BORDA



BORDA–ASA South–North Project 2006

Potential Analysis of Adapted Environmental Technologies and their possible Link-up to CDM Projects

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II. Preface

Sustainability

Implementation of sustainable development can only be done future-oriented. In times of resources shortage and global warming, development has to be realized in accordance with ecological requirements. Proven eco-friendly technologies should be used wherever possible.

Situation in India

The energy demand of a booming country like India increases day by day. It has to be avoided that those requirements are getting satisfied through non renewable energy sources. The mistakes that have been done over decades in the developed northern industry nations should not be repeated once again—especially not in a country with more than a billion inhabitants.

BORDA/ CDD Technologies

The success of technologies like the Decentralized Waste water Treatment System (DEWATS) shows that eco-friendly technology is not only efficient but also meets the demand of energy generation and wastewater treatment simultaneously. As most of the cities and villages in India do not have any wastewater treatment units, the synergy effect of such technologies is very helpful.

Also the Micro Hydro Power Unit (MHPU) has proved to be an applicable system for the energy supply of remote villages and the Hydraulic Ram (HydRam) is a simple, cost-efficient and long lasting solution for water supply.

Perspectives

The dissemination of these technologies should be expanded. The option of including other technologies which are beneficial for the people should be considered. Biogas plants are an option to combine energy generation and waste disposal. Today, renewable energy technologies are mostly not economically competitive with conventional solutions so that additional funds are necessary to implement renewable energy technologies on a larger scale. The Clean Development Mechanism (CDM) is a new option of financing development projects that use such technologies.

Role of the Project

Within this project it has to be analyzed in which way German biogas technology can be transferred to India. Furthermore the expansion potential of projects with Micro Hydro Power Units in India should be researched. Finally it will be verified in which way the CDM could be useful to finance BORDA/ CDD projects in future.

Thinking long-term, acting now…

II. Vorwort

Nachhaltigkeit

Die Implementierung nachhaltiger Entwicklung kann nur zukunftsorientiert erfolgen. In Zeiten der Rohstoffverknappung und Erderwärmung muss Entwicklung im Einklang mit den ökologischen Bedürfnissen realisiert werden. Bewährte umweltfreundliche Technologien sollten überall eingesetzt werden, wo dies möglich ist.

Situation in Indien

Der Energiebedarf eines boomenden Landes wie Indien steigt Tag für Tag an. Es muss verhindert werden, dass dieser Bedarf mit nicht- erneuerbaren Energiequellen gedeckt wird. Die Fehler die über Jahrzehnte in den entwickelten nördlichen Industrieländern begangen wurden sollten nicht wiederholt werden – insbesondere nicht in einem Land mit über einer Milliarde Einwohnern.

BORDA/ CDD Technologie

Der Erfolg von Technologien wie die dezentrale Abwasseraufbereitungsanlage DEWATS verdeutlicht, dass umweltfreundliche Technology nicht nur effizient ist, sondern dem Bedarf an Energiegewinnung und Abwasserbehandlung gleichzeitig nachkommt. Da die meisten Städte Indiens nicht über eine Abwasser-behandlungs-anlagen verfügen, ist dieser Synergieeffekt sehr hilfreich.

Auch die Mikro-Wasserkraftanlage hat sich als geeignetes System zur Energieversorgung erwiesen und der hydraulische Widder ist eine einfache, kosteneffiziente und langlebige Lösung für die Wasserversorgung

Aussichten

Die Verbreitung dieser Technologien sollte ausgeweitet werden. Zudem sollte die Möglichkeit in Betracht gezogen werden, andere Technologien, die für die Menschen nützlich sind, einzubeziehen. Biogas Anlagen sind eine Option, Energiegewinnung und Abfallentsorgung zu kombinieren.

Heutzutage sind erneuerbare Energie- Technologien im Vergleich zu konventionellen Lösungen meistens nicht ökonomisch, wodurch zusätzliche Finanzierung notwendig ist, um erneuerbare Energien im größeren Maßstab einzusetzen. Der Clean Development Mechanism CDM ist eine neue Möglichkeit der Finanzierung von Entwicklungsprojekten, die solche Technologie verwenden.

Rolle des Projektes

Im Rahmen dieses Projektes soll analysiert werden, inwiefern deutsche Biogastechnologie nach Indien transferiert werden kann. Weiterhin soll das Erweiterungspotential von Projekten mit Mikro- Wasserkraftanlagen untersucht werden. Schließlich soll überprüft werden wie der CDM genutzt werden kann, um BORDA/CDD- Projekte in der Zukunft zu finanzieren.

Langfristig denken, jetzt handeln

1. Introduction

Affiliated Organizations

Bremen Overseas Research and Development Association (BORDA)

BORDA was founded in 1977 as a non-profit organization in Bremen, Germany. Since 1981, BORDA's programs have been supported by the German Federal Ministry for Economic Cooperation and Development *(Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung,* BMZ). As of 2001, BORDA works exclusively to facilitate development cooperation with an aim to provide sustainable services for basic needs to disadvantaged segments of society in an environmentally friendly manner. This is done through the dissemination of demand-oriented basic services in the fields of decentralized sanitation, water and energy supply, as well as solid waste and wastewater management.

BORDA's Portfolio

Quality and knowledge management
Decentralized water supply
Decentralized energy supply
Decentralized wastewater (WW) treatment
Community-based sanitation
Decentralized solid waste management

Characteristics

Immediate verifiable impact through/ of projects
High rate of sustainability of project implementation and services
Demand-oriented; bottom-up; multi-stakeholder approach
Application of proven environmentally friendly technologies
Applied quality and knowledge management
Building of local capacity, competence and expertise
Active networking and cooperation with policymakers, civil society, private non-profit and for-profit organizations, research institutes and the private sector
Supporting the UN Millennium Development Goals (MDGs) and the UN's Agenda 21

Consortium for Dissemination of DEWATS (CDD)

This Consortium is a framework organization founded in early 2002 in Bangalore, India. The CDD's objectives are: to coordinate dissemination activities, including development of strategies, lobbying and marketing, and to upgrade technologies related to DEWATS (Decentralized Waste Water Treatment System). The CDD's member organizations operate under various legal statuses, such as government-affiliated, NGO and private.

The CDD is engaged in pursuing environmentally adapted solutions to address India's critical wastewater situation across sectors. CDD members are organized within five separate working groups according to their respective everyday focuses. These groups seek to address: Research and Training; Environmental Management; Social Development; Architectural and Engineering Consultancy and Technical Cooperation and Development Projects.

CDD provides a suitable organizational framework which can provide its members organizations with other forms of support and/ or services, including: research, investigation; consultancy, training of CDD members, quality control and monitoring of DEWAT units.

Facilitating basic needs, girl at the LEDeG compound in Leh, Ladakh

1. Introduction

Ostasiatischer Verein Bremen e.V. (OAV)

In 1901, the OAV (*Ostasiatischer Verein Bremen e.V.,* East Asian Association Bremen) was founded by ten gentlemen who wished to retain memories of time spent in East Asia, as well as contact with the region's countries and peoples. The association regularly organizes dinners and presentations for its members and promotes cooperation with East Asia. Additionally, the OAV works publicly to promote awareness of regional issues and sponsors different projects (such as this one) and events benefiting the development of East Asia. The OAV, with approximately 500 members, considers its role as facilitator of cultural dialogue as critical.

The Hunnarshala Foundation

The Hunnarshala Foundation is a non-profit company, registered in August 2003 at Bhuj-Kutch, Gujarat. It has five divisions: Design; Construction; Matti (clay) works; DEWATS; and Social Mobilization. The HSF has a total staffing of 34. The Foundation is founded with the support of certain NGOs, educational and scientific institutions, and companies within the private sector.

An example of a solar lamp

The HSF operates in pursuit of the following objectives:

- To facilitate housing for the poor and develop governance and planning tools to create self-sustaining communities within local small and medium-sized towns. The HSF works in close cooperation with local residents to this end;
- To work with and further the interests of construction workers and their profession through training, assistance and capacity-building support to bring them into the mainstream construction market;
- To promote the use of environmentally friendly and cost-effective building materials and techniques drawn from local inputs and aesthetics.

The HSF has developed and transferred several environment friendly technologies in sewerage recycling and the housing sector. The Foundation has worked with disaster rehabilitation in India, Iran, Indonesia and Afghanistan, as well as helped in policymaking, developing technical guidelines in housing reconstruction for GOs, NGOs and their funding agencies.

Sahjeevan

Sahjeevan was founded in 1991 to develop approaches to implement projects with an environmental focus aimed at empowering women with Kutch Mahila Vikas Sangathan. The organization is financially supported by the Swiss Agency for Development and Cooperation (SDC), the Ford Foundation, the ministries of several states, the Indian central government, as well as the United Nations Development Programme (UNDP). Sahjeevan is working with a team of 22 professionals. Sahjeevan has developed a competence concerning natural resources like water, land, grasslands, coastal ecologies and non-conventional energy. With this, the organization has worked to strengthen natural resource-based traditional occupations like animal husbandry, agriculture and fisheries.

Sahjeevan's aims are: to develop an understanding regarding pertinent aspects of the environment in Kutch; to set up example models in cooperation with local residents; to lobby for wider application of organizational activities; and to assist in building capacities for wider dissemination. Sahjeevan encourages the establishment of knowledge-based institutions dealing with water, organic farming, renewable energy, housing etc. Sahjeevan has played a vital role in establishing organizations like Kutch Nav Niraman Abhiyan and the Hunnarshala Foundation. Furthermore, the organization has set up a platform for organic farmers (*Kutch Sajiv Kheti Manch*) and a Forum for Planned Industrialization of Kutch, which intends to nurture sensitivity for the impact of industrialization on local livelihoods and natural resources.

1. Introduction

ASA North–South Project

ASA/ inWEnt

ASA Seminar near Kassel

The Network for Development Education, ASA (Arbeits- und Studienaufenthalte in Afrika, Lateinamrika, Asian und Südosteuropa, directly translated, this means "Work and study stays in Africa, Latin America, Asia and South Eastern Europe") is a scholarship program giving students and young professionals the opportunity to broaden their perspectives during a three-month development work project. These projects are realized in cooperation with various organizations working in all different fields of development work. The program is financed through inWEnt (Internationale Weiterbildung und Entwicklung gGmbH; Capacity Building International, Germany), which is part of the German Academic Exchange Service (Deutscher Akademischer Austauschdienst, DAAD). ASA selects participants based on their respective skills and organizes preparatory and, upon project completion, evaluation seminars. These serve to prepare participants for the challenges within the social- and project-relevant fields. ASA aims to connect people, projects and initiatives worldwide and increase awareness, as well as to promote interest in development work.

ASA is also cooperating with other European organizations.

North-South Exchange

All four participants at the BORDA office in Bremen

ASA promotes so-called North-South Programmes. These provide the opportunity for an intense exchange between participants from Europe and other project regions as noted earlier. ASA believes that especially these projects create a beneficial environment for the participants to experience the various aspects of development cooperation and cultures, giving the opportunity to learn from and with each other. ASA supports the participants by arranging seminars for preparation, reflection and cultural exchange.

Furthermore, these provide a good opportunity for all participants to learn about other project aims, areas and participants. The participants are supporting each other in their respective countries within not only the project context but also in everyday, personal life. BORDA serves as a strong link between the different regions involved. By launching a North-South Project, BORDA has the opportunity to train members of partner organizations and to increase awareness of development issues and BORDA's activities in Germany while gaining information on appropriate technologies and project frameworks. The new perspective that project participants gain and the exchange between them can contribute towards a more perceptional and reflective survey on the linkage between technology and developmental issues.

ASA Seminar at Werftpfuhl near Berlin

1. Introduction

The North Phase | The South Phase | The Clean Development Mechanism (CDM)

The North Phase

Site visit in Bremen

The North phase of the project takes place from April 10th 2006 to July 6th 2006. Dhairya Dholakia and Amit Sawant visit Germany to carry out an analysis of anaerobic waste digestion (biogas digesters) and solid waste management as practised there. The objective of the project is to provide an opportunity to gain information and experiences on Waste Management and Biogas Generation and to analyze the elements transferable to Indian conditions for a strategic expansion of services provided by CDD. To prepare for visits and to work on results, the participants are placed at the headquarters office of BORDA in Bremen. Mr. Gert Kreutzer helps to organize project visits. The participants visit various companies, agencies and institutions related to the project and attend seminars, fairs and a construction of a biogas plant. Through these experiences, they get information about the framework conditions, the technical concepts and approaches as well as different provider models in Germany. This is needed to analyze the viability of technology transfer to the Indian context. During the project period Caroline Luebke and Roland Schumacher support Dhairya Dholakia and Amit Sawant in acclimatising to their new living conditions, organizing visits and translating from German to English. This experience helps to broaden their perspectives and helps to provide a clear and differentiated idea about which anaerobic digestion process are applicable in India.

The South Phase

Staff of CDD in Bangalore

Within the South Phase (August 8th to November 16th 2006) Caroline Luebke and Roland Schumacher are based in Bangalore working with BORDA India and its partner CDD. Their aim is to study the setting of micro hydro power units (MHPU) in India with the objective to create a quantitative and qualitative mapping of micro hydro system activities. Background information is gained using the Internet and relevant available literature. The main focus of the project is on visiting sites as well as meeting with individuals and organizations active within this field in different parts of India. The information gained is evaluated and presented in the form of a best-practice analysis, a mapping of the activities of different actors, and finally, an evaluation of the potential for further development in the country. The project is implemented in consultation with BORDA India and CDD under the supervision of Pedro Krämer. This arrangement afforded the participants significant freedom and responsibility.

The Clean Development Mechanism (CDM)

Supporting sustainable development

CDM is a tool provided for by the UN-administered Kyoto Protocol, which aims to support sustainable development in developing countries. This is done by allowing industrialized countries the possibility to reach emission reduction targets through investment in “clean” technologies in developing countries. The CDM gives companies and organizations working within this field an additional financial source which could (also) be of interest for BORDA and CDD. With this project, BORDA and CDD intend to gain information about the prospects for linking CDM with BORDA/ CDD activities within those sectors considered within the project and beyond. Thus, CDM serves to link the two different project backgrounds.

2. Project Conclusions

Transmission wires near Agali

Garbage versus Nature in Ladakh

Due to the wide spectrum of issues and topics addressed within the project, it is difficult to give a short and general conclusion.

After studying different approaches to sustainable development in India and technologies possibly applicable in the Indian context, it became clear that promising ideas and concepts exist in abundance. The same, however, can be said for the number of considerable problems and challenges. The management of water resources, waste, and wastewater as well as electricity supply are but some of these areas.

A wide number of parties are involved in promoting and implementing sustainable technologies, often with the same goal but with differing concepts and understandings. These parties include, among others: the government of India and of its component states; NGOs operating from at the community level to the international level; as well as national and international companies, who might be interested in promoting their products.

Relatively new within this field is the implementation of CDM projects, supporting sustainable development in developing countries while allowing industrialized countries and their industries to retain high levels of emissions.

