Energy and climate change in cold regions of Asia

Proceedings of the Seminar

21 to 24 April 2009

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Ladakh
India
2009

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Foreword

People living in the mountains and cold regions of Asia are amongst the most vulnerable communities in the world and have to adapt to particularly harsh living conditions. Physically isolated, marginalized and with limited access to natural resources, they depend on traditional energy sources – mainly biomass, which is scarce at such altitudes – for all their daily activities: heating, cooking, transportation.

Two hundred million people face this situation in Asia. Although the setting may be very different for a city dweller in Harbin, north-east China, and a farmer in a remote valley in Ladakh, north India, the improvement in their living conditions implies, in both cases, a strong growth in energy demand, with a heavy impact on the local (deforestation in the poor regions) and global (massive use of carbon) environment.

Moreover, climate change has particularly serious effect on mountain ecosystems and communities. There are ominous signs, such as accelerated glacier melting with villages abandoned by their populations, risks of glacier slip that could engulf entire valleys, drastically decreasing snowfall and hitherto unknown parasites arriving in the high Himalayan valleys.

Many initiatives have been launched over the last 10 years, helping both to improve the living conditions of communities and to reduce energy requirements, especially through the use of solar energy and micro hydraulics.

The international community, including the European Union and French development co-operation (AFD, FFEM and ADEME) have supported many renewable energy and energy efficiency projects in Asia to boost local development. We now know that these projects have and will have a lasting impact on the climate, through restricting CO_2 emissions and improving communities' ability to cope with the consequences of climate change.

It therefore seemed entirely appropriate to organize a gathering between the key players on the development and energy scenes as well as with policymakers in order to adopt the best energy solutions and work out strategies for a common coping policy. The focus on the international approach, especially with a view to scaling up existing programmes, was essential to ensure wide-ranging, sustainable impacts.

The four-day seminar in Leh was attended by representatives and experts from seven countries (Nepal, India, Afghanistan, China, Mongolia, Tajikistan and Kyrgyzstan), drawn from local non-governmental organizations along with companies and governments. They pooled their experience and good practice in the areas of impact of energy efficient projects on development, as well as strategies to assist local communities in adapting to climate change.

We wish to thank the local authorities who greatly facilitated the organization of this seminar and the organizers who helped to overcome the geopolitical obstacles that can be so formidable in this region.

Ellen PEDERSEN
Development Co-operation
Delegation of the European Commission
to India, Bhutan and Nepal

Dominique CAMPANA
Director of International Affairs
ADEME

Agenda

Tuesday 21st April

Morning 9:00 am - 12:00 pm

Conference Hall
Welcome & Registration (starts at 8:30 am)

9:00 am - 10:30 am

General Introduction

Chair: Alain Guinebault *GERES, France*

Jigmet TAKPA	*LAHDC, India*
Sandeep GARG	*BEE, India*
Ellen PEDERSEN	*European Union*
Dominique CAMPANA	*ADEME, France*

10:30 am - 12:00 pm

Thematics Introduction

Challenges and opportunities for sustainable energy in rangelands - experiences & lessons from the HKH
Bikash SHARMA - *ICIMOD, Nepal*

Water and energy: challenges and trends in energy in the central Asian republics
Ruslan ISAEV - *CAMP Alatoo, Kyrgyzstan*

Climate change:
a major challenge for development
François MOISAN - *ADEME, France*

Financing renewable energies
Shirish GARUD - *REEEP, India*

Afternoon 2:00 pm - 5:00 pm

Conference room 1
Working session 1
Impacts of energy projects in development
Chair: Dominique CAMPANA - *ADEME, France*

Decentralised rural electrification

The solar lantern service of Sunlabob using commercial charging stations in the villages
Andy SCHROETER - Sunlabob, Laos

Renewable energy in Ladakh
Jigmet TAKPA - LREDA, India

Determinants of success and failure of community based micro hydro project
Mibi ETE - LEDeG, India, Frieda PROCHASKA - BORDA, Germany

The Quality Electricity Plus strategy
Ralph PFÖRTNER, Oliver HAAS - Integration, Afghanistan/China

A 100kW solar photovoltaic power plant at Tangtse (Durbuk) by LEDeG
Sonam JORGYES - LEDeG, India

