM project and the benchmark. If the returns are below the benchmark, the project would not be built, above it, it would.

All rice husk and Cement based CDM projects in the study have used Financial analysis. They have shown in their PDDs that the price of biomass and the related installations costs make the rate of returns to fall. Hence the projects required extra

revenues to build make it a CDM project that would be possible through the sale of CERs.

### 5.1.2 Barrier Analysis:

The barrier analysis describes and presents evidence for the existence of one or several barriers that prevent the proposed CDM project from going forward without the additional income from carbon credit sales. The Bagasse based projects use Barrier Analysis as they are only energy efficiency projects shifting from low pressure boilers to high pressure boilers.

In bagasse based CDM projects, Common practice barrier is usually used to prove the additionality. Common practice barrier means that there is no tradition of using the method or technology that will be employed by the respective CDM project. And it is being claimed in the PDDs that the high pressure technology has not been used earlier commonly in sugar industries in Pakistan. Therefore, the projects need extra revenues in the form of CERs to have a CDM project. In literature, McNish (2009) has described that there is a lot of potential of reducing emissions through bagasse cogeneration However; on the other hand, Haya *et al* (2009) has described that particularly in the bagasse CDM projects, there is a need for the sectoral targets in order to achieve emission reductions rather than individual CDM projects

The type of additionality being used in each project is given below.

**Table 7: Additionality of Biomass CDM projects used in individual projects**

| Industry | Additionality Analysis | |
|---|---|---|
| | **Financial Analysis** | **Barrier Analysis** |
| Kohinoor Textile | ✓ | |
| Sapphire Textile | ✓ | |
| Master Textile | ✓ | |
| Engro foods | ✓ | |
| Madina | | ✓ |
| Shakarganj, bhone | | ✓ |
| Almoiz bagasse | | ✓ |
| DG Khan cement | ✓ | |
| DG cement | ✓ | |
| Lucky cement | ✓ | |
| Attock cement | ✓ | |

**(Source: PDDs of the Biomass CDM Projects)**

## 5.2 Motivation for Biomass CDM projects:

This section is based on the analysis of the information being drawn in the interviews with the CDM Project Mangers during site visits.

### 5.2.1 Alternative to gas load shedding and HFO:

In order to investigate the reasons for adopting Biomass CDM projects, questions were asked to explore the reasons to choose CDM projects. One of the reasons we were told for Biomass CDM projects were the severe energy crisis in Pakistan. Particularly Gas Load shedding has forced the industrial sector to shift to Biomass burning. Though for industries, Sui gas is the cheapest source of fuels in Pakistan. The rough figures being quoted by the CDM managers during the interviews were that heat or electricity being

produced from using Gas is the most convenient for the industrialists. The cost per unit of energy production while using gas is Rs 5-6. However, the severe gas load shedding in the last 3-4 years had forced the industrialists to look for alternative sources of energy. One of the options available to them is to use Heavy Furnace Oil (HFO) but it costs them very high that is almost Rs 12-13 per unit of energy production. The second largest energy source after gas as fuel in the industry is furnace oil fuel which is expensive and associated with environmental concerns.

Therefore they prefer to move towards energy resources like Biomass, rice husk etc that costs 8-9 Rs / unit of energy production which is costlier to Sui gas but cheaper than HFO. So the industries particularly the textile industries are moving towards use of Biomass for energy production in the non availability of Sui Gas. This suggests that these projects are being executed for economic reasons rather than the environmental reasons.

There is frequent shut down of the gas in the industry which is hampering industrial activity badly. Industry is looking for different alternatives to Sui gas. One of the alternative fuels is the rice husk due to its cheap price and availability in the country. Though the burning of biomass in industries is not new at least in Pakistan but it is now gradually increasing. The gas load shedding becomes worse in winter season so the best alternative industries can have in this case is the rice husk and other agricultural residues so that the process of production keeps on going. Therefore in such a situation where in they are forced to make a switchover from fossil fuel to the biomass, they also apply for CDM registration because as according to one interviewee “if the project gets approved

that would be fine and good, if not there would be no harm since we have not invest anything big".

Sometimes no extra investment is required in the case of Biomass installations because we were told during the interviews that the boilers being running in the industry were locally manufactured and they required just small fixings that could be done easily. Also the industrialists do not worry about the transaction costs involved because do not need to pay carbon consultants. Carbon consultants will do all the data collection, documentation and communication with the Executive Board and DOEs. These consultants will get a certain percentage of the CERs when the project will get registered.

### 5.2.2 Green Environmental Label:

It was also found that having a CDM project gave the industries an added advantage of being environmentally Green. Since this label can help them to have more international clients and increased orders. Sometimes the project developers are advised by their partners in the other developing countries like India to have a CDM project.

The interviews revealed that Biomass CDM projects have skeptical additionality in the eyes of participants in the CDM project cycle. In the interviews, carbon consultants stated categorically that almost all the CDM projects are non-additional whether they are biomass or non-biomass. As it has been discussed in the last section 5.2.1, that these projects had to take place in any case therefore it is difficult to call them additional. There are many other industries that are using rice husk and bagasse as an

alternative fuel but they have not have claimed themselves for CDM projects. for example, Ghee Mills, Paper industries, cardboard manufacturing units etc to name a few.

### 5.2.3 How Biomass prices have fluctuated during the CDM projects:

Rice husk has been used for variety of purposes such as fuel, fertilizer, soil conditioner, animal feed, etc (Papong et al., 2004; Gilbertson, 2009 and Lal, 2005). Currently, the rice husk has got a monetary value as an important raw material for many industries. Considering the commercial use of rice husks, rice husk has been sold by the rice mills and shellers to the other industries. Biomass prices have increased overtime due to its increased commercial significance. Biomass prices have increased gradually from Rs120 to Rs340 per 40 kg over the period of last four years that is constantly increasing. Their prices also vary from season to season. In rice season, the availability of rice husk is easy for the industries. While in winter season the price of rice husk particularly rose to Rs 440/40 Kg.

In the PDDs it is mentioned that through pricing biomass, the rural people would be benefitted from selling the biomass to CDM industries. However, in the interviews it was found that Rice husk projects do not give any extra income to the farmers in the form of a price premium. It gives an extra income to the rice mills (owners) rather than the farmers directly.

## 5.3 Carbon Offsetting:

Carbon offsetting is the replacement of projects emitting carbon (or other GHGs) by projects emitting less carbon and thereby offsetting carbon emissions. Biomass burning is considered a carbon offset process as biomass is assumed to be carbon neutral. But the question arises that does biomass burning not emit $CO_2$ when it is burnt? This is obviously a fake assumption. So why is biomass considered to be carbon neutral?

### 5.3.1 Carbon neutrality:

Under the UNFCCC accounting systems, the $CO_2$ emissions produced from biomass burning are not accounted for in the energy sector, resulting in what is referred to as the 'carbon neutrality' assumption (UNFCCC, 2006). Biomass burning is accounted for in land use changes like deforestation. Though all $CO_2$ molecules have similar chemical and physical properties they have different climatic effects depending upon the source of emission. The difference between the two types of $CO_2$ molecules has been explained below in detail.

#### 5.3.1.1 Fossil Carbon and Biotic Carbon:

The concept of carbon neutrality arises from considering the difference between sources of $CO_2$ emissions in the atmosphere i.e. Fossil Fuels and Biomass sources. Carbon being released from the burning of biomass is known as Biotic Carbon and the Carbon being released by the burning of Fossil fuels are known as Fossil Carbon. Fossil

fuels (oil, gas and coal) are formed over hundreds of millions of years from decomposing plants. They are energy dense fuels and produce $CO_2$ on the burning of fossil fuels to generate energy. The carbon released from burning of fossil fuels has actually been locked up underground in the fossil fuels geologically over millions of years. This fossil carbon was the part of an inactive/inert pool that does not come into contact with the terrestrial carbon until or unless it is burnt. $CO_2$ being released into the atmosphere will remain there above the ground for thousands of years. It never gets re-fixed underground on human time scales. This process only takes place on geological timescales. Therefore the carbon gases released from burning of fossil fuels will accelerate the process of climate change by adding additional GHGs to the atmosphere.

Biomass (plants or crops) fix carbon dioxide from the atmosphere during the process of photosynthesis. When biomass is burnt for energy, this process of burning releases $CO_2$ into the atmosphere (along with various other gases) that it had absorbed from the atmosphere during its growth period. This released $CO_2$ gases from burning are assumed to be taken up back by the plants. Hence the carbon continues its cycle being the part of an active pool in the process of regrowth of the biomass. This process of regrowth is different for different types of biomass. Because the carbon emitted when plants are burned is equal to that absorbed during regrowth it seems self-evident that biomass is a zero carbon (or carbon neutral) fuel.