BORDA, as an NGO is interested in sustainable development for the sake of humanitarian assistance, such that the livelihoods of people are improved while protecting the environment and resources at the same time. To support this development, waste management including biogas production and micro hydro power systems are suitable concepts which are put into operation by BORDA and its partner organizations. These project types have a potential for expansion but also should be developed further and improved as well as new concepts and technologies can be applied. Especially the cooperation with the local communities when implementing projects should be considered and an independent development of the technologies on the open market should be encouraged, since it should be ultimate aim to make them compatible and economical. With this in mind, BORDA has the potential of supporting and spreading sustainable development in India.

2. Schlussfolgerung des Projektes

Pico Hydro Unit in Kerala

BORDA making a difference for and in Ladakh

Aufgrund des großen Spektrums an Themen und Fragestellungen, die innerhalb des Projektes betrachtet werden, ist es schwierig eine kurze und allgemeine Zusammenfassung zu geben.

Nach dem verschiedene Ansätze nachhaltiger Entwicklung in Indien und Technologien, die möglicherweise in Indien angewandt werden könnten, untersucht wurden, war klar, dass eine große Anzahl von viel versprechenden Konzepten und Ideen existiert. Das gleiche lässt sich allerdings auch über die zu bewältigenden Probleme und Herausforderungen sagen. Das Management von Wasserressourcen, Abfall und Abwasser sowie Stromversorgung sind nur einige Themen aus diesem Bereich.

Eine große Anzahl von Teilnehmern ist an der Verbreitung und Umsetzung erneuerbarer Technologien beteiligt, oft mit demselben Ziel aber unterschiedlichen Konzepten und Vorstellungen. Diese Teilnehmer sind unter anderem die Indische Regierung und die der untergeordneten Staaten; Nichtregierungsorganisationen, von lokaler bis hin zu internationaler Ebene; sowie nationale und internationale Unternehmen, die Interesse am Vertrieb ihrer Produkte haben könnten.

Recht neu in diesem Bereich ist die Realisierung von CDM- Projekten, die nachhaltige Entwicklung in Entwicklungsländern fördern, während Industrieländern und ihrer Industrie die Möglichkeit gegeben wird, höhere Emissionslevel beizubehalten.

BORDA als eine Nichtregierungsorganisation ist and nachhaltiger Entwicklung vor dem Hintergrund der humanitären Hilfestellung interessiert. Dabei sollen die Lebensbedingungen von Menschen verbessert werden während gleichzeitig die Umwelt und Ressourcen geschützt werden. Um diese Entwicklung zu Unterstützen, sind Müllmanagement einschließlich Biogasproduktion und Mikrowasserkraftsysteme geeignete Konzepte, die von BORDA umgesetzt werden. Diese Art von Projekten hat Expansionspotential, sollte aber auch weiter entwickelt und verbessert werden, außerdem können neue Konzepte und Techniken angewandt werden. Insbesondere der Zusammenarbeit mit den lokalen Gemeinschaften sollte Beachtung geschenkt werden und eine unabhängige Entwicklung auf dem freien Markt sollte angeregt werden, da es das Ziel sein sollte, diese Technologien wirtschaftlich und wettbewerbsfähig zu machen. Vor diesem Hintergrund hat BORDA das Potential nachhaltige Entwicklung in Indien zu unterstützen und zu verbreiten.

3. North Phase

Introduction | Visits related to Solid Waste Management

Since ancient time humans and animals have used the resources of earth to support their life. As it was hard work to gain resources, waste products were also used for many purposes. Waste didn't need to be disposed because it was used as a resource.

Due to rapid growth of the earth's population, the increasing consumption by mankind and the production of goods made also of inorganic material, waste has become a serious problem. Its disposal causes enormous ecological and hygienic problems and as resources are getting rare it is necessary to reuse waste material. To reuse the waste of modern cities efficiently, a very complex solid waste management is needed.

As there are almost no organized waste management concepts existing in India, one focus of the north phase is on solid waste management in Germany. Germany has adopted a multi-disciplinary approach for waste collection, transportation, conversion and its disposal.

The utilization of organic waste to produce biogas is common in Germany as well as in India. As biogas technology has been developed and optimized continuously during the last years in Germany it is another important part of the project to analyse the transferability of adapted biogas technologies from Germany to India concerning the different conditions.

Biogas being the topic of study and probable sources of biogas generation are studied with variation in the type of processes. Subsequently visits to Biogas plants using different substrates and anaerobic processes of dry and wet fermentation impart wider perspective of the topic. It is remarkable to see the innovations and adaptation of criteria practiced in Germany to suit the supply and demand aspects of energy generation with a focus on waste management.

The energy supply and demand gap, which is increasing day by day in India, has to look forward to this idea of "waste to energy" from renewable sources as an alternative to meet this gap.

Visits related to Solid Waste Management

Office of Senator for Infrastructure, Environment and Traffic, Bremen

In Bremen City, the municipality is responsible for solid waste management. However, this task has been outsourced to a private operator "Holding Bremer Entsorgung GmbH & Co.KG" (HBE), which holds subcontracts with "Kompostierung Nord GmbH (KNO) for composting, "Entsorgung Nord GmbH" (ENO) for garbage collection, "Reinigungs- und Entsorgungsservice Nord GmbH" (RNO) for cleaning and collection services and "Abfallbehandlung Nord GmbH" (ANO) for waste combustion.

To understand the role of the different levels of government and methodology of framing legislation, a visit to the office of a Bremen "Senator" (equivalent to a ministry in other contexts) is helpful. This Senator deals with various stakeholders in the municipality, such as the public, private companies and other local level government authorities.

In meeting with representatives from the Senator, the authors come to learn about certain factors framing relevant legislation and how a framework is providing appropriate strategies for successful implementation with a dynamic contribution from certain government departments.

3. North Phase

In Bremen State, the ministry for Infrastructure, Environment and Traffic (Bremer Senator für Bau, Umwelt und Verkehr) was established in 1976. The department is responsible for issues relating to energy, environmental protection, pollution control, ground protection, flood protection, wastewater and solid waste treatment. There are guidelines on certain issues set by the European Union. Adherence to these guidelines is mandatory and is enforced through framing laws and the development of strategies. In the European context, national and state governments enforce relevant laws while local municipalities/cities are required to follow these. In part, this entails developing local plans for implementation. In the case of Bremen, the Senator is responsible for designating partners for the implementation of the laws, regarding among other things of solid waste management. The Senator is also responsible for monitoring functions whereas the municipality has authority to develop an operational methodology. In this instance, Bremen City is responsible for collecting fees for waste management but handles only landfill management. The rest of operations, as noted above, are outsourced to private actors. But even in outsourced tasks the municipality and the state ministry (Senator) together are responsible for monitoring the process in its entirety, but also for promoting awareness of this process.

Entsorgung Nord GmbH, Bremen (ENO)

ENO has the vital responsibility for efficient solid waste management in Bremen. This company is responsible for handling waste collection of different types of wastes from households, companies, shops, streets, local neighbourhoods and public places. City residents are required to pay fees for garbage collection and dumping to the municipality. ENO has a yearly contract with the municipality for collection of wastes, salt distribution on area roads during the winter months, and other crucial services.

Waste managing companies in Bremen

ENO conducts systematic operations to collect organic wastes from the above noted brown bins. These are emptied at composting stations. Meanwhile, garbage from gray bins are transported to a combustion plant. The contents of yellow bags and paper bins are transported to area recycling stations. Brown bins and grey bins are available in different sizes depending on household size. Textiles, shoes and glasses of different colors (green, brown, and colourless) are collected in larger-sized containers and placed at common public sites.

Each area has its own yearly collection schedule, which also describes the number of times bins are to be emptied. An inbuilt electronic chip in the collection bin is intended as a tracking device. Data, including the frequency of collection, etc. is stored at the office of the collecting agency. In practice, this data is used to indicate when to exact additional fees if bins necessitate emptying more often than scheduled.

Garbage collection vehicle

Street cleaning in Bremen city

Question-Answer session at ENO

3. North Phase

ENO owns and operates a total of 50 garbage collection and street-cleaning vehicles. These vehicles typically start cleaning and waste collection from early morning. Operations are complete by late afternoon. In certain circumstances, such as large public gatherings, ENO's services may be contracted for waste collection duties.

Blocklanddeponie, Bremen

The "Blocklanddeponie" is a dumpsite operated by the "Bremer Entsorgungsbetriebe" (BEB) which belongs to the municipality. It stretches across an area of 100 Ha and is scientifically managed since 1969.
The station signs yearly contracts with industries to dump certain amounts of garbage in a year, which does not contain any hazardous components.
One section of the dumpsite is used as a collection and segregation point where approximately 100 t of garbage like cuttings from the garden, worn out tires, tube lights, fridges, furniture, paper, clothes, shoes, metal articles, glass, "yellow sacks" and construction debris are dumped every day by the residents and industries from and around Bremen. The fee structure is different for several types of waste. Wastes are segregated in different containers and from this point particular companies are responsible to collect them.
The non-recyclables, industrial wastes and debris are collected and dumped on the landfill site. The landfill site is managed in layers of dumped garbage. There are two kinds of pipeline networks placed underneath. One network collects landfill gas generated through the digestion process of the waste underground and the other is to collect leachate into storage tanks to protect ground-water of pollution. This water is collected and treated in the municipal wastewater treatment plant.

Containers for different garbage with landfill site in the background

Electronic wastes segregation

The anaerobic digestion underneath the dump produces about 250 m³/h of landfill gas. Collected by the pipeline network the landfill gas drives a generator which generates 450 kW electrical energy. The electricity is fed into the grid and heat is used for the warming up of buildings of dumpsite and of other company premises.

Abfallbehandlung Nord GmbH, Bremen (ANO)

ANO is handling incineration of waste which can neither be composted, digested nor recycled. ANO operates with 130 employees and combust 470000 t of waste per year from a radius of 200 kilometres around Bremen. There are two garbage bunkers of 3500 t and 4500 t capacity in which garbage including industrial waste, household waste, textiles and wooden pieces are dumped. Dumped material is mixed, shredded and again mixed to ensure a consistent calorific value of 11.8 kJ/kg. The waste is fed into incinerators by two assembly lines. The temperature inside of the combustion chamber is 1000°C and due to that water, circulating through the inbuilt pipes of incinerator converts into steam which is used to run a turbine to and as a source of

3. North Phase

Bunkers filled with combustible waste at ANO

Waste combustion inside the incinerator

heat. The exhaust gases produced during the combustion pass three electric filter, an absorber and textile filter before they are liberated into environment through a chimney. The generated electricity is sufficient for 20000 households. The heat out of the steam supplies 14000 households. ANO has contracts with households, industries and the university as consumer of heat and electricity. Ash as a by-product of the combustion is used for road construction and vendors separate metal from it.

Kompostierung Nord GmbH, Bremen (KNO)

The composting station is operational since 1970 and treats around 48000 t of garden and organic kitchen waste collected from residents of city of Bremen, from surrounding industries and various firms. This waste gets converted into 29000 t of compost fertilizer which is sold through own outlets.

Display of different products of Bremer Kompost

Garden waste like small bushes, grass and small trees are treated in the open air where raw material is collected from recycling station and also directly brought by people. The composting process is biological and done aerobically. Waste is dumped in different piles. In the first step segregated wood branches and pellets shred into small pieces are mixed with rest of the material and then dumped upto a height of 3m from the ground which are set aside for three months for decomposing. Partly decomposed organic matters are shifted to different dumps and mixed with some already composted matter to speedup the process. The same process is repeated for each heap to achieve optimal temperature for composting. Temperature is measured regularly by inserted sensors. The material is completely decomposed within one year. Finally it passes through blowers and a magnetic belt to remove unwanted material like plastics, metal and wood. There are three types of compost to use for flowers, vegetable and for soil enrichment. The

Citizens of Bremen dumping garden wastes

Piles of shredded garden waste arranged for composting

Plastic, Wood and metal separating machine

quality of products is controlled regularly.

As kitchen waste is containing different kind of food products, composting process liberates some harmful gases like Ammonia. Hence, composting is preferred in closed shed. The process of composting is the same as of the composting of garden waste. The reactions which take place in the shed are partly aerobic and partly anaerobic which generate an optimum temperature of 55–60°C and the process takes four months to be completed. This fertilizer is only allowed to use only for agriculture purpose but not in gardens. The air circulated in the closed shed during the process is treated scientifically by specially designed wood filters and is finally liberated into the environment.

Müllvergärungsanlage, Freiburg (BKF)

The BKF is the example of biogas generation through dry fermentation from municipal organic solid waste from kitchen and gardens used as renewal source of energy. The garbage is collected from the city of Freiburg and its surrounding area by 300 trucks.

The wet and dry organic wastes are unloaded into bunkers and pass through a cylindrical sieve. Plastics and metals are separated manually and residues are shredded further. The material is preheated by steam before leading it into the digester. The digester does not have an agitator to mix the substrates but this is done by inserting fermented gas from the bottom of the digester and a partition wall.

From the biogas 700 kWh electricity and 1400 kWh of thermal power is generated. The heat is used to preheat the substrate. The electricity is sold to the Energy Company at the rate of 9 cents/ kWh which is higher then the purchasing of conventional energy from an electricity company. This difference of the prices attracts investors to produce energy from renewable energy sources like organic waste instead of only composting it. In this specific case, an additional income is generated by selling compost. Produced gases and leakages are treated as per government norms.

Biogas digester and engine room at BKF, Frieberg

Organic waste to be shredded at BKF, Frieberg

Compost material and packing process of compost fertilizer.

3. North Phase

Conclusions related to Solid Waste Management Visits

The fundamental outcome of the visits to the agencies working on solid waste management is the understanding of an integrated approach. This approach is adopted by the managing authorities through constituting a framework for efficient managing of waste treatment.

As this is cost effective endeavor, the framework involves different aspects like:

At Source and Category wise Segregation

Distribution of different bins for different wastes restricts people to throw their garbage at other places. In addition it is less difficult to collect and segregate the garbage.

Designing of Collection System

Various sizes of bins for individual household and communities are available for all category of waste. The collection system also covers residential areas, offices, industries, shops and public utilities not only urban areas.

Optimal Routing of Collection of Vehicles

An annual schedule is prepared to avoid any mismanagement and also create preparedness among the people. The route is decided for collection vehicles on the base of timetable of particular area to empty specific bins.

Recycling and Re-use of Waste

As per the characteristics of the waste, the process of recycling or reuse is possible. Organic wastes can be composted, digested and can produce landfill gas. The combination of the natural processes with advanced technologies is useful to make commercially viable ventures out of waste. The introduction of promotional laws is the significant for the successful spread adoption of the Renewable Energy Technologies and also by the system like "Der Grüne Punkt" encourages recycling as a sector and possibility to get cheaper recycled product which is also and part of climate protection measures.

Safe Disposal Options (Hazardous Waste Management)

The garbage, which cannot be reused by any process, is dumped scientifically on a landfill site by following strict norms for the hazardous waste disposal. Municipality is acting as a monitoring entity as well as a responsible body for the creation of public awareness by organizing events to enhance people's cooperation. The landfill site also can be productive by capturing landfill gas and generating energy out of it.

Effective Stakeholders Participation

The stakeholders range form authorities like the European Union to the inhabitants of a city, town or village.

The active involvement of each is achieved by the enforcement of law and by creating common understanding between them. Here, the framework is creating interdependency as well as control mechanism. In the case of solid waste management public and private companies are partners. The companies are part of single holding whereas internal coordination is the only key for the accomplishment of effective management. The noticeable part is the special emphasis on the environmental protection issues and laws which cannot be changed for the interest of any single entity.