Conference room 2
Working session 2
Adaptation strategies of local communities to climate change
Chair: François MOISAN - *ADEME, France*

Climate change impacts and adaptation

Impacts of climate change in Ladakh and Lahaul& Spiti of the Western Himalayan region
S.N. MISHRA - Indian Airforce, Tundup ANGMO - GERES, India

Impact of climate change on mountain women's livelihood & challenges regarding energy access
Yankila SHERPA, Snow Leopard/T-Help, Nepal

Building community resilience towards climate channge adaptation through awareness & education
Rashmi GANGWAR - Centre for Environment Education, CEE, India

Conference room 3
Working session 3
Financing issues
Chair: Samuel BRYAN - *GERES, Cambodia*

Role of carbon market in catalyzing revenues for clean energy investments

CDM potential in SMEs (J&K)
Abhijit CHATTERJEE - EAGA, India

Climate Change mitigation and sustainable development: the Gold Standard approach
Ayse FREY, Neha RAHO - Goldstandard, Switzerland

Clean Development Mechanism and demand-side energy-efficiency improvement: when will the sleeping giant wake up?
Daisuke HAYASHI - Perspectives, Switzerland

Wednesday 22nd April

Morning 9:00 am - 12:00 pm

Conference room 1
Working session 4
Impacts of energy projects in development
Chair: Alain GUINEBAULT - *GERES, France*

Energy and Household

Biogas for developing countries with cold climates
Eric BUYSMAN - GERES Cambodia

Introduction of improved metallic stove for people living in high altitude regions of Nepal
Hari Gopal GORKHALI - CRT, Nepal

Rehabilitation of degraded rain fed agricultural land in Tajikistan through household energy efficiency
Frank LÖWEN - Welthungerhilfe, Tajikistan

Cane reed houses: 19th century idea, 21st century solution
Indira ASEYIN - Habitat, Kyrgyzstan

Improving winter livelihood of rural population in the cold desert of Western Indian Himalayas
Aurélie AGNIEL- GERES, Rigzin DORJEY - LEDeG, Rigzin NAMGYAL - SECMOL

Conference room 2
Working session 5
Financing issues
Chair: Ellen PEDERSEN - *European Commission*

Role of civil society in capitalizing the carbon market

Integration of CDM funding into micro credit based programs to disseminate energy efficient stoves
Alexander WIRTH - Atmosfair/WECF, Germany

Improved Stoves
Abhijit CHATTERJEE - EAGA India

Getting 'carbon money' into rural areas, examples based on ARTI technologies
Priyadarshini KARVE - ARTI, India

Linking local and global level-CDM recommendations and other sustainable energy upscaling tools
Sabine BOCK - WECF, Germany

The carbon solidarity co-operative helping to transform the household cooking sector
Samuel BRYAN - GERES Cambodia

Afternoon 2:00 pm - 5:00 pm

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Working session 6
Impacts of energy projects in development
Chair: Alain GUINEBAULT - *GERES, France*

Energy and Household

Energy risks in Kyrgyzstan and their mitigation through use of renewable sources of energy
Ilia DOMASHOV - BIOM

Community involvement in constructing energy efficient houses in rural Kyrgyzstan
Ruslan ISAEV - CAMP Alatoo, Kyrgyzstan

Impact monitoring in renewable energy projects
Ralph PFÖRTNER - Integration, Germany

Appliance Energy Labeling, What did we learn in EU? / The situation of appliance labeling schemes in India
Robert ANGIOLETTI - ADEME, France, Sandeep GARG - BEE, India

Energy efficient rural houses pilot project in Heilongjiang province of China
Robert CÉLAIRE - Concept Energy, Alain ENARD - Architect, France

Conference room 2

Working session 7

Adaptation strategies of local communities to climate change

Chair: François MOISAN - *ADEME, France*

Climate change impacts and adaptation

Artificial glaciers: a high altitude cold desert water conservation technique
Chewang NORPHEL - LNP, India

Integrated approach for adaptation to climate change
Gehendra GURUNG - Practical Action

Climate change and micro level planning in Chang-Tang region
Jigmet TAKPA - Dept. of Wildlife Protection, India