Terrestrial carbon consists of carbon dissolved in the oceans, soil carbon, plants and organic carbon and atmospheric carbon. This is part of an active pool with

considerable movement between the different pools within it. Climate instability has been created from the transfer of carbon from fossil carbon locked underground in an inactive carbon pool into carbon in the atmosphere created by the burning of fossil fuels and now becoming part of the an active pool of carbon involving the soils, plants, oceans and the atmosphere. The Carbon neutrality concept applies that the carbon which is the part of this active pool does not necessarily lead to increase in the overall $CO_2$ concentrations in the atmosphere. Hence the process of burning biomass does not result in the accumulation of carbon in the atmosphere on a long time scale as biosequestration will return the atmospheric carbon to the plant carbon pool.

Biomass has been further classified into Renewable and non renewable sources considering the time required for biomass to regrow. Renewable Biomass includes the crop and plants which can regrow on annual basis (take a year or so to regrow). While non renewable Biomass includes the biomass that takes more time like years or decades to regrow hence called non renewable biomass i.e. trees. However, the distinction between the renewable and non renewable is not precise and uncertainties relate to changes in soil carbon.

#### 5.3.1.2 Emissions are not equal to sequestration:

Fuel burning will leads to release $CO_2$ in the atmosphere in any case, regardless of the resource whether it is fossil fuel or biomass. Biomass like crop residues is a principal source of Carbon and contains various other nutrients that are presence in the biomass ash

after burning. Now once released into the atmosphere, it might take years to fix it back in the sequestration process. Burning is an instant process where emissions released at once from the burning of biomass. On the other hand, sequestration is a complex process which might take years or decades to take place and re-fix the Carbon that has been emitted in the process of burning. Hence, burning can never be equated with sequestration process except over long time periods. A time delay is involved which means the carbon being emitted from the burning process will be remained in the atmosphere until or unless it gets reabsorbed by the plants. This time is longer i.e. from 40 to 50 years in case of burning woody biomass like trees (O'Laughlin, 2010). But also in case of burning crop residues, the carbon going to be emitted in the atmosphere will stay there for a certain period of time that can vary producing the immediate effects of increased $CO_2$ in the atmosphere. Since the Earth has already crossed a threshold of $CO_2$ concentrations in the atmosphere, feedback processes will keep on accelerating the process of global warming (Rockstrom, 2009). Whereas the climate crisis requires reducing emissions now in order to control its destructive impacts. Emissions now and after may have quite different impacts on climate change dynamics because of these non linear effects. In this respect, time is very important consideration in order to address climate change (Searchinger, *et al*; 2009). The assumption of carbon neutrality can actually lead to other environmental issues like metabolic rift, soil carbon depletion, soil infertility etc. These issues have been discussed in the section chapters.

# 6 EMISSION MITIGATION AND SUSTAINABLE DEVELOPMENT

Biomass CDM projects are considered to be the type of CDM projects that involve a rural community and are more likely to have sustainable development aspects. Therefore, Biomass CDM projects are being highly praised for achieving the two goals (Emission Mitigation and sustainable development) more efficiently than any other type of CDM projects. These projects are assumed to provide not only a renewable and cleaner source of fuel but also because it provides an additional source of income to local people. In this chapter we elaborate on how the environmental benefits have been presented in the PDDs. We intend to contrast that with the way in which these environmental problems are described in environmental science and its research literature.

All biomass based CDM Projects are the carbon offset projects. So they all are meant to reduce the $CO_2$ emissions as such. PDDs also state the benefits like employment generation, community engagement etc being offered by the CDM projects. PDDs state that Rice husk has been utilized in an uncontrolled manner in brick kilns and the waste is allowed to decay in the fields. Burning in an industrial context will give a sustainable way of disposing off the rice husk.

## 6.1 Environmental Benefits as presented in the Project Design Document (PDD):

Following it has been described as what are the environmental benefits claimed in the biomass CDM projects and their PDDs.

1. **Air Pollution:** Reduction in local air pollutants will happen which will benefit the local community due to reduced costs for health care. Cement projects mentioned the improvement of the local environment by reduction of particles emission to the atmosphere. Use of municipal solid waste as RDF will help reduce the uncontrolled burning and decaying of municipal solid waste. Use of municipal solid waste as RDF will help reduce the uncontrolled burning and decaying of municipal solid waste. Use of scrap tires as TDF will result in abatement of environmental hazards associated with their uncontrolled burning.
2. **Cleaner Energy:** Improvement of the local environment by less contamination through replacement of fossil fuel based energy by electricity. Cleaner energy is one of the benefits that PDDs mentioned when using Biomass as a source of fuel in the industries.
3. **Job Opportunities**: The projects, according to PDD, will create new opportunities of jobs for local people and contribute to renewable energy development in the industrial sector in Pakistan.
4. **Presenting climate mitigation efforts again under sustainable development:** GHGs reduction is also reported in the sustainable development sections along with the other benefits in all the PDDs. The bagasse based CDM projects have particularly mentioned that displacing the fossil based grid electricity in the baseline by renewable biomass

residues (rice husk and bagasse) and by this means resulting in reduction of GHGs emissions. Conservation of local fossil fuel resources by avoiding fossil fuel based electricity from the power plants connected to the grid.

The statements made in environmental benefits section are more or less similar in every Biomass projects with little alterations depending upon the particular nature of the project. In every Biomass CDM project, it is mentioned that the local environment will be improved as a result of the project. Since the project will result in decreased GHG emissions and less particulate emissions to the atmosphere. As the environment will be improved that would provide health benefits. Naturally, the CDM bureaucracy focuses on CO2 pollution in the environment. However, there are various other problems created due to the burning of agricultural residues or RDF/TDF in the atmosphere but they are frequently not mentioned but if mentioned, they are downplayed in PDDs.

### 6.1.1 Air Emissions:

The interviews with the CDM Project Managers particularly in CDM Textile industries revealed that air emissions were one of serious problems in these industries. The project developers are themselves aware of this problem. On questioning about the emissions from biomass burning, one CDM manager told us about the dust emissions from the burning of biomass. One of the industries where CDM Projects were visited is located in the Sundar Industrial Estate, Lahore. He told that the neighboring industries in

the vicinity have serious problems from burning of biomass residues particularly the paint industries. These paint industries have been complaining again and again about the settling of biomass dust on their products and machinery.

It was also being told that the dust and emissions controlling devices have not been installed in these industries. The respondents were clear to say that the industrialists only see their profits and do not want to make extra investments. The CDM managers in the industries stated that they should install Electrostatic precipitators but they cannot because they are very expensive.

The major source of air pollution in sugar mills relates to boiler emissions. Boilers are operated under three different conditions: fuel oil only, bagasse only, mixed fuel (fuel oil and bagasse). The choice of fuel source significantly changes the emissions mix. Bagasse dust, fly ash and high noise levels (reaching up to 109 dB) are particular health irritants in sugar mills.

These results also agree with general observations by Kolshus *et al*. (2001), confirming that biomass CDM projects regularly have a negative impact on air quality (Parnphumeesup and Kerr, 2011) also mentioned the problems like air pollution and dust due to these projects.

### 6.1.2 Water consumption:

From sustainable development point of view, CDM project should take care of the water resources, assure the less water consumption and also ensure waste water treatment. It was found in interviews that water utilization is increased by many folds in case of Biomass consumption. It has also been supported by literature as well (Gilbertson, 2009). Biomass burning process produces a large amount of ash particles. The ash particles are removed from the chamber where water is showered on the incoming ash laden flue gases. The CDM project Managers informed that the amount of water being used in during the biomass usage increases from $2m^3$/ton to $6m^3$/ton. Industries take the water from the aquifer free of charge and the issue of excessive water consumption can lead to water scarcity in the locality.

Waste water treatment plants (WWTP) have been mentioned in IEEs but industries usually have a square open plot into where the boilers discharge their wastewater. Ash is taken out of the rice husk boiler manually just to keep the flow of water smooth. This ash is then collected to be disposed off in open field outside the factory. The water pond runs into a drain which just goes out crossing the industry boundary wall sometimes into a bigger drain or sometimes into open fields outside. They also made the point saying that the WWTP could not function since they also need energy to run.

### 6.1.3 Solid waste:

The composition of rice husk is basically composed of Silica. When rice husk is burnt, silica keeps on depositing in the bottom of the chamber in the form of huge balls. In order to clean the chambers during or after the burning process, this Silica ball is just taken out and disposes off in the nearby land. In one case the respondent said that this ash being produced after rice husk burning is taken out of the burning chamber and place on one side within the industry. Farmers from the villages come and take it for free utilizing it as fertilizers in their fields. Whereas the usual practice for the rest of the industries is to dump the ash outside the factory.