3. North Phase

Visits related to Biogas Technology

Energy and Nature Fair, Hildesheim

CHP unit container model

To be hand in hand with the latest developments and policies in the renewable energy sector, fairs provide the platform to break the knowledge barrier between the user and an expert. The fair at Hildesheim is organized for farmers who are interested in the renewable energy sector, especially Biogas. The significant opportunity in renewable energy policy framework of German government motivates them to invest in this sector. The fair composes of a mixture of knowledge sharing through presentations and site visits. The exhibition demonstrates the recent developments in the biogas field. Technical knowledge about process biology for substrates within the digester, dry and wet fermentation processes, economics of optimizing the costs for production and practical experiences prove helpful to analyze the missing link for Indian situation. Interesting new ideas of utilizing the process heat generated by a co-generation plant for the distillation of bio-ethanol, feeding biogas into the natural gas grid and the scope of feeding biogas as automobile fuel reflects the enormous potential biogas has.

Study tour to Biogas Units around Hildesheim

The intention of the tour to impart knowledge on dry and wet fermentation is motivational to the farmers. The boom in the biomass renewable energy sector has encouraged farmers to grow energy plants extensively for substrate generation to produce biogas. The first unit visited, is operated by such an 'energy farmer' who is using agricultural products and pig dung for biogas used for co-generation. The steel digester volume is around 1000 m^3 and is fed with 22 t of the mixture daily. The substrate is retained in the fermenter for 25 days to generate biogas at the rate of 150 m^3/d to 200m^3/d. The cogeneration unit consists of two piston engines each of 100 and 250 kW electrical capacity. The generated electricity is fed to the grid and heat is used for heating respectively.

Wet fermentation digester

Dry fermentation digesters

The second unit visited is a research unit developed by a bio-farmer at overall installation costs of 200000 Euro including the co-generation unit. The process applies dry fermentation of grass and cow dung. The unit consists of three RCC rectangular fermenter of 28 m^3 volume each fed with the substrate and sprinkled with water once in 2 hours for initiating the digestion process. It takes about 18 to 20 days to complete one cycle of optimum biogas production of 75 m^3/h. This gas will be used to run a cogeneration unit to get 40 kW of electrical power that is sold at the rate of 21 cents/kWh. The yearly running costs are around 25000 Euro with anticipated profit of 30000 •/a excluding the money saved for fertilizer at the rate of 112 •/Ha.

ISET– Research on Biogas

The Research & Development (R&D) division for the "Energetic use of Biomass" of the "Institute for Solar Energy Technology" (ISET) in Hanau has been working since 1995 and employs 125 staff in Kassel and Hanau. ISET is

3. North Phase

Biogas generation parameters monitoring at ISET laboratory

an applications-oriented research institute engaged in the design of electrical systems technology for the utilization of renewable sources of energy and for decentralized power supply. The fields such as wind energy, photovoltaic, use of biomass, energy conversion and storage, hybrid systems, energy economy, information and training are dealt. In addition to the main subjects the R&D division in Hanau is mainly focusing on the following

- Use of biomass in new energy conversion technologies, such as micro gas turbines, fuel cells, Stirling engines and thermo photovoltaic
- Optimization of the interaction between biogas generation and conversion units
- Process measurement and sensor technology for the optimized operational control of biomass systems
- Standardization and modularization of systems using biomass
- Integration of biomass systems into power supply structures
- Development of biogas-fed "micro gas grids"

Efforts are also being made to use substitute natural gas (SNG), which is cleaned biogas at 200 bar pressure for cogeneration and reduction of CO_2 and H_2S from biogas keeping in mind the economical aspects of it.

The conventional piston engine for co-generation is very costly and requires periodical maintenance. A Stirling engine uses the energy from combustion of the biogas externally. Due to that biogas can be used without being cleaned because the cylinder and the piston of the Stirling engine do not get in contact with the corrosive combustion gases of biogas. Micro gas turbines driven with biogas are studied extensively because they have less moving parts and require less maintenance. In comparison with the sophisticated co-generation piston engines, which have an efficiency of about 40%, micro gas turbines and Stirling engines have 30% and 20% efficiencies respectively. The Micro gas turbine has shown noteworthy improvements in its performance and is expected to replace the costly conventional piston engines in the near future.

Stirling engine at ISET

Stirling engine at ISET

Two wet fermentation digesters.

HAASE Energietechnik, Neumunster

"HAASE Energietechnik Gruppe", based in Neumuenster, Germany, is specialized in environmental engineering and plant production with a focus on energy systems, landfill engineering (landfill gas, wastewater from landfills) and biogas engineering. In 1981, "HAASE Energietechnik" was established in Neumunster where headquarters and production facilities are still located. In Germany HAASE operates a number of plants on the basis of operation and maintenance (O&M) schemes whereas local partners representing them abroad. Their key activities are the supply of products and services in the field of landfill technology and waste management. Industrial projects include water

3. North Phase

Flare construction at HAASE

CHP piston engine for assembly in container

treatment, purification of contaminated process air, energy recovery, and decentralized power supply.

The company is engaged in assembling of cogeneration units in containers, booster units and flares of various sizes, which are constructed in the workshop. The key business of "HAASE Anlagenbau AG" is engineering of biogas plants and mechanical-biological waste treatment systems. The company is involved in the implementation right from the planning, designing and construction of biogas plants with a staff of around 250 people. HAASE also has mobile treatment facilities, which can be hired for short durations and can be shifted from one place to another. This is devised for the people who cannot afford the cost of huge plants or who want to test the system before purchasing it.

"Biogas Nord" – Installation Tour

It is important not only to observe the developments in the field of biogas in Germany but also to get involved into the implementation process of biogas plants. This is accomplished from the internship program with Biogas Nord. Biogas Nord is extensively involved in construction of small scale to large scale Biogas plants all over Germany especially in the eastern and central part. Re-growing resources (NaWaRo) such as wheat, barley, cow dung and grass are the common sources of substrates for biogas generation. Small farmers growing different energy plants and grazing pig or cattle collaborate for a common biogas plant. This venture not only solves their problem of disposing the wastes safely but forms a source of income also. Farmers are involved in the construction from the very first stage to be aware of the technicalities and difficulties during its operation. It is taken care to design a plant, which suits the farmers' needs.

The first biogas plant visited has three digesters of 2600 m^3 volume and 25m diameter each. The CHP unit of 500 kWh output has been installed. The heat

Biogas pipe fixing for the digester

Ground preparation for digester construction work

Providing insulation for digester

3. North Phase

generated from the cogeneration unit is planned to use for drying of the substrate. The biogas plants are made robust in design and construction with small things addressed with equal importance. The temperature plays a very important role in the biological process. It is maintained by insulating the digester to use the cogeneration heat for heating the surface of the digester.
Laying of approved thickness of tarpaulin sheet under the biogas digester is made mandatory to avoid the pollution of the ground water. Similar foresightedness has to be maintained to prevent exploitation of natural reserves.

Large-scale biogas projects with huge investment are executed with collaborative partnership between different companies. Like the construction of the digester is given to one company and the dimensioning is done by Biogas Nord, piping is again subcontracted. This ensures timely completion of the project as early as three months. The thrust in the renewable energy sector is to some extent responsible for this competitive market, keeping the construction companies on the toes for survival.

Biogas Nord: Design, Construction and Management of Biogas Plants

The basic intention of the internship program with Biogas Nord is to gain first hand knowledge about the planning, construction and management of large-scale biogas plants through an extensive tour to construction sites.
The biogas plants installed by Biogas Nord are based on the flow-storage process. This involves the operation of several tanks (fermenters) with substrate continuously flowing through them. The addition of substrate into the fermenter (first tank) raises the level of the sludge and the putrefied sludge flows through the overflow into the next tank. This process is repeated if there is another tank connected to the second tank thus trapping maximum biogas. The organic Total Solid (oTS) content is an important factor that determines the biogas production from the input substrates. Sewage, which has low oTS, yields relatively low quantity of biogas compared to energy plants using NaWaRo. Hence UASB technology is more suitable for sewage treatment than the digestion in fermenters. Lagoon system is also used for this purpose which is simple and requires less investment costs.

Final positioning of a wooden truss of the digester's roof.

Planning, designing, construction and maintenance of a biogas plant starts with a list of enquiries to the farmer to get the basic necessary data such as the type and quantity of substrate, number of cattle, cultivated area of energy plant, etc. In consultation with the farmer the first hand concept is prepared with sizing, number of tanks, biogas output, co-generation capacity, investment costs and approximate income from co-generation. If the investor agrees with the drawn up concept, the final concept is prepared with optimization of certain parameters like requirement of substrate, volume of the digester, number of digesters, land requirement and co-generation capacity to be installed. The optimum proportion of various substrates in the digester has to be calculated to maintain the biology of the digestion process optimum for biogas generation. It is also important to decide the particular mix of substrates which can be put into the digester.

Mounting of the "biogas dome".

The contracts are formulated for the various stakeholders involved with responsibilities and time line for implementation. Once the contracts are signed the final drawing and designs are made taking into consideration the legislation of the government for proceeding with the construction.

3. North Phase

Conclusions related to Biogas Technology Visits

Out of the biogas visits lessons are learned as listed below:

- Reforms in the policies, framework and laws in the field of renewable energy sector can bring in considerable development in the field of Biomass used as a renewable energy source. Due to that there is an increased market of the biomass sector.
- Biogas has proved to be an alternative source for electricity generation.
- Micro gas turbines and external combustion engines like the Stirling engine can be an alternative for costly conventional CHP units.
- Research and improvements in the sector of biogas improve the efficiencies of cogeneration and the quantity of production. Due to that the biogas sector is more competent as compared to other conventional sectors.
- Dry fermentation of solid organic waste provides an option for waste management with additional benefits like production of biogas with compost as a source of additional income.
- Elimination of mechanical process for mixing the substrate by inserting gas from the bottom of the digester can reduce the maintenance costs
- It was learned how onsite construction management of biogas plants is done efficiently.
- Coordination with the farmer (client) is important to get necessary data.
- Subcontracting of certain sectors like construction of concrete digesters to specialized construction companies speeds up the installation process.
- The proportion of different substrates fed to the digester has to be varied to ensure optimum biogas output.
- Lagoon technology for biogas generation on the principle of UASB can be explored in the field of wastewater treatment specially sewage. This would reduce the number of modules and costs required for treatment.
- Coordination of the company with the farmer, investor and the government is needed to realize a sustainable biogas project.

3. North Phase

Summary, Reflections and Outlook of/ for the North Phase

In India, collection, segregation, storage, transportation and disposal of solid, liquid, agricultural and animal wastes are unscientific and chaotic. Uncontrolled dumping of wastes creates overflowing landfills that promote the spread of infectious diseases and affect serious environmental implications which contribute to global warming.

Waste (household & Industrial) as a renewable source of energy, has potential to generate 1700 MW of power. But in the absence of at source segregation, collection and processes like composting or combustion, it is hard to reach to the mentioned capacity. Livelihood of "garbage pickers" is totally dependent on the garbage. But since segregation and recycling is done informally, garbage pickers cannot generate sufficient income. But due to hazardous waste, they are working at higher health risks.
Government, NGOs and some city authorities have realized the problem as well as the potential and started scientific waste management for energy generation. But still the efforts are not in line of creating a mass practice.
In the case of agriculture residues and animal wastes, traditionally they are dumped in open space which liberate methane during the natural decomposition process and create health problems in the area. All these input material have latent energy, which can convert into thermal or electrical energy through biogas generation. In the current government program 29% of the total potential is trapped but still 71% has to be achieved.

Exposure to the systematic practice of waste management and strategic promotional efforts of biogas technology for climate protection in Germany comes to comprehend the basic facts of the effective implementation via constituting appropriate policies.

Looking to the transferability to India, there are some fundamental considerations which are in the area of policy framework and technological improvement. The crucial part for enforcing the practice is forming of laws by considering the cultural habits and benefit of environment as well as dependant communities.

- For better waste management practices, policy level changes are necessary to start at source segregation and appropriate treatments of different types of waste.
- In rural area, garbage can be seen as source of cooking fuel, compost material and an option for the grid electricity generation from biogas in integration with waste water treatment all covered under decentralized basic service model.
- For the water scarce areas, dry fermentation of agricultural waste and kitchen waste can be seen as potential sources for compost and electricity generation.
- Up gradation of technology is essential to ensure consistent gas production during higher and lower temperature conditions by providing insulation and heating of biogas digester.
- In India, biogas has only been seen as a cooking fuel like firewood, kerosene and LPG, but not for electricity generation in big scale. The attention should be given to the possibility of co-generation not only for households but also for industries using heat. And for that advanced options for co-generation like micro turbines or Stirling engines should be tried out.
- The operation of a large scale biogas plant by only one farmer is unrealistic in India because single farms usually do not produce enough organic waste to feed a big unit. In comparison to Germany it is not thinkable to feed grains

only for biogas generation, as they are needed for feeding the people. But big biogas plants could be fed with substrates from each household of a village. With them a cogeneration plant could be installed and the electricity generated can be supplied to the village or fed to the grid (if available). On village level it is likely that generated heat can be used for local industries which additionally will save a lot of energy.

- Policy level changes are inevitable to increase selling charges of power generated from the renewable energy source must be more attractive which encourage people to invest.

Without public cooperation, no technology or policy can be put into effect, hence community participation should be assured by policy in which people can be directly benefited and are attracted towards the adoption of such technologies.

Reflections of the North Phase

The project offered an enriching experience by living in such an environment which offered an uncommonly good blend of culture and science.

Project visits were mainly concentrated on solid waste management and biogas plants. Unfortunately, the authors were unable to visit water treatment plants used for biogas generation. The project's aim is to study and suggest technical possibilities for this field regarding the anaerobic digestion in the Indian context. However, the participants found that a project period of three months was relatively too short to gain adequate levels of relevant knowledge concerning technology transfers in particular. In the Indian context, with a large number of small-scale biogas plants, the authors nonetheless are of the opinion that it is not so easy to visualize large plants for co-generation on the scale and at the technological level seen in Germany. Hence, for the purposes of this project, the authors find that it would have been advantageous with greater exposure to small-scale production plants throughout the project period.

Furthermore, prior to the Indian authors' departure for Germany, it might have been helpful to have been provided with a preparatory tour of the aforementioned biogas plants in India. In this way, more fruitful and informed comparisons might have been made. Also, language barriers obviously hindered the authors' work at times.

4. South Phase

Introduction

Project Background and Aims

BORDA is thinking about an expansion of its micro hydro power projects. At present BORDA's activities in this sector are restricted to the region of Ladakh in Jammu and Kashmir. Out of these long lasting activities a pool of experience has been created. It is open to what extent this knowledge is applicable in project regions with a different cultural, social, geological and economical background. Furthermore it has to be figured out, in which regions a demand of electrification is existing as well as potential for micro hydro power projects. Finally reliable players have to be identified who could be cooperation partners in possible future projects.

Project Methodology

The required information is gained by visiting selected organizations, activists and project sites. In a preparation phase these organizations and persons are contacted to plan the visits. The first two weeks of the project are meant to familiarize with the BORDA activities in Ladakh. Within this stay a standardized questionnaire is created in which the essential questions are defined to gain comparable information about the visited organizations, projects, etc...
During the wrap-up phase, within the last weeks of the project, the information is evaluated and the reports are systematically drawn up.