Land legislation and pastoral adaptation to climate change - The example of Mongolia
Anna-Maika SCHULZE - Robert Bosch Foundation, Germany

Conference room 3

Working session 8

Financing issues

Chair: Dominique CAMPANA - *ADEME, France*

Role and experiences of financing institutions in the implementation of energy-related development projects

Role & experience of EU
Ellen PEDERSEN - European Union

Role & experience of financing institutions for energy-efficient buildings
Yazid BENSAID - AFD, India

How to accelerate the market
Sonya FERNANDES - REEEP/TERI, India

Thursday 23rd April

Morning 9:00 am - 12:00 pm

Conference room 1

Working session 9

Impacts of energy projects in development

Chair: Ralph PFÖRTNER - *INTEGRATION, Germany*

Energy and agriculture/productive activities

Livestock, remote mountain areas and climate change
Nitya S. GHOTGE - ANTHRA

Seabuckthorn
C. BALAJI - Divisional Forest office, India

Passive solar greenhouse- bringing better nutrition to the cold arid regions of Western Himalaya
Dorje DAWA - GERES, Mohammed DEEN - LEHO, Vincent STAUFFER - GERES, India

Ram pumps in China
Stanzin TSEPHEL - BORDA, India

Improving livelihood of Nepal rural mountain people through promotion of pico-hydro technologies
Hari Gopal GORKHALI, - CRT, Nepal

Productive Use of Renewable Energy (PURE)
Oliver HAAS, Integration, Afghanistan

Conference room 2

Working session 10

Impacts of energy projects in development

Chair: Robert CÉLAIRE - *Concept Energy, France*

Energy in public buildings

Insulation of school buildings: windows and doors
Dag Arne HOYSTAD - Norges Naturvernforbund, Norway/Little Earth, Tajikistan

Implementation of passive solar housing technology in Himachal Pradesh
SS CHANDEL - SCSTE, India

Dissemination of energy efficiency best practices in the construction sector of public buildings
Muhammad RIAZ - GERES/FGEF, Afghanistan

Afternoon 2:00 pm - 5:00 pm

Conference hall

Closing session

Plenary Session
Working Sessions Summary
Seminar Closing Remarks

Friday 24th April

5:00 am - 8:00 pm
Field visit

1. Pangong Lake
5am: Departure from hotel -- 4 hours drive (depending on road condition)
Visits:
• 100kW / PV Power station benefiting 15 villages – Tangtse
• Lake
• Passive solar housing – Tangtse
• Solar Greenhouses
8pm: Return to hotel

2. Alchi Gompa
7am: Departure from hotel - 3h30 hours drive
Visits:
• Microhydro Electronic Power Unit – Fangila
• Wood carving workshop – Wanla
• Alchi Gompa
• Solar Greenhouses – Basgo
6 pm: Return to hotel

3. Igoo village
7am: Departure from hotel - 1h30 drive
Visits:
• Artificial glaciers – Igoo
• Monasteries – Hemis / Thiksey
• Passive Solar Poultry farms / Greenhouses – Shey
6 pm: Return to hotel

10:00 am - 5:00 pm

Conference room 1
One-day WORKSHOP on
Energy efficient building and carbon finance in cold regions of Asia

Gaurav SHOREY - Area Convenor, GRIHA, The Energy and Resources Institute (TERI), India

Daisuke HAYASHI - Head of Business Unit Methodology Development, Perspectives, Germany

Sven SCHIMSCHAR - Ecofys

Alexander WIRTH - Researcher, Atmosfair/WECF, Berlin, Germany

Samuel BRYAN - Technical Director, Climate Change Unit, Carbon Solidarity Asia, GERES Cambodia

Sonya FERNANDES - Coordinator, Renewable energy and energy efficiency Partnership, India

Robert ANGIOLETTI - Senior Energy Expert, ADEME, France

Abhijit CHATTERJEE - Head, Sustainability Services, EAGA, India

Introduction

Julley and welcome to Ladakh!

GERES is happy to welcome you in Leh (Ladakh, India), the historical cross-road of the Silk Route for the first "Regional Seminar on Energy and Climate Change in the Cold Desert Regions of Asia".