### 6.1.4 Health Problems:

Biomass factories throughout the World are the source of serious health and respiratory problems. Silicosis is the respiratory problems caused by silica being emitted into the air through emissions. As it is shown below that when rice husk is burnt, silica makes a significant component of rice husk ash which can cause silicosis in workers and the people living around such facilities.

Silicosis is an occupational related lung disease. It is caused by inhalation of crystalline silica dust, and is marked by inflammation of lungs (Pelucchi *et al*; 2006) Silicosis (particularly the acute form) is characterized by shortness of breath, cough, fever, and bluish skin. It may often be misdiagnosed as pulmonary edema (fluid in the lungs), pneumonia, or tuberculosis. It basically falls in the category of occupational

diseases. The Table 8 shows the chemical composition of the rice husk that shows that almost 74% of the rice husk is composed of organic material while 22 % silica is present. While Table 9 shows the chemical composition of rice husk ash. And it can be observed that after burning the organic material disappears and the left over ash is composed of 80% silica. This silica rich ash causes the respiratory problems when inhaled.

**Table 8: Chemical analysis of rice husk**

| **Chemical analysis of rice husk** | |
|---|---|
| **Constituent** | **Content (wt %)** |
| Organic material and moisture | 73.87 |
| $Al_2O_3$ | 1.23 |
| $Fe_2O_3$ | 1.28 |
| CaO | 1.24 |
| MgO | 0.21 |
| $SiO_2$ | 22.12 |
| $MnO_2$ | 0.074 |

**(Source: Sharma *et al*; 1984)**

**Table 9: Chemical analysis of rice husk ash**

| **Chemical analysis of rice husk ash** | |
|---|---|
| **Constituent** | **Amount present in rice husk ash (wt %)** |
| Silica ($SiO_2$) | 80 |
| Alumina ($Al2O_3$) | 3.93 |
| Sulfur trioxide ($SO_3$) | 0.78 |
| Iron oxide ($Fe_2O_3$) | 0.41 |
| Calcium oxide (CaO) | 3.84 |
| Magnesium oxide (MgO) | 0.25 |
| Sodium oxide ($Na_2O$) | 0.67 |
| Potassium oxide ($K_2O$) | 1.45 |
| Loss on ignition at 850 $^oC$ | 8.56 |

**(Source: Ismail *et al*; 1996)**

Excessive exposure to fly ash and bagasse dust may cause irritation to eyes, asthma, and other respiratory diseases including bagassosis (a lung disease caused by inhalation of bagasse dust).

### 6.1.5 Employment Generation:

Employment generation is being reported as one of the significant aspects in terms of renewable energy production. del Rı´o and Burguillo (2009) found out employment opportunities as one of the outstanding features of Renewable energy projects. The PDDs of the Biomass CDM projects stated along with other benefits that their projects create job opportunities for local people. And also generates an extra stream of income for the farmers through sale of crop residues and other biomass. Indirect employment is generated in collection and transportation of the biomass from the fields to the plant site.

However, local situation was found to be different in which farmers had no participation. In the interviews it was found that Rice husk projects do not give any extra income to the farmers in the form of price of biomass. It gives an extra income to the rice mills rather than the farmers. CDM Industries usually buy rice husk from other rice processing mills and bagasse from sugar mills.

The interviews also revealed that there was not a significant employment generation in case of Biomass CDM projects. The few jobs that are created are low level

jobs like truck driver, helper etc. A supplier was contacted in this regard and asked if there were benefits accruing to him due to the CDM projects. He replied that this was a routine work for him. He is an all time driver and it does not matter at all to which industry he is supplying Biomass. He mentioned that besides textile industries, he supplied biomass to many other industries as well like paper industries, ghee mills, etc. Carbon consultants and CDM Managers both were also not very optimistic about the employment generation and were of the view that the employment generation is not significant in CDM projects. For them the most important thing is to get the project registered for CDM.

### 6.1.6 Stakeholders meetings:

The CDM project are intended to address the sustainable development indicators i.e., economic, social and environmental. For the assessment of these indicators as positive or negative, on-site measurements and stakeholder meetings are held. The community ownership of these projects is intended and there should be a healthy involvement and representation of the community in such meetings. However, the credibility of stakeholder meetings has also been raised in the literature. It has been argued that real stakeholder participation is necessary for the project implementation but critical aspect is that it is just present in the PDD on paper and has no real significance.

The interviews raised such questions as well and project developers and consultants revealed that these meetings and stakeholder participation are nothing but a

place filler that they have to present in the PDD. On the ground, local people and other stakeholders have no practical role in decision making. The interviews revealed that locals are not involved or encouraged to play an active role in the decision making process and these meetings are for public consumption. Centre for Science and Environment (CSE) indicates this aspect in a study in India. In India, the CSE has observed that stakeholder comments have frequently been cut and pasted from one PDD document to another PDD document (Down to Earth, 2005). It was seen that the same questions were asked and more or less same comments are repeated in the PDDs. The stakeholder comments were repeated in many documents. This shows the actual significance of these stakeholders meetings.

Stakeholder participation is actually a part of a bigger issue and not just in case of CDM. In order to address the issue of climate change, the need is to address the issue of "climate injustice". Climate Change has differentiated impact on people so climate mitigation efforts should also focus on impacts on people. Stakeholder's meeting has been made a compulsion in the CDM process to ensure the communal participation in the process. This is the way to ensure the community participation in the project activity. For stakeholder's meetings there was a consensus among all the interviewees that this is just a formality fulfilled in a very perfunctory way. Actually the requirement is to have some photos of the event that has taken place.

### 6.1.7 Impacts on Soil Fertility:

Burning of agricultural residues and biomass in industrial factories may imply some long term impacts on the soil structure and soil fertility. Soil Organic Carbon (SOC) has been remained a focus of researchers to find out the appropriate values for SOC for plants proper growth. The carbon being released from the burning of biomass is assumed to be come from the atmosphere, though it might have also come from the soil which is actually the largest reservoir of Carbon. Hence it can disturb the soil structure and its fertility because Soil Organic Carbon (SOC) is an important characteristic of the soil that needs to be assured. Therefore it is not always necessary that the $CO_2$ being released into the atmosphere from the burning of biomass has come from atmosphere only and not from the soil. Hence researchers have argued that changes in the size of the various terrestrial pools also need to be measured and assessed.

The three large carbon pools on biosphere are given as following.

**Table 10: Relative Sizes of Carbon Pools**

| **Carbon Pools** | **Size (Billions of tons)** |
|---|---|
| Soil | 1600 |
| Atmosphere | 750 |
| Terrestrial vegetation | 540-610 |

**(Source: GRID-Andreal, UNEP, 1998)**

Crop residues are also a principal source of Carbon, which constitutes about 40% of the total biomass on dry weight basis (Lal, 2005). In terrestrial ecosystems there are two

interrelated processes in terms of carbon sequestration from the atmosphere. First one is sequestration of carbon in biomass and second one is the sequestration in soil. The biomass which is returned to soil is converted into stable humic substances with long residence time. Therefore the carbon sequestration in soil depends upon the quantity and quality of biomass returned to soil. Most importantly, crop residues are the principle source of biomass in crop fields. Its quantity defines the health of the soil in terms of carbon.

Traditionally, crop residues were made to be burnt on the fields after the harvest. This practice used to increase the soil ability to re grow crops for the next season. If large amounts of crop residues and agricultural residues are burnt outside the fields as in industries, they might be helpful in providing energy but they cannot serve the purpose of clean development unless the impact of crop residues removal on SOC is understood. Such practices could lead to long term soil nutrients imbalances hampering the plants growth while transferring a stock of carbon from the soil and into the atmosphere.

### 6.1.8 Emission Factors:

Emission factor is defined as the amount of $CO_2$ emitted per unit of energy produced.

**Emission Factor = $CO_2$/ Energy**

Since Biomass is considered carbon neutral, their emission factors are taken as zero. In PDDs the emission factors of the biomasses have not been given at all. However, biomass

does have an emission factor. Technically, Biomass is a dirtier fuel compared to that of coal when burnt. An analysis of emission factors for fuels shows that natural gas is the least polluting fuel with respect to magnitude of emissions per heat unit. Lignite is the most polluting fuel with considerable negative climate change impacts. Fuel oil and diesel have roughly similar emission factors. Residual fuel oil (RFO) also has an emission factor that was slightly higher than the average for fuels in the energy sector. Gas/diesel oil, which in Pakistan is referred to as High Speed Diesel (HSD), has the highest polluting potential within the fuels used in the road transport sector. As it is shown in the following table, IPCC has given the emission factor values of Wood, Oil, coal and Natural gas.