Hydro Power in India

In India hydro power is traditionally used since ancient times. Experts place the origin of watermills in India, used for grinding grains, somewhere in the North-Eastern region around the 7th century. Nowadays hydro power plants amount 23.3% of the total installed capacity for electricity generation in India whereas the content is only 13% in Germany. India has an extensive wealth of experience in hydro power technology.

Micro Hydro Power in India

Pico (up to 5kW), Micro (5-100kW) and Small (above 100kW) hydro power plants are often used for rural electrification purposes all over India, especially in the Himalayan regions. The enormous potential of hydro power in these regions and the relatively simple technology make hydro power units an attractive and applicable source of energy for remote villages.

With a basic introduction into this technology even uneducated people are able to operate such a unit successfully. Maintenance is relatively low as well as the running costs.

In the past it was NGOs like BORDA who disseminated this technology. Nowadays government agencies, private investors and even the army use this technology to electrify villages in remote areas.

Pico Hydro System near Agali, Kerala

SHPU in near Mankulam, Kerala

4. South Phase

Rural Electrification

Village home in the village Fateh near Dehra Dun

According to the Indian Ministry of Power 20% of the 600.000 villages in India are still unelectrified. Per definition a village is declared to be electrified if minimum 10% of the households have access to electricity. In total there are 78 million rural households without any supply of electricity what is equivalent to 44% of all rural households in India.

The Indian Ministry of Power has introduced the support program "Rajiv Gandhi Grameen Vidhyutikaran Yojana" (RGGVY) in April 2005. This scheme aims to provide electricity to all households by 2009. Therefore the Indian government made about 3 billion Euro available.

A lot of people and organizations doubt that a complete electrification through the government will be realized, particularly not until 2009. Hence a lot of electrification projects have been implemented by NGOs. Basically these projects have to be permitted and registered from the state governments for what a fee has to be paid. But in most real cases this is not required because such projects help to reach governments aim of electrification.

Decentralized Energy Supply

For about a quarter of the unelectrified villages a connection to the grid is not feasible or cost-effective due to their geographical conditions and location. The supply of these villages should be ensured with stand alone systems like e.g. MHPU.

Another reason for the need of decentralized energy systems is the low stability of the Indian grid. Frequent power cuts do not allow developing a business that depends on electricity and strongly varying frequencies are harmful to electrical machines. On this account decentralized energy solutions are the better option for many villages.

Electrified Hamlet in northern Uttaranchal

House near Joshimath

Small shop in Ladakh

Photovoltaic cells at SECMOL, Leh

Complete rural electrification

4. South Phase

BORDA–LEDeG Cooperation in this Context

About the Organization

MHPU in the village Fanjila, Ladakh

LEDeG was founded in 1983 with the support of the Ladakh Project with the aim of ensuring that Ladakhis themselves actively shape their future based upon Ladakh's own resources and its ancient culture. LEDeG is promoting sustainable development based on solar and water powered technologies as well as income generation projects including capacity training and supports the formation of women self-help groups.

With its approximately 100 members under two offices in Kargil and Leh, LEDeG is active in those Kargil and Leh districts of Ladakh (part of Jammu and Kashmir in Northern India).

LEDeG is promoting MHPU actively and finances the projects mainly through grants from BORDA, but also from local and regional governmental agencies, the villagers are financially involved as well. Approximately 50 units have been installed through LEDeG, providing as many villages with electricity. Another activity of LEDeG, which is also supported by BORDA, is the promotion and installation HydRams, used to lift water to places where it is needed.

Concept

The project is planned, implemented and supervised through LEDeG involving the villagers.LEDeG is installing complete micro hydro systems, mostly using Pelton turbines and making an effort to construct the civil works from local materials and in a sturdy design at the same time. The villagers are actively involved in the construction of the unit.

Also an Electricity Committee has to be formed by the villagers, which has to meet certain requirements e.g. one third of the members need to be women and the committee is elected through the villagers. The electricity committee carries the legal responsibility for the project, and is managing the finances of the project and its members sign the memorandum of understanding which gives the legal framework for the work between the villagers and LEDeG. To ensure the use of the equipment and its beneficence to the population, the memorandum now includes LEDeG's right to uninstall the system in case of neglecting, since LEDeG pays for the technical components that belong to the organization.

Monitoring of projects using a Logbook

LEDeG Centre in Leh

Transmission wire in Tangole, Kargil district

To have access to electricity, each household has to pay a fee which is collected on a monthly basis and used to pay the operator, cover other expenses while the rest is usually put into the bank account. This backup money is supplying a financial backup for repair works etc.. The operator is requested to keep record about the projects using a log book; his other tasks are the maintenance of the unit and including minor repairs and contacting LEDeG in case of bigger problems.

LEDeG remains heavily engaged in the project after its installation. A yearly check

Remote houses in Ladakh

Operator of the MHPU in Tangole with a local family

of the system is done by LEDeGs staff and which is also called for in case of small and major repairs of the system, for all of which the villagers have to pay. In order to increase the usage and sense of responsibility for the system by the villagers, additional machinery useful for income generation measures is supplied in many instances, e.g. spinning wheels, carpentry machines and flour mills.

The first destination of Caroline Luebke and Roland Schumacher is LEDeG with the aim of gaining a better understanding and insight concerning the work of BORDA and its cooperation with its partner organizations but most importantly to understand the concept and framework of MHPU systems and the environment they are set up in and which they influence.

Coming from Germany it is impossible to understand the real living conditions of the rural population in India's remote regions. Life there is very simple and the people often struggle to satisfy their basic needs including drinking water and food. Especially to people in remote Ladakhi villagers, electricity is very unfamiliar and the people lack even basic understanding of electricity and power systems, what electricity is and how it can be beneficial for them.

Ladakh is strongly influenced by the presence of the military which is also attempting to increase the livelihood in this region to gain the peoples confidence and make the population supportive towards India and its military actions. Thus even the military is investing in rural electrification projects, partly through MHPU but not always successfully.

This beautiful region is especially attracting NGOs and foreign supporters and there are a range of NGOs active within different aspects of development existing which presented themselves during the Ladakh NGO fair in Leh.

Directly prior to the visit of Ladakh by the participants, heavy rains had hit this region which is classified as a cold desert. Buildings and infrastructure in general are not designed and built in a way that they can withstand heavy rainfalls and floods since those weather phenomena are traditionally unknown. Due to climate change these events occurred progressively more and it is necessary to respond to those natural influences but takes time and create problems, especially due to the scarcity of sturdy building materials.

Many of the HydRams and MHPU installed by LEDeG where damaged by the floods and since the villagers themselves are not capable of repairing the systems themselves it takes LEDeG's staff months to get all of them running again.

The visit of LEDeG provided the participants with a good insight into the

4. South Phase

Poster at the fair in Leh

Animal Husbandry and harvest in Ladakh

different aspects relevant for the further study and the interaction of the different parties involved in the projects.

Visits regarding Micro Hydro Power

Himalayan Environmental Studies and Research Organization (HESCO)

Gharat in Fateh near Dehra Dun

HESCO is an NGO formed in 1979 and formally registered in 1983 with a broad approach to improve the living standard of the people in rural areas of the Indian Himalayan Region while promoting sustainable development. HESCO initiates different appropriate activities aiming to increase the income and living standard of the villagers such as bee keeping, fish farming, growing of flowers, furniture production from lantana weed and the promotion of fruit production including its processing and conservation. One of HESCOs objectives is women empowerment and education, the HESCO headquarter in Dehra Dun also housing a women education centre and a workshop in which the Gharats (traditional watermills) are designed and manufactured by local people.

HESCO also publishes newsletters in Hindi and English to inform about different topics ranging from basic science, environment, local geography and appropriate technologies. Research on appropriate technologies and the organization of public events and workshops etc. are further activities of HESCO.

HESCO is convinced that development has in the rural areas has to take place slowly, giving the people time to adopt. Due to low levels of education, villagers are believed to be able to manage simple technology only, which is promoted by HESCO.

National Water Millers Association

Gharats are traditionally used in Northern India to grind flour and mostly owned and run by private water millers, generating their income through their mill. According to HESCO, there are approx. 70 000 watermills in Uttaranchal, more than 40 000 in Himachal Pradesh and at least another 60 000 in Jammu & Kashmir.

With the initiative of HESCO, the National Water Millers Association was formed in 1998 to organize and strengthen the position of the water millers and as a platform of knowledge exchange as well as for the promotion of the upgrading future use of Gharats. Under this, there are also several regional

sub- associations, mainly in the Indian Himalayan states.

Concept

Beekeeping promoted by HESCO

HESCO is mostly upgrading existing Gharats, which are traditionally used for flour milling in this area, instead of installing complete new systems. HESCO started upgrading Gharats to increase their milling capacity. Some years ago, their activities in this field expanded and they started to include electricity generation also. Through making use of the existing structures and civil works this approach is comparatively inexpensive and fits well into the villages' structure. Most of the Gharats make use of the water flow directly instead of using the static pressure that is obtained through the construction of a forebay and penstock. The simplicity of the technology allows the villagers to operate and maintain their unit with little training, barely any assistance dependency on others. HESCO offers the supply, installation and basic training for the operation of the System. Usually no external funding is used, so the costs have to be borne by the people themselves, which is a reason for the fact that to date, many watermills are upgraded without the installation of a generator and the system for electricity contribution. The Gharats can be owned by the community or the water miller himself. If the water miller supplies electricity to the other villagers, he can collect money for this; he also increases his income through the higher efficiency of his plant for milling flour. A single unit has a capacity of 2–5kW electricity.

HESCO is actively trying to influence the activities of the state and national governments within this field to support an appropriate development in the field of rural electrification and is also cooperating with the military in border regions.

Uttaranchal Renewable Energy Development Agency (UREDA)

The State of Uttaranchal, which its government likes to present as "Energy State" has a thorough plan for rural electrification, mainly based on renewable energy technologies. In this development, the registered society UREDA is an important player. UREDA was set up under the administrative control of the Department of Energy of the Government of Uttaranchal (UEID) in 2001. The head quarter is in Dehra Dun, the state capital and a project office is situated in each of the thirteen districts. UREDA is implementing renewable energy programs at local, district and state levels to help electrifying Uttaranchal. Different NGOs and stakeholders are cooperating with UREDA. Concerning the technical development, UREDA is intensely cooperating with AHEC (Alternate Hydro Energy Centre). UREDA is financed through a budget provision under the State Plan budget and receives additional funds to implement the Integrated Rural Energy Program set up by the Ministry of Non-conventional Energy Sources; some projects also are funded additionally through external sources, e.g. the World Bank and CCC (Canadian Commercial Corporation).

Concept

UREDA is planning, implementing, operating and maintaining community based renewable energy programs using solar energy, small hydro power and biomass. Since UREDA started working, the agency gained a lot of knowledge and now is aware of the fact that only community based projects can be working in the long run, which caused changes of their project planning and implementation.

In the field of Hydro power, UREDA is installing plants at micro and mini scale, but also started upgrading traditional watermills for both, decentralized electricity supply and grid feeding. The projects are planned in cooperation with AHEC, who also trained several para- technicians this year to have local skilled people, who are able to repair micro hydro systems as part of the scheme launched by UREDA. This attempt of capacity building is beneficial for the people and an

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economical development of micro hydro systems in the long run.

MHPU in Niti

Specifically the MHPU in Niti, a small village near the Indo-Tibetan boarder was visited within this project. The villagers live only in Niti during the summer months in order to yield their fields, during the winter they are staying in villages and town in lower altitudes and are used to having access to electricity there. A 25kW MHPU was constructed in Niti in 2005, though only a small part of this energy is used today, namely to light the streets. Connections to the households still have to be set up. There are also plans to install additional electrical equipment beneficial to the local economy such as flour mills, which would allow the villagers to process their harvest themselves and such sell it at higher prices. The area is prone to landslides, though the risk of damages to the system due to natural causes is minimized through outstandingly sturdy civil works.

Woman carrying the yield in Niti

Village life in Niti

Niti near the indo-Tibetan border

Alternate Hydro Energy Centre (AHEC)

AHEC at the Indian Institute of Technology (IIT) Roorkee, has been established in 1982 with initial sponsorship by the Ministry of Non-conventional Energy Sources (MNES) with the task to promote power generation through SHPUs. The Centres activities cover academic and non-academic education, research on improvement of small and micro hydro power applications, power system operation and planning, environmental impact assessments etc.. With a focus on hydropower (HP), the centre also deals with other renewable energy sources such as solar and wind energy systems. AHEC provided UREDA with detailed GIS-based maps with information regarding the state of rural electrification of the State of Uttaranchal including suggestions for suitable technologies for electrification. AHEC developed a modularized turbine for MHPU, which is suitable for mass production, thus making the technology less expensive.

AHEC also does research on traditional water wheels and possibilities of upgrading existing systems.

Malari Project

The Micro Hydro Unit in Malari was set up as an example project, an attempt to show other players how such a project can be realized in a less expensive and more long-term oriented manner than other projects prior to this date were set up.

Pankaj Kumar, at that point working with the Society for Wastelands Development (SPWD) in Dehra Dun was convinced of the suitability of micro hydro technology for the remote regions of the Indian Himalayans. The fact that many project at that time were not running well and had very high investment costs encouraged him to prove it can be done better. He saw the reason for the limited success of those projects in the lack of participation and integration of the villagers. Very complex and expensive units were installed but they were

Display of the MHPU in Malari

Penstock of the Malari Project on rough ground

Powerhouse in Malari

not set up and owned by the villagers and no sufficient training to operate and maintain the system was given to them.

At the same time, Chait Singh in the village Malari in north-eastern Uttaranchal had already drawn up detailed plans for a micro hydro system in their village. The villagers only live in Malari during six months in the summer, mainly to till the fields. During the winter they live in lower and warmer regions, e.g. the town Chamoli and Joshimat where they are used to having electricity so they also wish to have electricity in Malari but didn't have the financial means to realize the project. Thus the villagers of Malari where perfect partners for Pankaj Kumar who was looking for a highly motivated community for his project.

Concept

Based on his analysis of the reasons for problems faced by other projects, Pankaj Kumar planned the projects in close cooperation with the villagers. In preparation to the realization of the project a site visit to Nepal, where a lot projects have been realized successfully was undertaken, this provided the villagers with a good idea about the projects framework, implementation and benefits. The project was planned and set in tight cooperation of the different parties involved and financially supported by SPWD.

In order to have a totally independent project, five villagers were thoroughly trained in the operation and maintenance of the plant, they underwent training with the producers of the technical components of the system in order to be able to manage a lot of the reparation works themselves and also participated in all purchase processes, providing them with the knowledge to manage future purchases successfully and independently. Labour, material and money were contributed by the villagers when setting up the unit, increasing the understanding of the project and increasing their sense of responsibility.

The MHPU was designed and constructed in high quality though today, the channel is at risk, because the ground consists of loose rock and sand fractions which are prone to erosion. Proper maintenance is especially important.

To manage the system and the finances, an electricity committee was elected, which today is meeting once or twice yearly in order to make decisions about the future of the project. Also the fees collected from the villagers are set by the committee.