Information exchange and endorsement of best energy technologies for development projects, designing strategies for a joint climate change adaptation policy — such were the objectives of the Seminar held in Leh (Ladakh, Himalaya), from 21 to 24 April 2009.

Hosted in a unique environment at 3,500 meters above sea level in the Transhimalaya, the Seminar more specifically addressed the region of South and Central Asia, with participants from countries such as Nepal, India, Afghanistan, China Mongolia, Tajikistan and Kyrgyzstan. During the three-day working sessions and a one-day field visit, representatives and experts conferred around the table in order to set in motion a long-term collaboration process. Their common intention was to share successes and good practices regarding social, economic, and environmental impacts in development projects highlighting energy efficiency and adaptation to climate change in Asia's cold regions.

The Seminar put emphasis on the following themes:

- Impact of energy efficiency projects on development.
- Strategies to assist local communities in adapting to climate change.
- Funding alternatives (role of institutions, carbon finance).

One of the objectives of the seminar was to discuss impacts of energy efficiency projects on economic, social and environmental dimensions of local livelihoods, as well as identifying dissemination processes for best methodologies and the conditions needed for scaling-up mechanisms. It mainly focused on discussions on energy matters related to: energy and household, decentralised rural electrification, rural access to energy, solutions for remote mountain areas, affordability, rural development, gender participation, sector improvement and policy development, capacity building. It also particularly addressed the increasingly rapid impacts of climate change on mountain ecosystems and communities, as well as the adaptation strategy choices which have become a priority for the inhabitants of these regions.

Particularly promoting a regional rather than bilateral approach to problems and solutions, the Seminar set out to stimulate discussions and networking possibilities among key players (donors/investors, private sector, NGOs, local communities; governments and multi/bilateral organisations). In this line of thinking, the Seminar sought to promote and design a series of practical recommendations to be used in methodologies and policies adapted to the local contexts of these regions.

This is the first time that a meeting of this scope on energy and climate change in cold regions is organised at international level. It is strongly hoped that the participating countries and stakeholders will continue interchanging and working together to come up with a regional strategy for cold regions that will provide a basis for actual initiatives in the concerned areas.

Acknowledgements

Proceedings of the seminar "Energy and Climate Change in Cold Regions of Asia" was compiled and coordinated by Samten Choephel under the guidance of Vincent Stauffer.

We want to express our sincere thanks to all the authors who have contributed to the book. They have put so much effort into the documentation and compilation of the full-paper (manuscript). Without their contribution, this book would not have been possible.

We also would like to take this opportunity to thank the sponsors and partners of the seminar: EU, ADEME, LAHDC and GTZ for their moral and financial supports.

Special thanks goes to Raul Anaya for making the book easy to read and navigate. We are also thankful to Alain Guinebault for his valuable advices and suggestions from time to time.

This book is an outcome of a great teamwork. Many experts in GERES India helped in proofreading the papers (manuscripts). Our proofreading team comprises of Tundup Angmo, Mathilde Herisse, Rinchen Dolkar, Claire Auzias, Aude Petelot and Marion Triquet. We would like to sincerely thank the proofreaders for their valuable time and dedicated work in reducing the errors.

Finally, we want to acknowledge the organizers of the seminar. Thank you to Marion Triquet, Claire Auzias and Raphaele Deau for organizing the seminar and making it an outstanding event.

Thematic introduction

Challenges and opportunities for sustainable energy in rangelands - experiences & lessons from the HKH