**Table 11: IPCC Emission Factors of various fuels (2006)**

| **IPCC Emission Factors (2006)** | | |
|---|---|---|
| | **Fuel** | **$GgCO_2/MJ$** |
| Wood | Solid Biomass | 100.0 |
| | Wood/wood waste | 112.0 |
| Oil | Diesel/RFO | 74.1-77.4 |
| Coal | Anthracite/lignite | 98.0/101.0 |
| Natural gas | | 56.1 |

**(Source: IPCC Emission Factor (2006)**

Even in literature (Petersen, 2006), the higher emissions from burning of wood and biomass has been reported particularly in coal-based power plants.

### 6.1.9 Energy Intensity of Fossil Fuels and Biomass Fuels:

The energy intensity is defined as the amount of energy produced per unit of mass.

**Energy Intensity = Energy/ Mass**

Since the energy intensity of the biomass sources is smaller than that of fossil fuels, larger quantities of biomass needs to be burnt in order to meet the same energy requirements which not only produce more gases, but dust particles and other pollutants as well causing local pollution problems. A comparison is given in the following two tables.

**Table 12: Energy intensities of Fossil fuels**

| Fossil Fuels | Calorific value |
|---|---|
| Natural Gas | 34.36 MJ/m3 |
| Coal | 26.1 GJ/ton |
| Residual Fuel Oil(RFO) | 41.03 GJ/ton |
| Furnace oil | 43 GJ/ton |

**(Source: PDDs of the Biomass CDM projects)**

**Table 13: Energy intensities of Biomass fuels**

| Biomass Fuels | Calorific Values (GJ/ton) |
|---|---|
| Rice husk | 12.73 |
| Bagasse | 14.011 |
| Corn cob | 15.6 |
| Wheat straw | 14.99 |
| Poultry waste | 10.72 |
| RDF | 17.63 |
| Tyre waste | 28.26 |
| Agro waste | 12.14 |

**(Source: PDD of the Biomass CDM projects)**

#### 6.1.9.1 Disinterest of industrialists in CDM:

The biomass CDM Projects Managers in Textile industries were not very satisfied with the whole process of CDM project.

First of all, they have to provide the information about production capacity, Energy consumption, data regarding energy bills etc to the carbon consultants and DOEs. This is something the industrialists don't like because according to them they can't provide exact information to outsiders; otherwise it might create other issues as well. So there are issues in the data provided by the industries.

Secondly, the process of CDM getting approved and the issuance of the CERs is very lengthy and slow. In interviews it was highlighted that we had gone for CDM because we were convinced by the carbon consultants that it will give us some market benefits like green label and extra financial flows. Again, in these interviews, it was found that the industrialists were not happy about CDM. They found the procedures of the project cycle too difficult and complex. According to them, the processes take too much time to be completed.

Thirdly, they are not serious about by the financial flows that accrue to them in the form of CERs. On asking the reason for having little interest in earning CERs, they responded ridiculing by claiming after so much effort, commitment and time wasting, the amount of money they get is just like cream on the top of the cake. They said that CDM could be fruitful for the very large industries having huge investments and production.

Because only such industries with large set ups can afford the time delays in the procedures, spend money and engage in meetings with carbon consultants, DOEs, stakeholder meetings etc. this reinforce the perception of CDM being biased in favor of the large polluters.

# 7 CONCLUSION

Creation of Carbon market is the result of internalizing the cost of Environmental degradation. It is presented as the polluter should pay. Since environmental costs were always treated as an externality and not included in economic calculations. These markets were created in response of the criticism to include the cost of the environmental damage into the economic calculations. The idea is that environment can be sustained by putting a price on nature. In this situation, people not directly engaged in environmental damage should benefit.

Biomass CDM projects can be taken as an example of how biomass has been commodified in the process of climate mitigation. Crop residues like rice husk, agricultural residues etc have been freely available for different purposes and were employed by local people to fulfill their energy and other needs. Now biomass has a price and it is assumed that it would be helpful in achieving the sustainable development. It is being considered that through commodification of biomass, farmers will get extra benefits though which is not the case found. Much literature has explored that the results of the commodification of nature do not necessarily benefit the poorer sections of society frequently dependent on biomass for their sustenance and livelihood (Agarwal, 1985).

Considering the amount of energy required, it has been found that the biomass burning can meet the household needs but is not suitable for industrial requirements in a sustained way. In addition, the commercial burning of biomass leads the system to an

Open cycle. Whereas the traditional uses of biomass operated in a closed cycle. In a closed cycle the wastes of a part of the ecological cycle provides needs for another part. In an open cycle the nutrients of the soil do not return to the soil causing soil nutrition depletion. If still biomass has to be used for the industrial requirements, it will not be without creating an ecological rift.

In case of Biomass CDM projects in Pakistan, the project developers or the carbon consultants are found to be least bothered for the Sustainable development aspects. The project developers themselves have various problems related to Biomass Energy Production in their industries. Considering the environmental issues related to biomass energy production, these projects cannot be enlisted as steps towards Clean Development.

Biomass CDM projects appear to be an example of a metabolic rift or environmental rift where mitigating one rift accentuates another rift. The environmental rifts are not solved but just shifted by accentuating another rift. The most cited example is the issue of biofuels (McMichel, 2009). Focusing on one issue of reducing $CO_2$ emissions into the atmosphere but leads to increased dust and particulate pollution in the air, increased water consumption, soil nutrients depletion and waste disposal problems. The climate change is being considered as more of a technical problem with technical solutions proposed. The study of these Biomass CDM projects raises the question about the clean development character of CDM projects. Though Climate Change itself is the

biggest example of the market failure but still the market solutions are being proposed to solve the issue.

World is focusing more and more towards Biomass sources through a number of approaches in lieu of peak oil, energy resources being running out, climate change etc. Biomass burning is also just part of this larger transition from fossil fuels to biofuels. That does not include only biomass burning as such but Agrofuels, REDD projects etc are also the part of this transition. Both Agrofuels and REDD projects are highly controversial issues. It is being argued that through Agrofuels, the land in the Global South is being used to meet the Energy requirements of the North (Borras *et al*, 2011)

Emissions into the atmosphere are released through two ways, either by burning Fossil fuels or by deforestation. Since forests are the carbon sinks, the degradation of forests would lead to less sequestration of carbon from the atmosphere which is equated with increased emissions into the atmosphere. So REDD projects are meant to protect the forests but there are a lot of controversies involved (Hall, 2010). These controversies include how the agents of deforestation or afforestation are framed. REDD projects are still not a part of CDM but there is considerable interest in making such projects a part of CDM.

Another important future consideration is the establishment of synthetic biology and genetic engineering of biomass, the process of which has already started. It is being argued that the only way to move the economy forward World needs a replacement for

fossil fuels and chemical industry feedstocks (French, 2009). However, there has been a lot of criticism for converting biological resources into an industry just to meet the capitalist energy requirements (ETC, 2011).

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# APPENDIX I: Summary of Each Biomass CDM project in Pakistan:

## 1- Biomass Fuel Switch Project at Sapphire Finishing Mills Ltd, Pakistan

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM06032 |
| 2 | Title of the Project | Biomass Fuel Switch Project at Sapphire Finishing Mills Ltd, Pakistan |
| 3 | Date of PDD submission most recent | 22nd January, 2010 |
| 4 | Factory process/product | fabric finishing, dying |
| 5 | What is BAU in this process? | A set of natural gas fired boilers to generate steam for process applications. |
| 6 | Nature of industry | Textile industry |
| 7 | Corporate identity | Sapphire Group of Industries (*www.sapphire.com.pk)* |
| 8 | Public comment period | 29 Jan 10 - 27 Feb 10 |
| 9 | Date of Stakeholders meetings | December 11, 2009 |
| 10 | How can the CDM project be categorized | Biomass fuelswitch project |
| 11 | Present status of CDM project (1.4.2012) | AT validation |
| 12 | Location of project | 3.5 km off the Raiwind Manga Road from Raiwind |
| 13 | Size of project<br>annual estimated CER | 33,502 $tCO_2$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | natural gas and RFO (as backup fuel) |
| 16 | Description of CDM project | Use of biomass fired boilers in place of gas fired boilers. |
| 17 | What emission factors have been used?<br>Default/local | Natural gas: 56.1 tCO2/TJ<br>RFO: 73.3 tCO2/TJ |
| 18 | Crediting period | 2010-2016 |
| 19 | How is additionality demonstrated | Investment analysis<br>The project needs investment; involves risks associated with biomass fuel supply and generate little economic revenues. |
| 20 | Carbon consultant | Grue and Hornstrup |
| 21 | DOE for validation | TÜV NORD |
| 22 | Any particular environmental impacts | Increased particulate matter in air, decreased soil organic carbon in fields. |
| 23 | Any seasonal character of project? | Rice husk available in rice season only |

| | | |
|---|---|---|
| 24 | Nature for biomass used | Rice husk, rice straw, cotton residues, corn residues, wheat straw, wood waste, bagasse |
| 25 | Calorific value of biomass | Rice husk=3,000, Rice straw=3,500, Cotton stack=4,200, Cotton pods=4,200, Cotton shells=4,200, Corn stack=4,200, Corn cob=4,400, Wheat straw=3,700, Saw dust=4,400, Wood waste=4,400, Bagasse=4,200 kcal/Kg. |
| 26 | Calorific values of fuels used | Natural gas: 34.36 MJ/m3<br>RFO: 41.03 MJ/kg |
| 27 | Quantity of biomass required | Not given |