A major concern of Pankaj Kumar was to establish local industries benefiting form the MHPU, so plans exist(ed) to trigger this development. Till date, the

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electricity is only used for lighting and for the communal television set.

Since the project first started operation, some changes have been occurred concerning the financing of the project. While the fees where connected to the household income earlier, they are equal and also lower today. In order to compensate this loss of capital, the salary of the operators was decreased. The project is well integrated into the civil structure of the village.

Kerala

No organization that is disseminating MHPU at a large scale is existing in Kerala, but several MHPU and Pico systems have been set up, either by individual organizations or privately, mainly supplied by Mr. Benoy from Kanjirappally in Kottayam district.

Several organizations and individuals who are working together have been visited within this study and will be described in the following.

Malanadu Development Society (MDS)

Malanadu Development Society (MDS) was founded in 1977 as the official organization of the Diocese of Kanjirappally for social and development interventions with the vision to create a just society ensuring dignity and sustainability of life. Being committed to integrate rural development, livelihood security and sustainable development, MDS does not only promote sustainable methods and technologies but also offers the farmers a marketing platform and distributes the products under the brand name Malanadu. MDS is also giving training in different fields of farming and other income generating activities and runs processing plans for the products of the farmers, such as a bakery, a soap production unit and a spice processing plant.

Biogas Plant initiated by MALANADU

Pepper plantation in Kerala

Sign advertising Malanadu's products

Sustainable Development Association (SDA)

Sustainable Development Agency (SDA) is a federation of about 50 organizations in South India working within the field renewable energies. SDA was founded and registered as a partnership of NGOs in 1993 and its members are active in Kerala, Karnataka, Andhra Pradesh, Tamil Nadu, Goa, Andamans Islands and Pondicherry.

SDA's missions are capacity building for its member organizations and technology transfer to the grass root level, making sustainable energy technologies affordable for resource poor people. Their activities include: biogas, micro hydropower, active and passive solar technologies (solar water heater, solar cookers and photovoltaic), biomass gasifiers, wind energy, energy audit and briquetting.

India's Farmers' Movement (INFARM)

India's Farmers' Movement (INFARM) started functioning in late 2000 in order to organize Kerala's farmers who were and still are suffering form devaluation of agricultural products which occurred after India joined the WTO. In order to

have a lobby and voice against the state policies and traders in times when cheap foreign products were flooding the Indian market, INFARM was formed. Among others, INFARM sees its task in educating the farmers and empowering them, e.g. through promoting ecological farming to decrease carcinogenic substances in the soil and water, sustainable energy technologies, different kinds of cultivation, the forming of credit groups and societies to sell and distribute their products etc..

Thulapally MHPU

MHPU in Thulappally

Thulapally is a remote village in Pathanamthitta District surrounded by reserve forest and the Naranamthode stream, thus the village was not likely to be connected to the grid any time in the near future when the project was thought of. The project was planned and implemented in close cooperation between MDS and the residents of Thulapally who make their living on small scale agriculture and animal husbandry. The approximately 1000 houses of the village are spread over a large area in clusters of five to fifteen houses, making the establishment of a net connecting all households near to impossible. Initially, 70 households were participating in the project, where 20 kW were installed with financial support of UNDP through the small grants programme. The villagers contributed labour, material and money to the project, the project is legally owned by the community, an elected electricity committee makes decisions concerning the project, secretary deals with financial issues such as the collection of the fees from the villagers and an operator runs and maintains the plant. Before an operator may quit his job, he trains his successor.

After a period of two years, it was clear, that enough water was available to run a larger plant and the demand was higher than the amount of electricity available, thus the system was upgraded from 20 kW to 30 kW with the financial support of SDC. This system allowed supplying 350 households, of which only 250 are still fed today, 100 of them have been connected to the grid. The electricity is used for lighting (substituting kerosene) and for television sets.

Independent Projects

Pico hydro system near Agali

Other micro and pico hydro systems in Kerala have been set up by villagers themselves, often supplied by Mr. Benoy who runs an electric store.
This gives a good example for how this technology can be competitive at the free market. In the area around Agali, a lot of private systems have been set up. The villagers here are comparatively educated and strive for a higher standard of living, thus wishing for electricity to run televisions and lighten their homes. For this, they are willing to invest financially and also operate and maintain their systems. System sizes here range from 500 W for one household, the system consisting of an aluminium wheel and a used motorbike dynamo to 10kW systems supplying communities of approximately 50 households. Another plant is used to run a cardamom dryer, thus providing an

Powerhouse in Nedumkandam

Penstock in Nedumkandam

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additional income to its owner. All projects make use of very simple and cheap technology, allowing the people to meet their demands in the moment. When visiting the project sites, the participants are asked about ideas to improve the systems, ranging from load control to minimizing transmission losses.

Himalayan Small Hydropower Summit (HSHS)

AHEC, IITR and UREDA organized the International Small Hydro Power Summit at October 12 and 13, 2006 in Dehra Dun. This summit aims to provide a platform to exchange knowledge about the small hydro power development in the Himalayan Region and beyond.

The summit is addressing project planners and implementers as well as political decision makers that are active in the Himalayan region or in other parts of the world. The organizers believe that through the exchange of knowledge and experience, more confidence in the SHP sector can be created, thus boosting the sector. Various subjects connected to SHP and MHP are presented in poster presentations and speeches and discussed. It also serves as a practical platform to make connections to people from other parties working within this field. The most significant conclusion from this summit is that community participation is a major factor to be taken into account when planning, implementing and running a project.

Two connections are of special relevance to this project: Dr. Nishantha, who, together with his colleagues, is working on a best business model for certain countries or societies for community based hydro power systems and Dipti Vaghela, Energy Co-coordinator at Gram Vikas, an NGO working in Orissa.

Best Business Model Sri Lanka

Dr. Nishantha and his group are working on an equation, which aims to help identifying a suitable business model for any given society. Nine different factors which are significant for the society are taken into account and evaluated according to their importance. Thus, an equation with 18 variables has been created. The project is still running and an important step towards an economical development on the free market of HP.

Gram Vikas

MHPU in Karlapat, Orissa, implemented by Gram Vikas
(Picture: Dipti Vaghela)

Gram Vikas is a rural development organization benefiting poor and marginalized communities in Orissa, aiming to improve their livelihoods while promoting sustainable development. With it's nearly thirty years of experience in rural development, Gram Vikas has established the "Movement and Action Network for Transformation of Rural Areas" (MANTRA). MANTRA is based on five core values: inclusion, social equity, gender equity and sustainability. According to those values, each of their projects is evaluated, constantly working on the improvement of their work according to MANTRA.

Gram Vikas has implemented two MHPU so far, with more projects planned. Using MANTRA values helps analyzing the success and impact of the projects. Gram Vikas sees each of their project activities as a challenge to improve the general life quality within the community, thus all project activities are considered as parts of their environment.

The HSHS provided the participants with valuable deeper insights into the situation of the SHP and MHP.

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Project Outcome– Mapping

To provide an overview over the organizations contemplated within this project this map shows where which of them is active. A description of their individual activities is provided in the subchapter “Visits regarding Micro Hydro Power”.

Due to the timeframe of this project, it is not poosible to create a map that is anywhere near complete though it gives readers the option to use this map as a start-off point for further work as well as the contact information is aiming to give the various organizations the oppertunity to gt in touch with one another to exchange knowledge or hopefully even co-operate within future projects.

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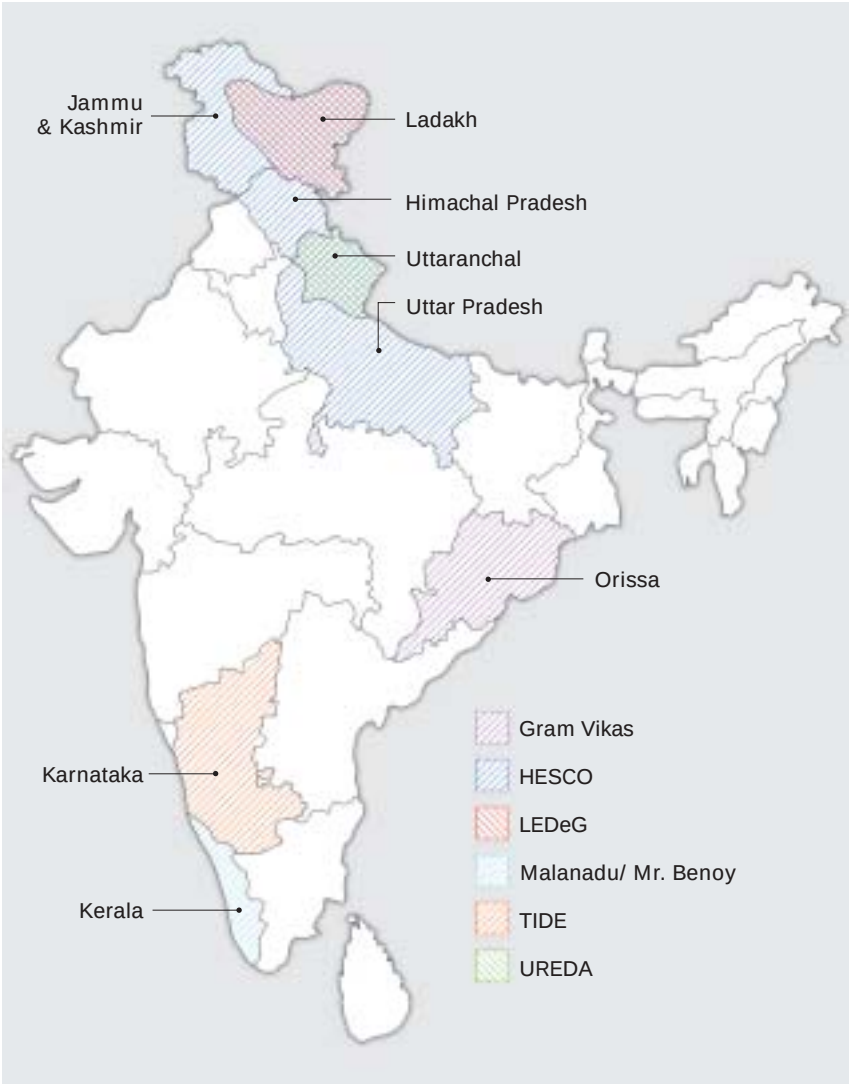

Project regions of the organizations

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Project Outcome– Potential Analysis

General

Further MHPU projects can only be realized where a village or community requires electricity supply and the hydro power potential is given through a sufficient amount of water and an adequate decline of the stream. As BORDA does not implement projects by itself a local organization is needed which is willing to contract a cooperation preferably for more than one project only. All places that have been visited are located in mountainous areas where the required potential of hydro power is given.

Ladakh

In Ladakh, the already existing cooperation of BORDA and LEDeG responds to the local demand. Maybe the frame of these activities could be expanded.

Uttaranchal & Northern States

In Uttaranchal the electrification of the remote villages has been done very systematically by HESCO and UREDA whereas HESCO is also active in Himachal Pradesh and Jammu Kashmir. The further electrification program of UREDA makes it unnecessary to establish any projects in Uttaranchal that are interesting for BORDA.

A cooperation with HESCO in Himachal Pradesh or Jammu Kashmir could be interesting as the philosophies of BORDA and HESCO seem to be quite similar.

Kerala

In Kerala most of the MHPU projects are implemented privately. Demand exists but no organization is specialized on the dissemination of MHPU technology. MHPU owners asked for training about maintenance and operation of a MHPU. Knowledge is given in efficient and single projects have been implemented by organizations like Malanadu.

Feasibility Study Kochara

Mr. Thomas in front of the potential intake-weir.

In Kochara, a small village in Idukki district in Kerala, a community of cardamom farmers, members of INFARM, is planning to build up a shared cardamom oil mill. This mill should be supplied by a MHPU to be independent from the grid. Over capacities fed into the grid could give an extra income to the poor farmers.

During the stay with Malanadu the technical feasibility of the project site was studied. The measurements of the discharge and the geographical conditions result in a hydro power potential of about 70 kW.

values	Description	Variable	Unit	Value
input	Maximum height	h (2)	[m]	1039
	Minimum height	h (1)	[m]	1004
	Waterflow	Q	[m^3/s]	0.3
	Diameter of penstock	D (ps)	[m]	0.3
	Length of penstock	l (ps)	[m]	268
	Efficiency (turbo generator)	n (tg)	[%]	80
	Density of water (norm)	p	[Kg/m^3]	1000
calculated	Static pressure intake	p (it)	[Pa]	10192590
	Static pressure powerhouse	p (ph)	[Pa]	9849240
	Velocity in penstock	v	[m/s]	3.50
	Pressure difference netto	dp (n)	[Pa]	343350
	Pressure losses	dp (l)	[Pa]	52467
	Pressure diff. brutto	dp (b)	[pa]	290883
	Generated power	**P**	**[kW]**	**69.81199**

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Orissa

In Orissa Gram Vikas just started to implement MHPU projects. An expansion in this sector is planed but experience is missing. There is demand and potential for more MHPU projects and the philosophy of Gram Vikas fits into the philosophy of BORDA. A cooperation is conceivable and could be fruitful.

Project Outcome– Best Practice Analysis

Operator of the MHPU in Niti

The most important result of this study is the fact that one single bets practice model for MHPU project activities, which guarantees a maximum of project success, does not exist. Too many factors of social, economical and technical nature influence the status of the project and none of these factors can be considered independently. Possibly, a best practice function could be formed, although the interactions between the diffrent factors and their interactions are nowhere the same. But everywhere the purpose of a MHPU is the identical: To supply people with electrical or mechanical energy within their social and natural environment.

A best practice model for a MHPU project is related to a best output of the project which has to be defined. In the sense of sustainable development it cannot be satisfying if only the MHPU itself is operating without technical problems. The generated energy should also have a maximum impact on the development of the local community.
Thus there are basically two reasons why a MHPU does not fulfill its purpose. Either the technology fails or the working MHPU is not used appropriately.

An ideal design of a unit according to only the geographical conditions of a project site is not difficult to find. There are a lot of guidelines existing which say how components have to be constructed to get the highest output. The "Micro Hydro Standard" from AHEC is one of those documents, which is based on experience of many years and scientific studies.

A common problem noticed at many project sites is the safety of the system. Since financial resources and sometimes even consolidated knowledge about electricity are insufficient safety devices such as earthing and safety fuses or load control are often not installed creating a potetntial risk for the people and also the electric devices used by them. The awareness about this topic should be adressed and aimed to be increased.

But if a MHPU e.g. cannot be or is not maintained correctly sooner or later this plant will fail completely. And there could be many reasons why e.g. maintenance is insufficient. The people might not be trained properly or they are not able to pay for maintenance if they cannot do it by themselves. It is possible that the operator needs to work on the fields during the harvest season or channels cannot be repaired because building material can not be provided – or is needed for other purposes. Maybe the operator left the village or does not fulfill his job due to missing salary. Possibly the people just do not care about the condition of the MHPU because they do not really need it, due to its use for lighting only or the people have other priorities.

Insufficient maintenance is just one of many possible reasons for the technical failure of a MHPU. Spare parts might not be available or affordable, the water might be needed for other purposes or the unit is not operated appropriately, etc. etc.....