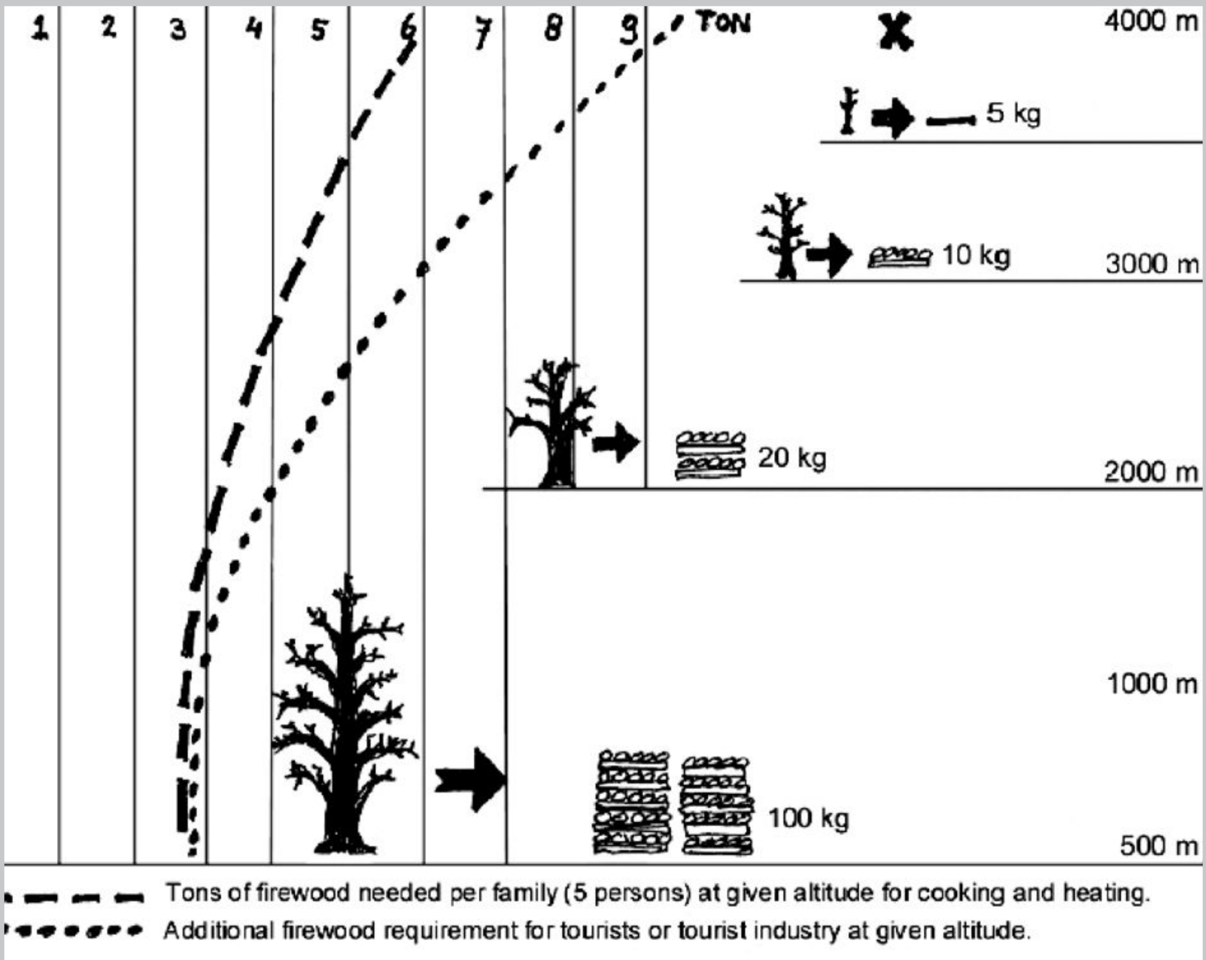
Bikash SHARMA

Hindu-Kush Himalaya (HKH) is spread across eight countries in Asia namely Myanmar, Bangladesh, Bhutan, China, Nepal, India, Pakistan and Afghanistan.

It is likely that no other region in Asia will suffer as much from changing climate and looming energy crisis as the high altitude cold areas of HKH region (mainly rangelands), where living conditions are harsh and many people are both vulnerable and marginalised. The upper belt of HKH region lies at an altitude of over 3,000m above main sea level. The temperature can drop as low as -30°C in winter. Natural resources are scarce; however, demand for energy is high, especially for heating and cooking. Herders cannot survive the winters without fuel. There is heavy pressure on bushes and scrubs due to overexploitation, overgrazing and uprooting. People rely heavily on animal dung for cooking and heating, which causes adverse impacts on fragile ecology and environment. Women and children face disproportionate burden of energy crisis. They spend long hours collecting animal dung and bushes. Besides lost opportunity, they face serious health hazards from cooking in a smoky environment.

The following diagram shows that the biomass growth rate decreases with the altitude, whilst energy demand increases concurrently.