## 2. Biomass based Energy Generation at Kohinoor Mills Ltd

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM08680 |
| 2 | Title of the Project | Biomass based Energy Generation at Kohinoor Mills Ltd. |
| 3 | Date of Pdd submission most recent | September 19, 2011 |
| 4 | Factory process/product | The Kohinoor Genertek Division provides electricity and steam for captive requirements. |
| 5 | What is BAU in this process? | Use of HFO for steam generation |
| 6 | Nature of industry | Textile ( Dyeing & Weaving) |
| 7 | Corporate identity | Kohinoor maple leaf group (www.kmlg.com) |
| 8 | Public comment period | 29 Sep 11 - 28 Oct 11 |
| 9 | Date of Stakeholders meetings | 28th March 2010 |
| 10 | How can the CDM project be categorized | Partial fuelswitch: Partial switching of Pet Coke with biomass residue to generate steamfor captive requirement thereby partially replacing 100% fossil based steam generation in the baseline. |
| 11 | Present status of CDM project (1.4.2012) | At validation |
| 12 | Location of project | 8 km off-Raiwind Manga Road, District Kasur. |
| 13 | Size of project<br>annual estimated CERs | 23,912 $tCO_2$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | 100 % petcoke |
| 16 | Description of CDM project | Partial switching of Pet Coke with biomass residue, The project activity involves the installation of a biomass residue (Rice husk) and Pet Coke based Co-fired Boiler, which will generate steam for captive requirement thereby partially replacing 100% fossil based steam generation in the |

| | | |
|---|---|---|
| | | baseline.The project activity will involve upto 40% of pet coke co-fired with rice husk 60%. |
| 17 | What emission factors have been used? | Pet coke: 97.5 tCO2/TJ |
| 18 | Crediting period | 2012-2018 |
| 19 | How is additionality demonstrated | investment Barrier<br>Technological Barrier<br>Quality of Fabric<br>Barrier of biomass (Rice Husk) supply |
| 20 | Carbon consultant | Climate ventures |
| 21 | DOE for validation | TÜV SÜD |
| 22 | Any particular environmental impacts | Increased particulate matter in air, respiratory diseases |
| 23 | Any seasonal character of project? | Availability in rice season only, moisture content |
| 24 | Nature for biomass used | Rice husk |
| 25 | Calorific value of biomass | Rice husk: N/G |
| 26 | Calorific values of fuels used | Pet coke: 23 TJ/Gg |
| 27 | Quantity of biomass used | 28,512 tons |

## 3. Biomass based Cogeneration project for Madina Enterprise Limited (MEL).

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM08686 |
| 2 | Title of the Project | Biomass based Cogeneration project for Madina Enterprise Limited (MEL). |
| 3 | Date of Pdd submission most recent | 10/09/2011 |
| 4 | Factory process/product | Production of steam and power for sugar mill and export to steel mill to produce inhouse power |
| 5 | What is BAU in this process? | Fossil fuel based electricity to power steel mill |
| 6 | Nature of industry | Steel mill/sugar mill |
| 7 | Corporate identity | Madina Group of Industries (www.madinagroup.com) |
| 8 | Public comment period | 30 Sep 11 - 29 Oct 11 |
| 9 | Date of Stakeholders meetings | ---- |
| 10 | How can the CDM project be categorized | Renewable energy production |
| 11 | Present status of CDM project (1.4.2012) | AT validation |
| 12 | Location of project | Faisalabad Road, Chiniot |

| | | |
|---|---|---|
| 13 | Size of project<br>annual estimated CER | 28,684.82t$CO_2$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | Fossil fuels based grid electricity |
| 16 | Description of CDM project | The project activity is the retrofit of existing boilers and installation of high pressure turbines in an existing sugar mill using rice husk and bagasse. Project Activity will provide surplus power to steel mill which would otherwise be imported from grid. |
| 17 | What emission factors have been used?<br>Default/local | 0.517 tCO2-eq<br>(Combined margin emission factor for grid electricity) |
| 18 | Crediting period | 2012-2019 |
| 19 | How is additionality demonstrated | The project activity requires a massive capital investment, the first of its kind in Pakistan which lead to technological challenges. |
| 20 | Carbon consultant | Climate ventures |
| 21 | DOE for validation | TÜV SÜD Industries Service GmbH |
| 22 | Any particular environmental impacts | Air pollution |
| 23 | Any seasonal character of project? | Rice husk available in rice seasons only, bagasse in sugar crushing season |
| 24 | Nature for biomass used | Bagasse, Rice husk (30% of extra demand), bagasse (70% of extra demand). |
| 25 | Calorific value of biomass | Bagasse 7.58 GJ/tonnes of dry matter on wet basis<br>Rice husk 14 GJ/tonnes of dry matter on wet basis |
| 26 | Calorific values of fuels used | Not given |
| 27 | Quantity of biomass used | Bagasse (indigenous)= 176,750tonnes, bagasse (imported)=40,881 tonnes, Rice husk (imported)=51,292 tonnes |

## 4. Biomass based Energy Generation at Master Textile Mills Ltd.

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM08678 |
| 2 | Title of the Project | Biomass based Energy Generation at Master Textile Mills Ltd |
| 3 | Date of Pdd submission most recent | Sep 10, 2011 |
| 4 | Factory process/product | Manufacturer of textile products |
| 5 | What is BAU in this process? | HFObased steam generation for captive consumption |
| 6 | Nature of industry | Textile industry |
| 7 | Corporate identity | Master Textile Mills Limited(www.*master.com.pk*) |
| 8 | Public comment period | 29 Sep 11 - 28 Oct 11 |

| | | |
|---|---|---|
| 9 | Date of Stakeholders meetings | Dec 09, 2009. |
| 10 | How can the CDM project be categorized | Renewable energy generation |
| 11 | Present status of CDM project (1.4.2012) | AT validation |
| 12 | Location of project | 3 km off-Raiwind Manga Road, District Kasur |
| 13 | Size of project<br>annual estimated CER | 24,177 $tCO_2$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | Use of carbon intensive Coal |
| 16 | Description of CDM project | The proposed project activity reduces greenhouse gas emissions by switching coal with biomass residue, which would otherwise be generated totally from carbon intensive Coal in the baseline. |
| 17 | What emission factors have been used?<br>Default/local | Furnace oil: 77.4 $tCO_2$/TJ<br>Coal: 94.6 $tCO_2$/TJ |
| 18 | Crediting period | 2012 (Apr-Dec)-2019 (Jan-Mar) |
| 19 | How is additionality demonstrated? | additional investment required,<br>Project proponent has to rely on an uncertain biomass market; cost of steam generation is also higher as compared to coal. |
| 20 | Carbon consultant | Climate ventures |
| 21 | DOE for validation | TÜV SÜD |
| 22 | Any particular environmental impacts | Air pollution |
| 23 | Any seasonal character of project? | Rice husk available in rice season only |
| 24 | Nature for biomass used | Rice husk |
| 25 | Calorific value of biomass | Not Given |
| 26 | Calorific values of fuels used | Coal: 26.1 TJ/Gg<br>Furnace oil: 43 TJ/Gg |
| 27 | Quantity of biomass used | 25,200 tonnes |