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Poster at Exhibition in Leh

It is most important that the MHPU is integrated into the project environment and meets the people's demand concerning their needs and skills. It is not sufficient to take the current situation into account. Since a project will run for years, it is important that possible future scenarios are considered. Risks that could cause a failure of the project need to be minimized by collateral project activities.

Missing knowledge about operating and maintaining, as one reason for failure, should be compensated through intense training which should not be continued once the operator stars his job. A person without any technical education might not be able to learn all skills needed to operate a MHPU successfully and efficiently within one seminar. Knowledge should be built up step by step parallel to increasing practical experience.

Furthermore a platform should be available where questions are being answered. A newsletter released on a regular bases could be used for such purposes. This would be a cost-efficient platform which enables operators to express and help themselves and each other. Knowledge could be disseminated that exceed the essential skills. As involvement increases the feeling of being attended, it will increase awareness and the operators' sense of responsibility.

The destruction or demage of any part of the unit can be caused through human failure or by outer influences. In either case reparations are costly. The unit has to be designed to be protected against outer influences as much as possible. But in the end the extent of incidents like landslides, floods or earthquakes is unpredictable. Furthermore the protection of a unit causes higher investment which might not be affordable by the people.

Repair of civil works and transmission lines might be realizable by the people. But if the turbine or the generator is damaged it is most likely that this has to be repaired by a professional engineer – especially if complex technology is used.

To reduce the risks of project failure caused by financial reasons, collateral project activities should be undertaken.

As efficient technology is relatively complex and expensive it has to be determined which kind of technology is applicable at each site. Concerning the investment and possible costs for repairs it has to be as simple as necessary and as efficient as possible. Spare parts have to be affordable and the accessibility of spare parts has to be considered as transportation is expensive and might be time consuming.

Creation of emergency funds and contracting of insurances are additional activities to avoid a complete failure of the projects due to financial reasons. But therefore a regular and solid income is needed. If the generated electricity is "only" used for lighting purposes the community will not have any extra income. As the MHPU can be replaced by traditional solutions like kerosene lamps or torches, it will not be of high priority for the people. But income generation projects, using the generated energy, will increase the amount of money that flows into the community from the outside. The boost of the local industries has the most effective impact on the development of the project region and should be the aim of every project. People are able to care for the MHPU and they will do so as it is the backbone of their daily income.
From this perspective the MHPU is not the focus of a project but the collateral project activities.

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For some cases it might be enough to install only the machinery and give training to an operator. This will work where local industries already exist or for people who had access to electricity previously etc.. In Kerala this model is practiced by private enterprises. This is a further step of development that should be aimed at. Here it is more important to increase the technical knowledge of the people planning and setting up the systems, as it is was required and requested by the people met during the visits.

To reduce the economical risk to a minimum it might be advisable to create a step-wise MHPU development concept. In the beginning a unit of low capacity and complexity could be used. As it is required this unit could be upgraded to a bigger, more efficient and complex one. An exchanging system could be created through which units are exchanged between different villages.

Of course the permanent components like e.g. the channel have to be designed in consideration of the expected future upgrading. But as civil works can be done by the people this will not be much more expensive.

As the replacement of a penstock is very cost intense it could be economically feasable to create a standardized system that enables the use of several parallel penstocks to feed one turbine. As soon as a turbine of a larger scale is installed another penstock is added to the system. Friction losses would be relatively high but can be limited with a good design. A modular system for other parts using standardized components could also be economically interesting if the “exchange” system includes a bigger number of units within one region.

It has to be analyzed under which conditions such a modular system would be feasible.

People shopuld not serve the technology but the technology should serve people.

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Summary, Outlook and Reflections

Mindmap

Concerning the variety of our aims we are content with the outcomes of our project. For more detailed results the project's duration would have to be much longer. Nevertheless we worked on each topic as profoundly as possible. As we were free to organize our travel we plan the visits in a way that within one visit we could gain information for each aim of the project.

The map is definitely not complete but with the contacts we made it should be possible to fill the gaps within further activities. Especially the north eastern states should be analyzed as there are some activities, potential and demand as well

To work out a more detailed best practice analysis it will need a project of its own in future. A lot of time is needed to work on this topic as a lot of travelling and information gaining is necessary.

Regarding our own activities we would say that due to missing knowledge about this field we chose the wrong methodology. We got to know MHPU projects in Ladakh where the frameworks of the different project sites are very similar. Based on this information we defined the questions that we tried to get answered on each further site visit.
But after we got to know all the different "faces" of MHPU projects we realized that other questions would have given more relevant information. It would have been important to have a manifold reference. But due to the timeframe of the project this was impossible. A further project could tie in with our results.

The research for new MHPU projects was successful as well even if there is only one concrete project site. We spotted regions where further activities are not needed what is a result as well and the contacts we made could be a basis for new co-operations in future.

Our "project journey" took us to several different places in the far north and the far south of India. Although there was never enough time to be engaged with the places we got to know people and their lives as no tourist will be able to do. The personal experiences we made "on the road" and "in the field" are unforgettable. Therefore we would like to thank all the persons and organizations that were involved in the realization of this project.

Our loving host in Mankulam

Site visit in Mankulam

Our jeep in Uttaranchal

5. Excurse to Passive Solar Technology

Background

Within the stay in Freiburg to visit the BKF an excurse to the VAUBAN complex was organized. As solar energy is a very interesting sector of the renewable energy technology this visit should give an impression of how this technology is used within building services engineering in Germany.

As Passive Solar Houses are also constructed in Ladakh an excursion to SECMOL was undertaken by personal interest during the south phase.
As both visits are of the same topic they are mentioned in this extra chapter.

Vauban Complex and Energy plus Houses in Freiburg

Building of the Vauban Complex

A cost-efficient multi-family residence is constructed extremely energy-saving by following the passive house energy standard of 15kWh/ m²a. The principal axis of the building is east to west. The very important aspect of saving energy is by inserting pipes for cold- hot air circulation and special design of windows with three layers of glasses, the volume in between is filled with inert gases and the surface is covered with heat reflective material.

For energy generation Building Integrated Photovoltaic and solar heat collectors are mounted on roof. A gas operated co-generation unit is installed to generate heat as well as electricity. An alternative sanitation concept is promoted by using vacuum toilets, directly connected with the biogas plant to produce biogas for cooking. The rest of sewage is treated in the treatment plant and used for irrigation of the garden.

In comparison to conventional buildings this ‘passive house’ is saving 79% of total heat energy consumption. The extra investment for the components like windows can be recovered within a few years due to the reduced running costs through saving fuel for heating.

By focusing on economical, ecological and social aspects, ‘Vauban’ represents the ‘Sustainable Way of Living’ that could be the standard of the future.

Students’ Educational and Cultural Movement of Ladakh (SECMOL)

SECMOL was founded in 1988 by a group of young Ladakhis with the aim to reform the educational system of Ladakh.

Today the activities are extremely varied:
Training of teachers, changing primary level textbooks in a locally relevant manner, translating books to Ladakhi to reduce language confusion (English, Hindi), improvement of teachers’ and administrators’ accountability, organization of villagers into committees to oversee and improve their schools
In Leh district the number of students passing the matriculation exam has increased from 5% in 1988 to almost 50% in 2005.

Phey Campus

The SECMOL campus is located near the village of Phey in the Indus valley 18 km from Leh. It was developed between 1994 and 1999. Built using simple, low-cost traditional techniques, the campus now comprises three residential houses, 20 small ‘cell rooms’ and a large school building—the campus also has a vegetable garden with greenhouses.

5. Excurse to Passive Solar Technology

The campus is the home of around 40 students, a few staff and some volunteers, who live, work and study here. It is run by the students themselves on a communal democratic basis.

Most of the students failed their matriculation exam and prepare here for one year to repeat it. The life on the Phey campus teaches responsibility and increases self-confidence of the students.

Illustration of SECMOL

Ladakh can be characterized as a 'Trans-Himalayan mountain desert' with minimum temperature in winters -20°C to -35° and hardly any rainfall. The cold climate of Ladakh generates a high demand for heating. But lack of rainfall makes trees and thus firewood a scarce resource. However, its average of 300 days of sunshine per year makes this region especially suited for solar energy.

Since 1994 SECMOL has developed solar heated buildings and other forms of solar energy to make its campus self-reliant. Having gained a lot of experience from this process SECMOL has started a commercial section, Sheyson Solar Earthworks, for design and construction of solar buildings around Ladakh.

The Phey campus is almost completely solar powered.

Photo Voltaic

Four Photo Voltaic arrays of 16–24 panels each is generating electricity for lighting, computers, TVs, carpentry and soldering tools and pumps. The power is stored in 16 solar batteries, and stores enough to run for three days of cloudy weather.

Solar Cooker

Two concentrating dish-type solar cookers are used to cook most of the food directly on the sun's rays. They were assembled in 1997 by a group including SECMOL students at a workshop at LEDeG.

Low Cost Solar Water Heater

For the campus bathrooms low cost solar water heater from basic materials, easily available in Ladakh were designed. The heater contains no pipes that can freeze and break in winter, so it can be used all winter without draining. It is filled with water in the morning and by 12 noon, 100 litres of are heated to 45°C.

Passive Solar Building

SECMOL buildings are completely independent of conventional heating methods. They are designed to absorb heat from the sun and to store it within the building for as long as possible. The main features of the buildings that keep them warm are:

- South facing windows, as the sun stays low in the southern sky in winter.
- A greenhouse on the south side captures more of the sun's heat in winter. It is made of plastic sheets and is removed in spring to prevent overheating. A bonus feature of the plastic covering is that vegetables and flowers can be grown even in the Ladakhi winter.
- Thick earthen walls and floors (thermal mass) store the collected heat.
- Good insulation in ceilings, in front of outer walls and under the floor keeps the heat. Houses are built three feet below the ground level on the north side. The building benefits from the stability of earth's temperature at that depth, which is relatively warm in winter and cool in summer. As walls are built of rammed earth layers for which the dug out earth is ultimately used. Building material comes right from the site and is not transported. Similarly, when the construction is finished, there is no debris left to be thrown away, no addition, no subtraction. Earth buildings are the warmest in winter, coolest in summer and they also moderate the humidity of the building.

Building of Phey campus in winter

5. Excurse to Passive Solar Technology

Segregated Waste Collection

In 2000 the commercial income-generating section Sheyson Solar Earthworks was founded. Sheyson builds solar buildings on turnkey contract for private homes, the government, NGOs, and the army. The profits from Shesyon Solar Earthworks support educational reform, environmental awareness activities etc. in the region where it works.

6. Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM)– Overview

The Kyoto Protocol

The Kyoto Protocol from 1997, which entered into force in 2005, defines mandatory targets to reduce emission of greenhouse gases (GHG) in order to minimize the extent of global warming. 165 countries have ratified the protocol to date. The reduction goals of the different member countries are defined within the protocol and have to be reached by 2012. Countries will be penalized for not reaching their goal in time.

The European Union Emission Trading Scheme

The protocol has grouped industrialized countries into so called Annex I category. Countries can choose to meet their emission reductions individually or form a so-called "bubble" with one common reduction target, which was done by the EU who formed the European Union Emission Trading Scheme (EU ETS). Within this scheme, each country has to design a National Allocation Plan (NAP) including caps on emissions of energy intense industries. Thus, the responsibility for reaching the target is partly transferred to those companies. Companies exceeding their allowance have to pay a penalty.

A company that emits less than the amount permitted may sell the surplus emission rights. Those can be bought by companies which exceed their quota, thus increasing their own emission allowance. Another option to acquire the additional emission rights is to invest into climate protection projects. Also countries that have a net deficit allowances are permitted to buy credits to balance their account.

The Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM) allows companies from Annex I countries and other parties to invest into climate protection projects, which reduce GHG emissions in developing countries. The Certified Emission Reduction (CER) is equal to one metric ton carbon dioxide equivalent.
A company from an Annex I country which releases a surplus of for example 10 tons carbon dioxide equivalent would have to buy 10 CERs to compensate their emissions.

A CDM project is financed, or partially financed, through the CERs that are generated by the project itself.

The United Nations Framework Convention for Climate Changer (UNFCCC)

The United Nations Framework Convention for Climate Change (UNFCCC) is responsible for the functionality of the CDM. It defines requirements on CDM projects and regulations for their implementation. The Executive Board (EB) of the UNFCCC is the body which ultimately makes the decision about the certification of projects and issues the CERs. Figure on the right shows the role of the EB within an ongoing project.

Types of CDM Projects

CDM categorizes different methods of reducing GHG.

Type I: Replacement of high emitting technology for energy generation through renewable energy technologies where it is existing or would exist instead of the project technology

Type II: Upgrading or replacement of existing inefficient machinery to reduce energy consumption

Type III: Reduction of anthropogenic emissions by sources through trapping GHG to convert them into less harmful emissions or utilization as alternate fuel and switching from fossil fuels to regenerative fuels (biomass)

Small Scale Projects

Project Preparation

When the idea is born to implement a project connected to CDM it has to be surveyed whether this project makes the grade to the requirements of CDM. These are described further down.

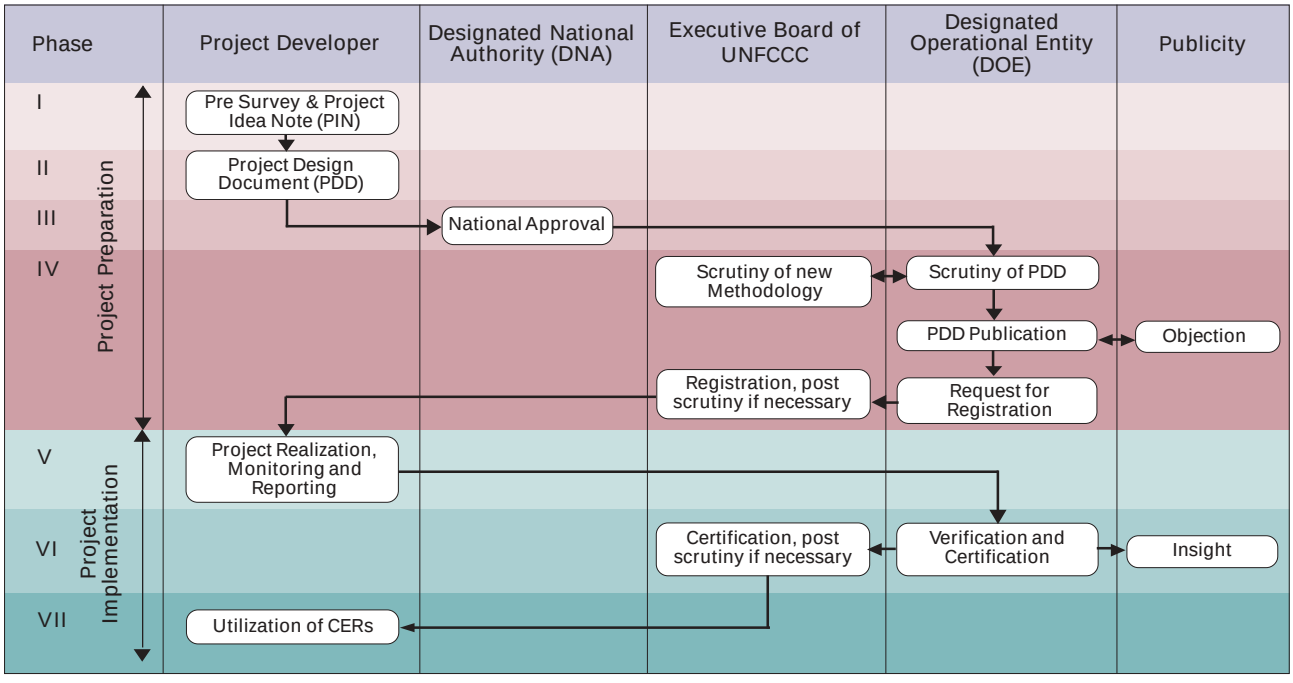
If the project seems to be a potential CDM project the Project Design Document (PDD) has to be written. UNFCCC provides a form that has to be completed. The PDD contains the general description of the project, the baseline methodology, the project duration, the monitoring methodology and plan, the calculation of the excepted GHG emission reduction through the project, the environmental impact of the project and comments of the stakeholders.
The finalized PDD is given to the Designated National Authority (DNA) which surveys the national requirements for a CDM project. As the PDD is approved the Designed Operational Entity (DOE) checks the CDM requirements and publishes the PDD that the public has possibility to raise an objection against the project within 30 days. If a new methodology for calculating the baseline is used the EB has to approve it and will add it to the existing approved methodologies. If the PDD meets all demands the DOE requires the registration of the project at the EB. The EB registers the project or does a post scrutiny if necessary. After the registration the project can be implemented.