Figure 1: Low biomass productivity- extremely slow growing period in high altitude rangeland



Rangelands contain the largest ecosystem in the HKH region, occupying 65% of its land area, providing enormous ecosystem services to more than a billion people downstream while regulating global climatic pattern. Despite this, they are still largely excluded from government planning and development spending. The rangeland poses many barriers - physical, economic, socio-cultural and political towards sustainable development. Physically, the villages are so remote and secluded that accessibility is difficult. Prevailing poverty makes technology unaffordable. Even if technology is viable, it may not be affordable and acceptable, due to these barriers. Sustainable energy service provision calls for harmoniously addressing the three broad criteria of sustainability – availability, affordability and acceptability (3A).

ICIMOD has conducted a research work in 2007-08 called “Development of Sustainable Energy for Rangelands (DESER- Phase I)”. The objective of the project was to design and support development of environmentally friendly, socially equitable and economically sustainable energy resources and technologies in rangelands to enhance livelihoods of people and their environment. Its immediate objectives were to assess household energy needs and supply situation, and to carry out onsite testing and demonstration of feasible energy technologies.

We selected four sites in four different countries for the pilot research. These sites and partners are:

a) Soi Yaksa, Nubri, Bhutan (Livestock Department)
b) Hongyuan County, Sichuan, China (Sichuan Academy of Grassland Science)
c) Upper Mustang, Nepal (National Trust for Nature Conservation)
d) Momi, Chitral District, Pakistan (Agha Khan Rural Support Programme)

The baseline survey showed the bitter realities of energy vulnerability at the project sites. Average annual energy consumption is very low. Energy use per household is highest in Bhutan (256GJ/yr) and lowest in Nepal (85GJ/yr). The detail figures on average annual energy consumption per household and per capita are shown in the following charts.

Figure 2: Average annual energy consumption

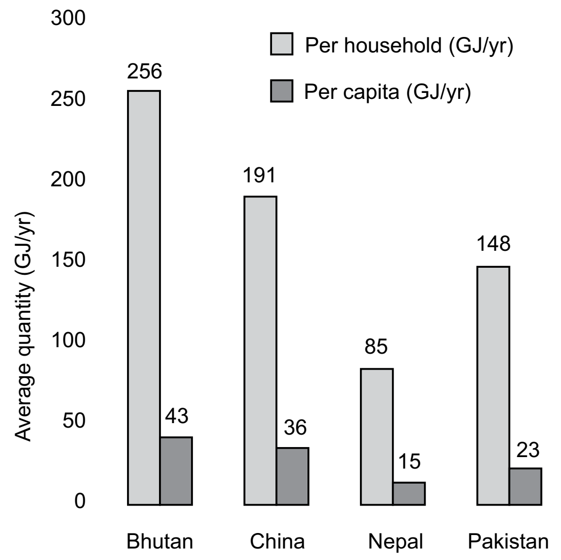
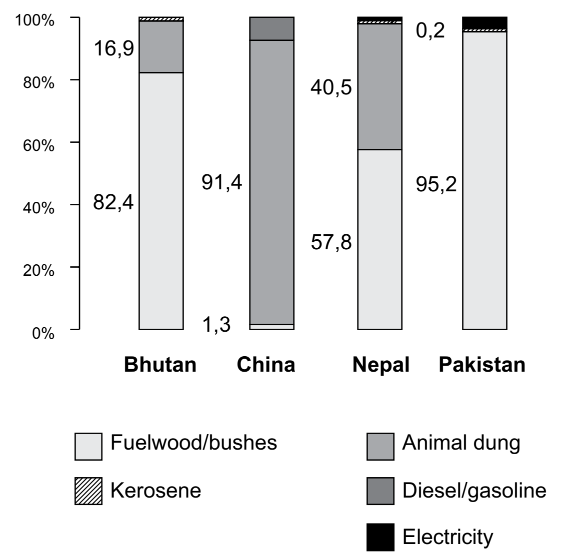