# 5. Almoiz Bagasse Cogeneration Project

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM03439/REF NO# 3300 |
| 2 | Title of the Project | Almoiz Bagasse Cogeneration Project |
| 3 | Date of PDD submission most recent | July 11th, 2010. |
| 4 | Factory process/product | Sugar production |
| 5 | What is BAU in this process? | Fossil fuel based electricity consumption |
| 6 | Nature of industry | Sugar mill (Paharpur sugar mill) |
| 7 | Corporate identity | Almoiz Industries limited<br>(website:no website found) |
| 8 | Public comment period | 27 Mar 08 - 25 Apr 08 |
| 9 | Date of Stakeholders meetings | September 28-29, 2005 |
| 10 | How can the CDM project be categorized | To replace grid electricity with bagasse produced electricity |
| 11 | Present status of CDM project (1.4.2012) | Registered (14 july 2010) |
| 12 | Location of project | 26 km Chashma Road, D.I.Khan, North West Frontier Province (NWFP). |
| 13 | Size of project<br>annual estimated CER | 23,319t $CO_2e$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | Fossil fuel based electricity |
| 16 | Description of CDM project | To replace grid electricity with bagasse produced electricity |
| 17 | What emission factors have been used?<br>Default/local | 0.4902 tCO2 / MWh (Combined margin CO2 emission factor of the grid) (Source=Pakistan Energy Year Book, 2004, 2005, 2006; Hydrocarbon Development Institute of Pakistan). |
| 18 | Crediting period | 2010-2017 |
| 19 | How is additionality demonstrated | Barrier analysis |
| 20 | Carbon consultant | Carbon services |
| 21 | DOE for validation | Not found |
| 22 | Any particular environmental impacts | Air emissions |
| 23 | Any seasonal character of project? | The sugar mill will operate for six months per year approximately from November to April |
| 24 | Nature for biomass used | Bagasse (from sugar industry) |
| 25 | Calorific value of biomass | Bagasse: 17.69 GJ/ton of dry matter |
| 26 | Calorific values of fuels used | Not given |
| 27 | Quantity of bagasse used | 144,000 Tonnes of dry matter |

## 6. Biomass based high pressure cogeneration project at Shakarganj Mills Limited, Bhone, Pakistan.

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM08326 |
| 2 | Title of the Project | Biomass based high pressure cogeneration project at Shakarganj Mills Limited, Bhone, Pakistan |
| 3 | Date of PDD submission most recent | 05/08/2011 |
| 4 | Factory process/product | Sugar production/ sugar |
| 5 | What is BAU in this process? | Fossil fuel based low pressure boilers and turbines |
| 6 | Nature of industry | Sugar and sugar-by products manufacturers |
| 7 | Corporate identity | Shakarganj sugar Mills (www.shakarganj.com.pk) |
| 8 | Public comment period | 10 Aug 11 - 08 Sep 11 |
| 9 | Date of Stakeholders meetings | December 31, 2010 |
| 10 | How can the CDM project be categorized | Cogeneration project using bagasse instead of grid electricity |
| 11 | Present status of CDM project (1.4.2012) | At validation |
| 12 | Location of project | Shakarganj Mills Limited Jhang Sargodha Road, Bhone, Pakistan |
| 13 | Size of project<br>annual estimated CER | 31,482 $tCO_2$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | Use of bagasse in Low pressure boilers and low pressure steam turbines |
| 16 | Description of CDM project | Use of bagasse in high pressure boilers and high pressure steam turbines |
| 17 | What emission factors have been used?<br>Default/local (Emission co-efficient) | HFO: 77.4 tCOR2R/TJ<br>Diesel: 74.1 tCOR2R/TJ<br>Coal: 96.1 tCOR2R/TJ<br>NG: 56.1 tCOR2R/TJ<br>Emission factor of grid= 0.4888 $tCO_2$/MWh |
| 18 | Crediting period | 2012-2021 |
| 19 | How is additionality demonstrated? | Technological barrier,<br>Institutional barrier, performance uncertainties, lack of trained man power |
| 20 | Carbon consultant | Carbon services |
| 21 | DOE for validation | TÜV SÜD |
| 22 | Any particular environmental impacts | Air emissions |
| 23 | Any seasonal character of project? | Only during sugar production |
| 24 | Nature for biomass used | Bagasse |
| 25 | Calorific value of biomass | Not found |
| 26 | Calorific values of fuels used | HFO: 0.04077 TJ/t |

| | | |
|---|---|---|
| | | Diesel: 0.04402 TJ/t<br>Coal: 0.01172 TJ/t<br>NG: 0.97971 TJ/MMCFT |
| 27 | Quantity of bagasse used | Not given |

## 7. Biomass based cogeneration in Engro foods Supply Chain (Pvt.) Ltd. IRPC

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM08017 |
| 2 | Title of the Project | Biomass based cogeneration in Engro foods Supply Chain (Pvt.) Ltd. IRPC |
| 3 | Date of Pdd submission most recent | 13/06/2011 |
| 4 | Factory process/product | Rice Processing plant |
| 5 | What is BAU in this process? | steam production using natural gas boilers |
| 6 | Nature of industry | Rice Processingplant. |
| 7 | Corporate identity | Engro Foods Supply Chain (pvt.) Ltd.<br>www.engro.com |
| 8 | Public comment period | 16 Jun 11 - 15 Jul 11 |
| 9 | Date of Stakeholders meetings | September 2010 |
| 10 | How can the CDM project be categorized | Renewable energy |
| 11 | Present status of CDM project (1.4.2012) | At validation |
| 12 | Location of project | 13 KM, MuridkeSheikhupura Road |
| 13 | Size of project<br>annual estimated CER<br>Annual energy consumption | 47,170t$CO_2$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | Natural gas |
| 16 | Description of CDM project | Biomass, rice husk<br>Thermal energy production |
| 17 | What emission factors have been used?<br>Default/local | Diesel: 0.0748 tCO2/GJ<br>Natural gas: 56.1 t CO2/TJ |
| 18 | Crediting period | 10 years |
| 19 | How is additionality demonstrated | Financially costs more, investment barrier |
| 20 | Carbon consultant | Not Given |

| | | |
|---|---|---|
| 21 | DOE for validation | Bureau Veritas Certification Holding SAS |
| 22 | Any particular environmental impacts | Fly ash, ash cake, waste water treatment |
| 23 | Any seasonal character of project? | Availability of rice husk |
| 24 | Nature for biomass used | Rice husk |
| 25 | Calorific value of biomass | NG in the PDD |
| 26 | Calorific values of fuels used | Diesel:0.0433 GJ/kg<br>Natural gas: 8,291 kcal/Sm |
| 27 | Quantity of biomass used | 20,000 tons/year own production, 15,000 tons will be purchased from the market |

## 8. Attock Cement partial substitution of fossil fuels with alternate fuels in cement manufacture project

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM10704 |
| 2 | Title of the Project | Attock Cement partial substitution of fossil fuels with alternate fuels in cement manufacture project |
| 3 | Date of PDD submission most recent | 21/02/2012 |
| 4 | Factory process/product | Calcination (heating limestone with small quantities of other materials), clinker manufacturing |
| 5 | What is BAU in this process? | Use of coal for clinker production. |
| 6 | Nature of industry | Cement manufacturing |
| 7 | Corporate identity | Attock Cement Pakistan Ltd |
| 8 | Public comment period | 06 Mar 12 - 04 Apr 12 |
| 9 | Date of Stakeholders meetings | October 27, 2011 |
| 10 | How can the CDM project be categorized | Partial fuelswitch to Agricultural residues: other kinds |
| 11 | Present status of CDM project (1.4.2012) | AT validation |
| 12 | Location of project | The proposed project activity is located at the Attock Cement plant 12 km north-northeast of the city<br>centre of Hub Chowski in the Balochistan Province |
| 13 | Size of project<br>annual estimated CER | 68,007 $tCO_2$ |

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|---|---|---|
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | In the absence of the project, heat used for the clinker manufacturing would be generated only by burning coal and biomass would be left for aerobic decay |
| 16 | Description of CDM project | Partial Substitution of fossil fuels |
| 17 | What emission factors have been used? Default/local | imported coal= 0.09932 tCO2/GJ, local coal= 0.0928 tCO2/GJ, HFO=0.0788 tCO2/GJ, Diesel=0.050 tCO2/GJ RDF= 0.050 |
| 18 | Crediting period | 2013-2023 |
| 19 | How is additionality demonstrated | financial barrier. |
| 20 | Carbon consultant | UPM |
| 21 | DOE for validation | BV Cert |
| 22 | Any particular environmental impacts | No |
| 23 | Any seasonal character of project? | Agricultural residues may vary |
| 24 | Nature for biomass used | agricultural waste such as rice husk, corn cob, cotton straw, Tyre Derived Fuel (TDF) and Refused Derived Fuel (RDF) from Municipal Solid Waste (MSW) |
| 25 | Calorific value of biomass | MSW=18.0GJ/t, biomass=13.59GJ/t, tyres=29.26GJ/t |
| 26 | Calorific values of fuels used | Natural Gas=46.5 GJ/t<br>imported coal= 24.68 GJ/t<br>local coal= 11.5 GJ/t |
| 27 | Quantity of biomass required | 34,622 tonnes |