Project Implementation

The project activities have to be monitored as defined in the PDD. Annually the monitoring reports are verified, certified and published through the DOE. According to the calculated emission reduction the EB certificates CERs or carries out a post scrutiny if necessary. The annual CER certification will be repeated until the project duration has run out.

Small Scale Projects

The procedure of a CDM project implementation is a complex process that proves to be time consuming and expensive due to administration costs. To justify projects of a small scale for these projects the baseline and the monitor-



CDM Project Cycle

ing methodologies are simplified. The simplified PDD is only valid for projects of:

1. Type I, with a capacity equivalent up to 15 MW
2. Type II, with a reduction of an energy consumption up to 15 GWh/a
3. Type III, with an emission reduction less than 15 kt/a (CO2 equivalent)

The baseline methodologies and the additionality required for CDM Small Scale Projects (SSP) are descript in the following chapter.

Additionality for Small Scale Projects

It has to be proven, that the SSC activities are additional due to one of the following barriers:

a. Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;

b. Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

c. Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

d. Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

Baseline

A baseline, representing the situation without the project activity, needs to be established as a reference for the calculation of the GHG emission reduction. The method of creating the baseline is given in the respective project methodology.

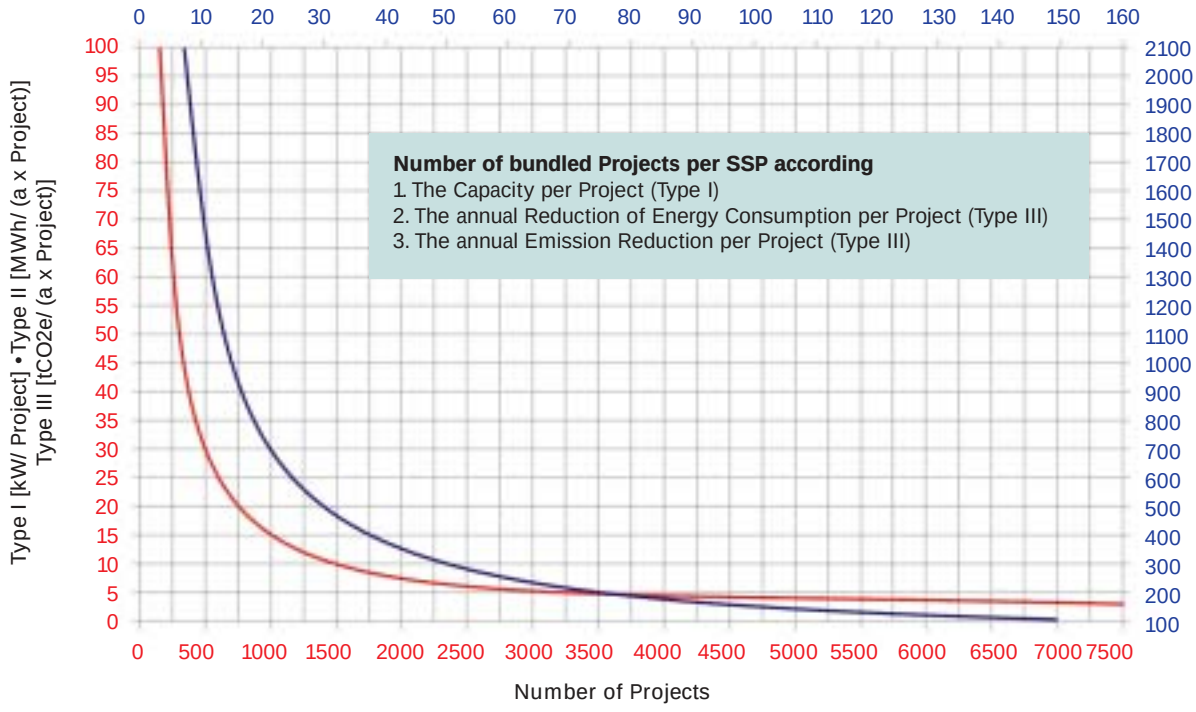
In many cases, different baseline scenarios would be possible, e.g. a micro hydro power plant could replace a diesel or gas engine or feed the grid. When feeding the grid, it is assumed, that in doing so electricity, otherwise produced by thermal power plants, only is substituted. In this case only the emission intensity of thermal power plants is taken into account. The justification for the chosen baseline scenario has to be given in Step 1 of the additionality assessment.

At present 20 methodologies for different technologies and applications are already approved. According the project profile these methodologies can be used. New methodologies created by the project developer have to be approved by the EB as it is shown in figure on preceding page.

Bundling

A further step to decrease the administration costs per project is the possibility of bundling a couple of projects. Bundling is only possible within the limits of the small scale projects types. At present only projects of the same type and category can be bundled whereas it is possible to use different technologies within these projects. It is planned to approve bundling of projects of different types and categories. The EB is checking this opportunity.

Projects within a bundle shall have the same crediting period. Within the project cycle de-bundling of projects can only be done in exceptional situations. Figure above shows the number of projects that can be bundled within one SSP.



Gold Standard

Even though CDM aims to promote development from a sustainable climate protection perspective, it is also criticized for its use as a tool for emission trading only, without the focus on sustainable development including social compatibility. As an initiative to ensure the focus on sustainable development and environmental as well as social integrity, the "Gold Standard" (GS) was developed by WWF together with NGOs in collaboration with governments,

Component
Local/ regional/ global environment Water quality and quantity Air quality (emissions other than GHGs) Other pollutants (including, where relevant, toxicity, radioactivity, POPs, stratospheric ozone layer depleting gases) Soil condition (quality and quantity) biodiversity (species and habitat conservation)
Social sustainability and development Employment (including job quality, fulfilment of labour standards) Livelihood of the poor (including poverty alleviation, distributional equity and access to essential services) Access to energy services Human and institutional capacity (including empowerment, education, involvement, gender)
Economic and technological development Employment (numbers) Balance of payments (sustainability) technological self reliance (including project sustainability, hard currency liability, skills development, institutional capacity, technology transfer)

Gold Standard Sustainability Matrix

corporations and experts around the world.

The certification as GS is voluntary and is achievable by projects falling under the types I and/ or II exclusively that fulfil specific additional requirements. GS projects must show a net positive benefit in each of the categories presented in the Sustainability Matrix (Figure xxx). To apply for GS the GS PDD is used instead of the ordinary PDD. The GS PDD includes clear indications of the GS requirements. Till date, no projects have been registered as GS.

A motivation for companies to buy Gold Standard CERs is to take a stand and use this to improve their image.

Potential for Biogas Technology

Project activities using biogas for heat or electricity generation (or both) are categorized in the Type I and Type III of CDM small scale projects. Those include renewable energy project activities with a maximum output capacity equivalent to up to 15 MW (Type I) or project activities for emission reduction by source with a maximum reduction of 15 Gg per year (Type III)
Within this type, biogas projects, depending on their application, fall into:

Type I	Category C: Thermal energy for the user
Type I	Category D: Grid connected renewable electricity generation
Type III	Category B: Switching fossil fuels
Type III	Category D: Methane recovery in agricultural industries
Type III	Category H: Methane recovery in wastewater treatment

For each of these categories the baseline calculation and the project monitoring are determined by specific methodologies.

Additionality

As biogas is generated from wastewater, municipal or agricultural waste the additionality is always given, because due to natural digestion methane would be emitted in absence of the project. If biogas is produced from energy crops that are cultivated for this purpose the project must not be the most economical option. In case of grid connected electricity generation the additionality is given as long as the grid is not exclusively fed by renewable energy sources.

The following chapter compares the emission reduction for:

1. Biogas (3.5m³/d) produced from the treatment of wastewater in a DEWATS Biogas settler:
   a. replacing fuel wood used for cooking with stove efficiency of 10%
   b. replacing fuel wood used for cooking with stove efficiency of 10%
   c. replacing kerosene used for cooking
   d. replacing charcoal used for cooking
   e. replacing natural gas used for cooking

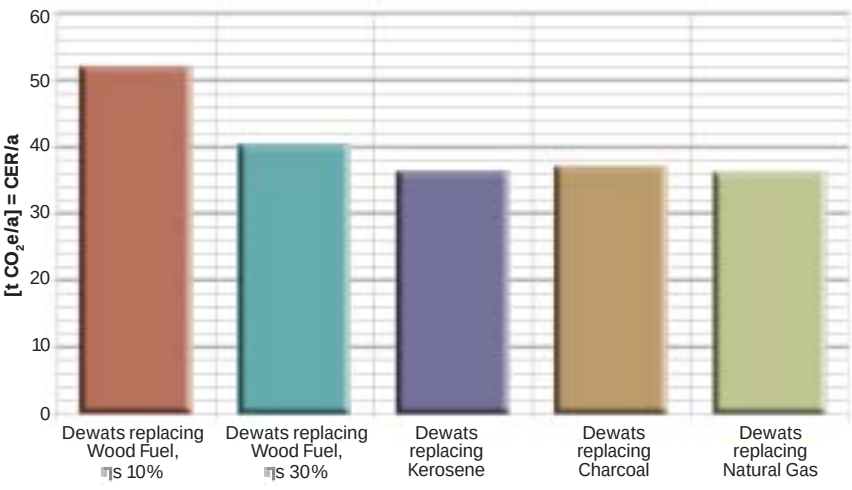
2. Biogas (200m³/d) produced in a Biogas Plant, fed with:
   a. Cow dung, replacing wood fuel used for process heating and grid connected electricity generation.
   b. Municipal waste, replacing wood fuel used for process heating and grid connected electricity generation

c. Agricultural waste, replacing wood fuel used for process heating and grid connected electricity generation

d. Agricultural waste, replacing natural gas used for process heating and grid connected electricity generation

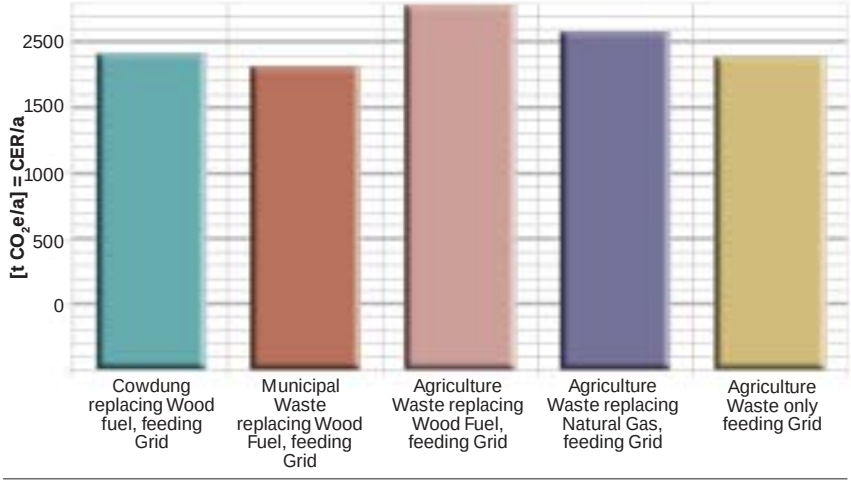
e. Agricultural waste, replacing natural gas used for grid connected electricity generation only

GHG Reduction (CO_2 Equivalent) and CER Generation per year, DEWATS 3.5 m^3/d



GHG Reduction of DEWTAS

GHG Reduction (CO_2 Equivalent) and CER Generation per year, BIOGAS Production 200 m^3/d



GHG Reduction of large scale Biogas Plant

6. Clean Development Mechanism (CDM)

Potential for Micro Hydro Power

MHPU are categorized in the Type I of CDM small scale projects which includes renewable energy project activities with a maximum output capacity equivalent to up to 15 MW (or an appropriate equivalent).
Within this type, micro hydro power projects, depending on their application, fall into:

Category A: Electricity generation by the user
Category B: Mechanical energy for the user
Category D: Grid connected renewable electricity generation

For each of these categories, the baseline calculation and the project monitoring is determined by specific methodologies.

Caused by the relatively high installation costs, most of the existing micro hydro projects could only be realized with an external financial support. Without this support other energy generating system would have been installed. This fact ensures the additionality (for small scale projects only) of micro hydro projects as long as the electricity of an existing grid is not generated exclusively by renewable energy systems.

One 70 kW MHPU project in Bhutan (Ref. 0062) was already connected to CDM.

The following diagram compares the emission reduction of a 50 kW micro hydro power unit used for different applications in different locations.

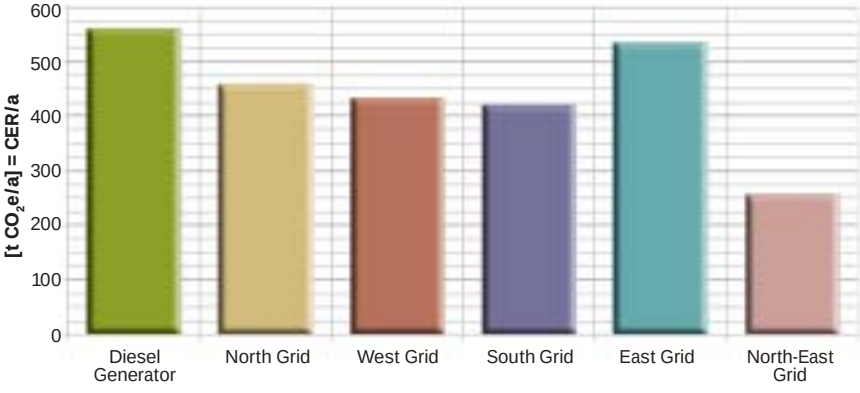
Following scenarios are chosen:

1 The MHP is used for electricity generation (24h/d, 360d/a) where no grid is existing and a diesel generator unit would have been installed instead.

2. The MHP is used for grid connected electricity generation (24h/d, 360d/a) in:
   a. Northern India
   b. Western India
   c. Southern India
   d. Eastern India
   e. North-Eastern India

The CO_2 intensity of the alternate electricity generation (with the absence of the project) would be different. This causes different baselines and emission reductions. Scenario 1 represents a project of the category I.A. and scenario 2

GHG Reduction (CO_2 Equivalent) and CER Generation per year, MHPU 50kW



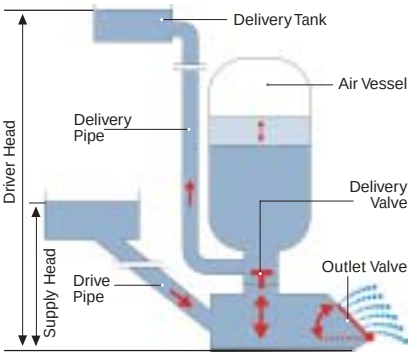
GHG Reduction of a 50 kW MHPU

represents a project of category I.D. Figure above displays the annual emission reductions.

Within one CDM small scale project 300 MHPU of this capacity could be bundled.

Potential for Hydraulic Rams

A HydRam uses the kinetic power of a water flow to lift up water. The adjacent figure shows the construction and the lifting process of a HydRam.



Sketch of running HydRam

The lifting process occurs periodically as follows:
The Water enters the HydRam through a drive pipe and opts out of the outlet valve. This valve is getting closed by the water flow as soon as its velocity reaches a specific value. The water flow is interrupted suddenly and its dynamic pressure overcomes the static pressure in the air vessel, the delivery valve opens and inflowing water compresses the air inside the air vessel. Once a specific pressure in the air vessel is reached, the delivery valve gets closed and the compressed air inside the vessel expands by pushing water through the delivery pipe to the delivery tank. Meanwhile the outlet valve is already opened and the velocity of water flowing through is increasing. The next cycle follows.

As per definition the small scale project category I.B. comprises renewable energy generation units that supply individual households or users with a small amount of mechanical energy. These units include technologies such as hydropower, wind power, and other technologies that provide mechanical energy, all of which is used on-site by the household or user, such as wind-powered pumps, solar water pumps, water mills and wind mills.

A HydRam is a power as well as a work machine, combined in an inseparable unit. The power unit is driven through hydro power but it does not provide mechanical energy to the user. It is converting kinetic into potential energy by lifting up water. By contrast the mentioned wind-powered and solar water pumps, water and windmills provide kinetic energy which is used for lifting water through a coupled pump. The mechanical (kinetic) energy could also be used for other purposes which is impossible with a HydRam.

In the strict sense HydRams do not fit into the definition of category I.B. Nevertheless we use its methodology to calculate the baseline because these technologies are comparable.

Based on the calculated baselines, the figure below compares the emission reduction of a 0.5kW HydRam (running 8640h/a) that:

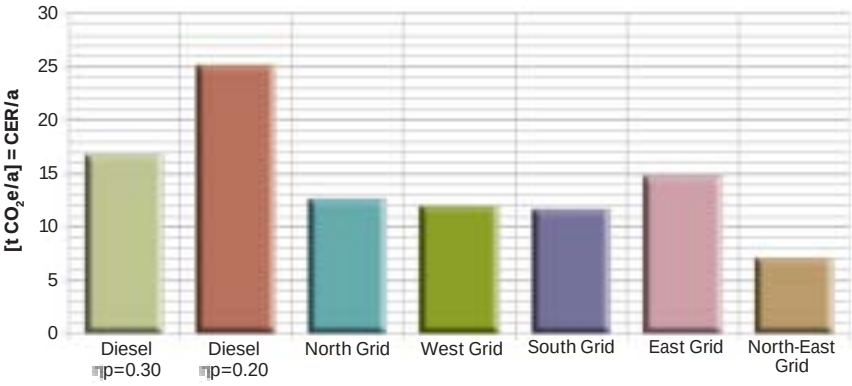
1. is set up where a new (efficient) diesel pump would have been installed instead
2. replaces an old and inefficient diesel pump
3. replaces an efficient electric pump supplied by the grid in
   a. Northern India
   b. Western India
   c. Southern India
   d. Eastern India
   e. North-Eastern India

Within one CDM small scale project 30000 HydRams of this capacity could be

6. Clean Development Mechanism (CDM)

bundled.The technologies that are disseminated by BORDA and CDD (MHPU, HydRam and DEWATS) are altogether linkable to CDM. In almost all real scenarios the additionality of their application is given. As BORDA and CDD support sustainable development even the CDM Gold Standard should be reached in most applications.

GHG Reduction (CO_2 Equivalent) and CER Generation per year, HydRam 0.5 kW



GHG Reduction of a 0.5 kW HydRam

6. Clean Development Mechanism (CDM)

Summary of and Outlook for CDM

Summary

The technologies that are disseminated by BORDA and CDD (MHPU, HydRam and DEWATS) are altogether linkable to CDM. In almost all real scenarios the additionality of their application is given. As BORDA and CDD support sustainable development even the CDM Gold Standard should be reached in most applications.

Biogas projects capture harmful GHG emissions and use them to replace fossil fuels as well. This synergy effect, concerning GHG reduction, makes biogas technology very attractive for CDM projects. The number of registered CDM biogas projects point that.

Replacement

Caused by the relatively low efficiency of small diesel generator sets, the replacement of such units will always reduce the largest amount of CO2 equivalent GHG emissions. Projects with grid connected energy generation will be worthwhile especially where old and inefficient thermal power plants are feeding the grid.

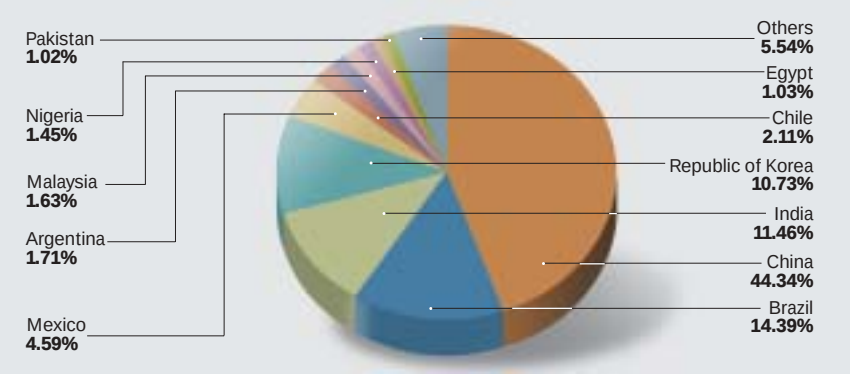
Outlook

The generation of CERs through BORDA or CDD projects could be an additional source of funds. Depending on the development of the CER's market value, projects could be completely financed through CERs, especially because the certificates of Gold Standard projects are of higher value. The possibility to bundle projects will reduce the administration costs per project.

Currently only projects of the same CDM category can be bundled what means that DEWATS and Biogas projects cannot be combined with MHPU and HydRam projects. At present the CDB Executive Board surveys the possibility to bundle projects from different categories.

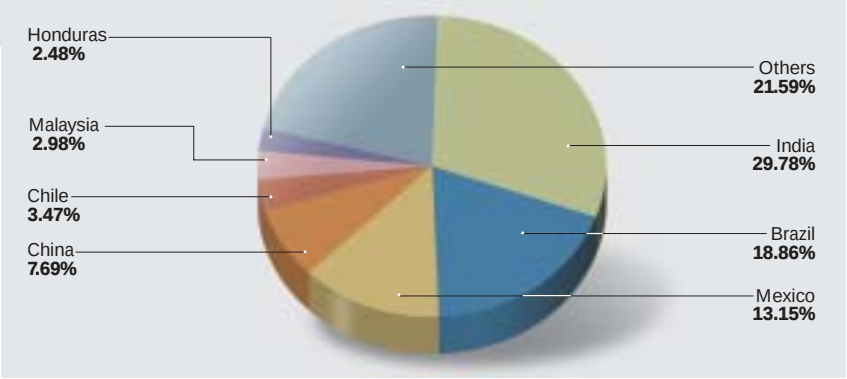
Biogas plants of a bigger size using agricultural waste could be used to run a cogeneration plant. Due to the relatively high investment costs, the need of biogas cleaning and the high maintenance effort of cogeneration engines it is economically not feasible to install such a unit in India without any financial support. But the generation of CERs provides for an economic efficiency.

The energy saving of low energy houses as they are constructed by SEGMOL have a huge potential of emission reduction. Also LEDeG did some demonstration projects with double walled passive solar houses. It should be taken in consideration to link such projects to CDM.

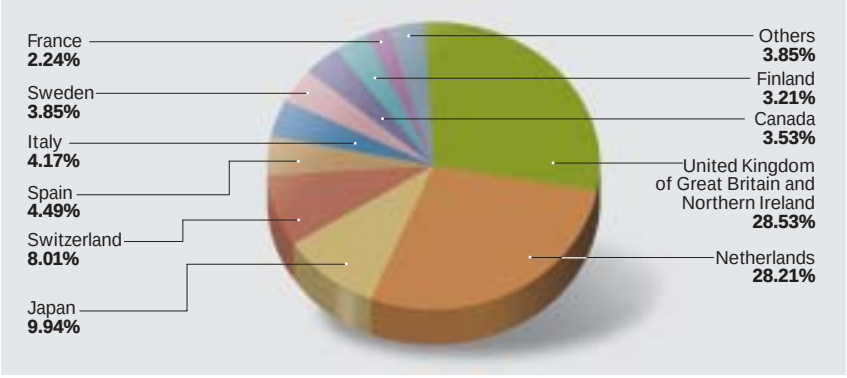


Expected annual CERs by Host Countries, 2006

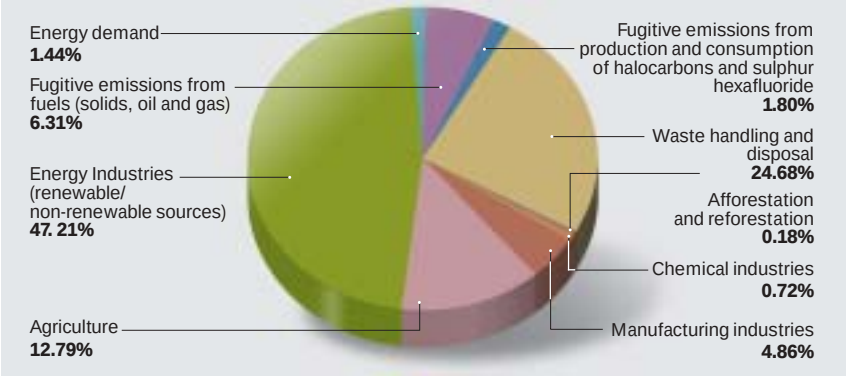
6. Clean Development Mechanism (CDM)



Registered Projects by Host Countries, 2006



Registered Projects by Investor Countries, 2006



Registered Projects by Scope, 2006

III. Abbreviations/ Acronyms

ANO	Abfallbehandlung Nord GmbH
AHEC	Alternate Hydro Energy Centre
ASA	Arbeits- und Studienaufenthalte in Afrika, Lateinamrika, Asian und Südosteuropa; Work and study stays in Africa, Latin America, Asia and South Eastern Europe
BEB	Bremer Entsorgungsbetriebe
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung; German Federal Ministry for Economic Cooperation and Development
BORDA	Bremen Overseas Research and Development Association
CCC	Canadian Commercial Corporation
CER	Certified Emission Reduction
CDD	Consortium for Dissemination of DEWATS
CDM	Clean Development Mechanism
CHP	Combined Heat and Power
DAAD	Deutscher Akademischer Austauschdienst, German Academic Exchange Service
DEWATS	Decentralised Wastewater Treatment Systems
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
ENO	Entsorgung Nord GmbH
EU ETS	European Union Emission Trading
GHG	Greenhouse Gases
GIS	Geographical Information systems
GO	Governmental Organization
GS	Gold Standard
HBE	Holding Bremer Entsorgung GmbH & Co.KG
HESCO	Himalayan Environmental Studies and Research Organization
HP	Hydro Power
HSF	Hunnarshala Foundation
HSHS	Himalayan Small Hydropower Summit
HydRam	Hydraulic Ram
IIT	Indian Institute of Technology
INFARM	India's Farmers' Movement
inWEnt	Internationale Weiterbildung und Entwicklung gGmbH; Capacity Building International, Germany
ISET	Institute for Solar Energy Technology
KNO	Kompostierung Nord GmbH
LEDeG	Ladakh Ecological Development Group
MANTRA	Movement and Action Network for Transformation of Rural Areas
MDS	Malanadu Development Society
MHPU	Micro Hydro Power Unit (5 - 100 kW)
MNES	Ministry of Non-conventional Energy Sources
NAP	National Allocation Plan
NGO	Non-Governmental Organization
OAV	Ostasiatischer Verein Bremen e.V., East Asian Association Bremen
O&M	Operation and Maintenance
oTS	organis Total Solids
PDD	Project Design Document
R&D	Research and Development
RGGVY	Rajiv Gandhi Grameen Vidhyutikaran Yojana
RNO	Reinigungs- und Entsorgungsservice Nord GmbH
SDA	Sustainable Development Association
SDC	Swiss Agency for Development and Cooperation
SECMOL	Students' Educational and Cultural Movement Ladakh
SHPU	Small Hydro Power Unit (100 kW and above)
SNG	Substitutional Natural Gas
SPWD	Society for Wastelands Development
SSP	Small Scale Project
UEID	Department of Energy of the Government of Uttaranchal
UNFCCC	United Nations Framework Convention Climate Change
UN MDGs	United Nations Millennium Development Goals
UNDP	United Nations Development Programme
UREDA	Uttaranchal Renewable Energy Development
WW	Wastewater

IV. Bibliography

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www.ipcc-nggip.iges.or.jp

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Dhairya Dholakia was born on August 26th, 1974 in Bhuj, India. She studied Masters of Philosophy in Physics with focus on optical band gap studies on tungsten sulpho selenide single crystals from Sardar Patel University, Vallabhai Vidya Nagar. Since July 2000, she is working with 'Sahjeevan' and involved with transfer of the renewable energy technologies in rural areas of Kutch district.

Caroline Lübke

Caroline Lübke was born in Göttingen in1983. She studied environmental engineering at the University of Applied Sciences in Bremen and at Mälardalens University in Västerås, Sweden, focusing on Renewable Energy Technologies. She plans to graduate from Uppsala University, Sweden. Most recently she completed an internship in Bremen where she worked in urban planning, specifically concerning wind park development and sustainable development.

Amit Sawant

Amit Sawant was born on April 14th 1978 in Belgaum, Karnataka. He studied Civil engineering from the Karnataka university, Dharwad, India. He is now working as a project engineer in Consortium for DEWATS Dissemination (CDD) society, Bangalore. He has worked in the field of irrigation projects like dams and canals, building construction and wastewater treatment for the past five years.

Roland Schumacher

Roland Schumacher was born on December 27th 1978 in Bremen, Germany. He studied mechanical engineering with a focus on energy and environmental engineering at the University of Applied Sciences in Bremen. Besides his studies he worked amongst others in the fields of laser welding technology (BIAS), construction and production of rotor blades for wind power plants (A&R Rotec/GE), construction of automated production tools (BIK/Airbus), ventilation technology for the application in passive solar houses (ZETA) and sound/stage technology (BLAX). He completed his studies in June 2006 with a German diploma.



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