## 9. Partial substitution of coal with alternate fuels at DG Cement, Khofli SattaiDera Ghazi Khan Plant

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM10685 |
| 2 | Title of the Project | Partial substitution of coal with alternate fuels at DG Cement, Khofli Sattai Dera Ghazi Khan Plant |
| 3 | Date of PDD submission most recent | Version 01 ; 01/03/2012 |
| 4 | Factory process/product | Calcination (heating limestone with small quantities of other materials) |
| 5 | What is BAU in this process? | Use of coal for clinker production while HFO is consumed for pre-heating purposes. |
| 6 | Nature of industry | Cement manufacturing |

| | | |
|---|---|---|
| 7 | Corporate identity | D.G. Khan Cement Company ;part of Nishat Group |
| 8 | Public comment period | 03 Mar 12 - 01 Apr 12 |
| 9 | Date of Stakeholders meetings | June 28, 2011 |
| 10 | How can the CDM project be categorized | Type: Biomass energy<br>Subtype: Agricultural residues: other kinds |
| 11 | Present status of CDM project (1.4.2012) | At validation |
| 12 | Location of project | D.G. Khan Cement Factory Khofli Sattai, District Dera Ghazi Khan Punjab, Pakistan |
| 13 | Size of project ( annual estimated CER) | 158,781$tCO_2$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | In the absence of the project activity, DG Cement shall keep using 100% coal in the clinker production process. |
| 16 | Description of CDM project | Substitution of fossil fuels |
| 17 | What emission factors have been used? Default/local | imported coal= 0.0895 $tCO_2$/GJ, local coal= 0.0928 $tCO_2$/GJ, HFO= 0.0788 $tCO_2$/GJ RDF = 0.050 tCO2/GJ, tyre waste = 0.062 $tCO_2$/GJ |
| 18 | Crediting period | 10 years |
| 19 | How is additionality demonstrated? | Financial barrier |
| 20 | Carbon consultant | First Climate |
| 21 | DOE for validation | TÜV-SÜD |
| 22 | Any particular environmental impacts | No |
| 23 | Any seasonal character of project? | Agricultural residues may vary |
| 24 | Nature for biomass used | agricultural waste such as, rice husk, corn cob, wheat straw, poultry waste, agro-waste and refused derived fuel (RDF) from Municipal Solid Waste (MSW) and tyre waste). |
| 25 | Calorific value of biomass | Rice husk =12.73 GJ/ton, Corn cob=15.60 GJ/ton, Wheat straw=14.99 GJ/ton, Poultry waste=10.72 GJ/ton, RDF, 17.63 GJ/ton, Tyre waste=28.26 GJ/ton, Agro waste=12.14 GJ/ton, Rice husk=12.73 GJ/ton, Corn cob=15.60 GJ/ton, Wheat straw= 14.99 GJ/ton |
| 26 | Calorific values of fuels used | Natural Gas=46.5 GJ/t, imported coal= 24.68 GJ/t, local coal = 11.5 GJ/t, HFO=0.04077TJ/t , Diesel=0.04402 TJ/t , Natural gas=0.97971 TJ/MMCFT (tera joule per million cubic feet) |
| 27 | Quantity of biomass required | 169,793 tonnes |

## 10. Substitution of coal with alternate fuels at Lucky Cement Limited, Karachi Plant

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM09448 |
| 2 | Title of the Project | Substitution of coal with alternate fuels at Lucky Cement Limited, Karachi Plant |
| 3 | Date of PDD submission most recent | Version 1; 10/01/2012 |
| 4 | Factory process/product | Calcination (heating limestone with small quantities of other materials)/ Ordinary Portland Cement, Sulphate Resistant Cement and Slag Cement |
| 5 | What is BAU in this process? | Usage of coal and HFO for heating purposes in clinker production |
| 6 | Nature of industry | Cement manufacturing |
| 7 | Corporate identity | Lucky Cement Limited |
| 8 | Public comment period | Not found |
| 9 | Date of Stakeholders meetings | May18, 2011 |
| 10 | How can the CDM project be categorized | Fuelswitch |
| 11 | Present status of CDM project (1.4.2012) | At validation |
| 12 | Location of project | 58 km Milestone, Super Highway, Nooriabad, Karachi, Sindh, Pakistan. |
| 13 | Size of project ( annual estimated CER) | 208,484t$CO_2$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | No substitution by alternate fuels and company continues cement production using existing technology |
| 16 | Description of CDM project | The project activity comprises installation of tyre derived fuel (TDF) and refuse derived fuel (RDF) systems (plants) that would result in 50% substitution of coal with alternative fuels (TDF from tyre waste, RDF from Municipal Solid Waste (MSW) and biomass residues such as, Rice Husk). |
| 17 | What emission factors have been used? Default/local | Weighted average $CO_2$emission factor for imported and local coal= 0.0895 t$CO_2$/GJ (same value for both local and imported)<br>Weighted average $CO_2$emission factor for HFO= 0.0788 t$CO_2$/GJ |
| 18 | Crediting period | 10 years |
| 19 | How is additionality demonstrated | Financial barrier |
| 20 | Carbon consultant | First Climate, Carbon Services Pakistan |
| 21 | DOE for validation | TÜV-SÜD |
| 22 | Any particular environmental impacts | Air emissions |
| 23 | Any seasonal character of project? | Biomass supply may vary |

| | | |
|---|---|---|
| 24 | Nature for biomass used | TDF from tyre waste, RDF from Municipal Solid Waste (MSW) and biomass residues such as, Rice Husk |
| 25 | Calorific value of biomass | TDF 26.77GJ/ton<br>RDF 13.94GJ/ton<br>Rice Husk 12.64GJ/ton |
| 26 | Calorific values of fuels used | Imported coal=25.00GJ/ton, local coal=24.54 GJ/ton, HFO=40.26 GJ/ton, NG=30.85 MJ/Nm3, Diesel=36.95 MJ/l |
| 27 | Quantity of biomass required | Tyre waste 153,214tons,RDF 63,608tons,Biomass Residues 3,836tons, Total 260,658 tons |

## 11. Substitution of coal with alternate fuels at DG Khan Cement Company

| Sr No | Brief Description | |
|---|---|---|
| 1 | Identification number | CDM07152 |
| 2 | Title of the Project | Substitution of coal with alternate fuels at DG Khan Cement Company |
| 3 | Date of PDD submission most recent | 23/11/2010 |
| 4 | Factory process/product | Calcination (heating limestone with small quantities of other materials)/ Clinker |
| 5 | What is BAU in this process? | Usage of 100% coal in the clinker production |
| 6 | Nature of industry | Cement manufacturing |
| 7 | Corporate identity | DG Khan Cement Company Limited |
| 8 | Public comment period | 25 Nov 10 - 24 Dec 10 |
| 9 | Date of Stakeholders meetings | Aug 23, 2010 |
| 10 | How can the CDM project be categorized | Patial Fuelswitch project |
| 11 | Present status of CDM project (1.4.2012) | At validation |
| 12 | Location of project | D.G. Khan Cement Factory Khofli Sattai, District Dera Ghazi Khan Punjab, Pakistan |
| 13 | Size of project ( annual estimated CER) | 149,469 $tCO_2$ |
| 14 | Annual energy production | Not given in the PDD as such but other information like quantities of fuels to be used and calorific values enable to do the calculation. |
| 15 | Description of baseline project used | 100% coal in the clinker production process |
| 16 | Description of CDM project | Partial Substitution of fossil fuels<br>The coal consumed consumed in the clinker kiln is partially replaced by biomass residues (e.g. rice husk, corn cob, wheat straw, etc), municipal solid wastes and industrial waste from fossil sources (e.g. tyre waste). |
| 17 | What emission factors have been used? Default/local | coal =0.0928 $tCO_2/GJ$<br>pet coke =0.0829 $tCO_2/GJ$<br>HFO =0.0755 $tCO_2/GJ$<br>RDF = 0.0275 $tCO_2/GJ$ |

| | | |
|---|---|---|
| | | waste based alternative fuels (textile, tyres) =0.183 $tCO_2/GJ$ |
| 18 | crediting period | Sep – Dec 2011- Jan – Aug 2021 |
| 19 | How is additionality demonstrated? | High capital cost and technological barrier |
| 20 | Carbon consultant | First Climate |
| 21 | DOE for validation | TÜV-SÜD |
| 22 | Any particular environmental impacts | Air emissions |
| 23 | Any seasonal character of project? | Biomass supply may vary |
| 24 | Nature for biomass used | agricultural waste such as, rice husk, corn cob, wheat straw, bagasse;<br>textile waste; tyre waste; and refused derived fuel (RDF) from Municipal Solid Waste (MSW) |
| 25 | Calorific value of biomass | Rice husk=, 13.161 GJ/ton, corn=16.289 GJ/ton, bagasse=14.011 GJ/ton,straw= 15.144 GJ/ton, textile= 14.405, tyre=15.427, MSW=13.991 |
| 26 | Calorific values of fuels used | Imported coal=25.00GJ/ton, local coal=24.54 GJ/ton, HFO=40.26 GJ/ton, NG=30.85 MJ/Nm3, Diesel=36.95 MJ/l |
| 27 | Quantity of biomass required | Corn=12,270 tons, rice husk=101,247 tons, bagasse=4,755 tons, straw= 4,399 tons, textile= 9,250 tons, tyre=13,109 tons, MSW=23,809tons |

## APPENDIX II: Questionnaires asked during the interviews

### Questions asked From Carbon Consultants:

1. What is your job description? What things do you manage?
2. How many of your projects have got registered?
3. What is the CDM project cycle?
4. What is a PDD?
5. Do you see any loopholes in the CDM project cycle?
6. How do you prove additionality of a project?
7. Do you think that the projects are really additional?
8. Who appoints the DOEs for the validation and monitoring of the project?
9. What should be the role of the DNA? Do you think they are performing their jobs rightly?
10. What sustainable benefits do you think your CDM projects achieve?
11. What is the process of establishing sustainable development objectives of a particular project?
12. Sustainable Development is represented as the central part of the CDM projects. How do you see aspects of Sustainable Development being addressed?
13. The first commitment is going to in 2012. What do you think about the future of the CDM?

### From CDM Managers:

1. How long have you been using biomass for energy purpose? Please specify the number of years.
2. When did you use biomass as fuel for the first time?
3. How do you come to know about CDM?
4. What was your motivation that made you to apply for CDM registration?
5. Since when the industry has adopted the CDM project? Specify the year.
6. What did you use before CDM project?

7. What is the amount of the biomass deposited in store house?
8. How do you store biomass in store house?
9. How long it is stored and can be stored?
10. Is its availability season dependent?
11. What do you use in biomass (rice husk, bagasse, corn waste or anything else) preferably and why?
12. The quantity you receive at the industry is sufficient or not?
13. Are pellets also used? Where do you get them from?
14. What is the process of buying biomass? How do you contact the biomass sellers?
15. Do you think biomass is clean to burn?
16. How much water do you need for the process of burning biomass? is it equivalent to the amount used when fossil fuels are burned?
17. Do you have any issues regarding dust or air emissions?
18. Have you put in any preventive measure for controlling dust?
19. Are there any public health impacts that you think related to biomass burning?
20. How do you deal with the waste water and solid waste being generated due to biomass burning?
21. Do these projects create employments for local people?
22. How are the stakeholders identified? And are made to get involved in the project?
23. What is the process of stakeholders meetings? Who are invited and how these meetings are conducted?
24. Do you think that the CDM projects help in transfer of knowledge or technology in renewable energy?
25. How are the prices of Biomass have been fluctuated over time during the CDM project?
26. Are you satisfied with the role of other participants in the CDM project cycle i.e. Carbon Consultants, DNA and DOEs?
27. How much money and time costs are involved in the process of getting a CDM registered?
28. What benefits do you think local community is accruing from your project?
29. What is your opinion about CDM projects? Do you think through CDM emission reductions can be brought about?

## From DNA:

1. What is the role of a DNA in a country in terms of CDM projects?
2. What are you really doing for the promotion of CDM in Pakistan?
3. How do you evaluate a CDM project?
4. How are CDM projects verified? By field work or paper work only?
5. Does Pakistan have any national sustainable development criteria?
6. Where do you think are the bottle necks in the CDM project cycle?
7. What key aspects do you investigate before issuing a letter of approval (LoA) to the applicant/industrialists?
8. Do you think that the CDM projects are not business as usual projects?
9. Why should Pakistan promote CDM projects?
10. Do you CDM will help in mitigating climate change?
11. Biomass CDM projects are increasing in number in the country, what do you think the reason is?

## Questions from CDM officials:

1. Why do you think Pakistan is lagging behind in the CDM race?
2. What benefits do you find CDM projects adoption can deliver particularly in case of Pakistan (considering its economic and social situation)?
3. Why do you think Pakistan should promote CDM projects in the country?
4. What is Pakistan's National Sustainable Development Criteria? What do you think it should be?
5. Does a consultant face a conflict of interest between serving the interest of the project developer and the interest of the public at large?
6. Do you think that public interests adequately presented in the CDM project design? How is this ensured?
7. Are you satisfied with the roles of people in the project cycle e.g. carbon consultant, DOE's etc?
8. How do you define and justify the "Additionality"?
9. Where do you think are the bottlenecks in the project cycle?

10. Where do you feel are chances to make some improvements in the process?
11. How do you describe the role of government in case of CDM? Is it not true that govt. is only doing promotional work?
12. What is your opinion about the evaluations of CDM projects? Are they rational, neutral or objective in character? Or does the technical character of project evaluation hide value judgments implicit in the projects from public scrutiny?
13. Sustainable Development is represented as the central part of the CDM projects. How do you see aspects of Sustainable Development being addressed? Is it not just a lip-service?
14. Do you think that by having more CDM Projects we could really be moving towards "a low-carbon economy"?
15. What environmental changes do you think can happen by adopting biomass CDM projects?
16. Do you remember any sort of social conflict during your entire experience regarding CDM?
17. Do you think about any other way to address climate change rather than CDM?

## 1. Biomass Suppliers:

1. What do you do by profession?
2. How did you involved in this process of supplying biomass to the industries?
3. What is the process of collecting biomass?
4. Which industries you are delivering biomass to?
5. What do you do off-season?
6. How many people are usually engaged with the activity at one time?
7. Where do you get those people from?
8. Do you see that this business will grow? If yes how?
9. How much time do you usually take to deliver one consignment of biomass to the industry?

10. Do you supply only to one industry or multiple of industries?
11. How the prices of biomass have increased over time?

**APPENDIX III: Details of the Persons Interviewed in the study.**

| Organizations | Name of the person interviewed | Designation of the interviewee | Mode of interview | Date | Location |
|---|---|---|---|---|---|
| Carbon Services | Mr. Armaghan Mr. umer kamal | Senior project engineers | One on one | 23-2-12 | Carbon Services (Private) Limited 2nd Floor, Al-Maalik, 19 Davis Road, Lahore |
| Global Environmental Lab (GEL) | Mr. Asim | Director | One on one | 3-3-12 | GEL's new office at Canal View Society, Lahore |
| Climate Ventures | Mr. Fawad | Carbon consultant | One on one | 16-6-12 | DHA, H-Block, Lahore |
| National Development Consultants (NDC). | Mr. Chaudhry Fawad | Director | One on one | 18-2-12 | 62-M Gulberg III, Lahore |
| CDM Cell | Mr. Ahsan Javed | In Charge CDM Cell | One on one | 5-6-12 | Alhamra building , Qaddafi Stadium (On a seminar on Environment) |
| DNA | Mr. Tahir | Deputy Director for Technology Transfer) Also keeps the charge for Research and Investigation Director | One on one | 3-3-12 | EPD building , Qaddafi Stadium |

| Organizations | Name of the person interviewed | Designation of the interviewee | Mode of interview | Date | Location |
|---|---|---|---|---|---|
| Kohinoor CDM Project | Mr. Sohail | Environment, Health and safety (EHS) Manager | One on one | 12-3-12 | Kohinoor Textile. 8 Kilometers Manga Raiwind Road, District Kasur, Pakistan |
| Sapphire CDM project | Mr. Muaz Khawaja | Environment, Health and safety (EHS) Manager | One on one | 12-7-12 | Sapphire Textile. 3.5 Kilometers Manga Raiwind Road, District Kasur, Pakistan |
| Master CDM Project | Mr. Amir Javed Malik | Manager Power House (also responsible for managing the CDM project) | One on one | 1-10-12 | Master Textile. 3 km off-Raiwind Manga Road, District Kasur |
| Biomass Supplier | Mr. Ramzan Saleem | Truck driver and Broker (Thekedar) | telephone | 22-7-2012 | - |
| CDM Cell | Mr. Saad ullah Ayaz | Ex- Chairman CDM Cell (Now coordinator in climate change IUCN) | e-mail | 28-4-2012 | - |