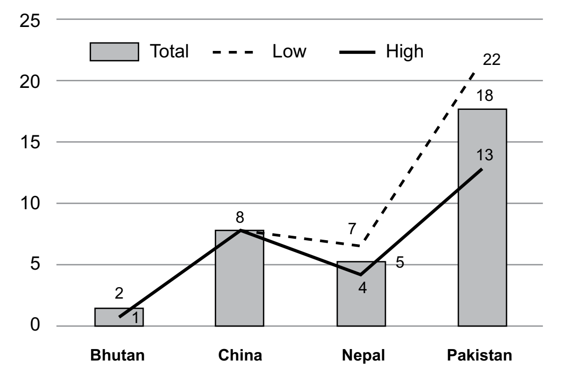
Figure 3: Energy mix pattern (% share in total energy use)



Persistence reliance on solid fuel is hallmark of poverty. In Bhutan, 82.4% of the energy demand is met by firewood and bushes, and Pakistan (95.2%) has similar situation. In China, 91.4% of the energy demand is met by animal dung and in Nepal there is a mix use of animal dung (40.5%) and firewood (57.8%). Women spent on average from 3 hours (Bhutan and China) to 7 hours (Nepal and Pakistan) per trip to collect fuel.

In Pakistan, a family spends 13% to 22% of the income on energy. In China, it is on average 8%, Nepal (5%) and Bhutan (1%). These mountain people are among the poorest in the world. This means, their capacity to invest in energy is low whilst the requirement is high. The analysis further shows that energy transition pathway is not straightforward and linear due to complex structural factors beyond income. This means, energy mix strategies for multiple cooking and heating are required away from the linear fuel switching notion of conventional energy ladder model.

Figure 4: Energy budget share by income



The pilot experiment of improved metallic stoves, solar cookers and portable solar lamps showed vast potential for saving fuel, reducing indoor air pollution and GHG emission, freeing up the excessive time and reducing drudgery of herders especially women for productive activities. Three types of improved metallic stoves tested for cooking and space heating showed an average daily fuel saving of 25 to 60% except China (12-17%) where people were already using some form of improved stoves. Given the baseline annual solid fuel use of 6.4 to 17 tons per household and annual GHG emission per household of 10 to 35 tons CO_2 equivalent, potential impacts of the fuel efficient stove are high due to their multiplier effects. However there exists trade-off between increased cooking efficiency and loss of space heating from a single stove. To overcome this, it is important to increase energy efficiency in domestic housing through improved insulation.

Solar parabolic cooker tested was able to save 6 to 12 kg of fuel per day. However households need to adapt to new ways of cooking as the process takes place outdoors and is dependent on good sunlight. As such solar cookers need to be promoted as a complementary rather than replacement technology for traditional cooking. A low cost small solar home system (two lamps with 4W LED each) were suitable for the semi-nomadic rangeland community to replace kerosene and dry cell battery as they are portable, and extremely durable producing a bright clean light for study and work.

For herder communities to adapt to climate change, they need to exploit new energy sources, make better use of existing biomass sources, and reinvigorate their own resilience enhancing adaptation practices. ICIMOD believes that properly designed renewable energy options are both a mitigative and adaptive response to climate change as they address core sustainable development priorities and build adaptive capacity, without increasing greenhouse gas (GHG) emissions – a win-win opportunity. Policies for sustainable energy solution need to focus on a) improving efficiency with which these solid fuels are used, b) promoting more sustainable way to supply these biomass resources, and c) facilitating the transition to the modern fuel by making them physically available, economically affordable and socio environmentally acceptable. Energy provision is not merely technology provision; it is about empowering local herders (both women and men) through building capability, creating economic opportunities, and enhancing their organisational strength to have a voice in shaping their energy choice – a lengthy process, which requires a long-term programmatic approach.

Building on these pilot experiences, ICIMOD in its second phase (2009-2012) is working to scale up of the tested technologies within project areas of five countries (Bhutan, China, India, Nepal, and Pakistan) in preparation for the programme into the remaining areas of the HKH through commercialization and market development. The project seeks to tackle the challenge of sustainable dissemination and commercialization through strategic policy, institutional and technological innovations to fit the specific local context. It aims to create enabling mechanism required to ensure multi-stakeholders' partnership for addressing availability and affordability issues through innovative financing, suitable production and delivery system in order to establish convincing good practice demonstration model that is sustainable, replicable and scalable across the HKH rangelands.

References

1. Sharma, B and Banskota, K. 2008. Development of sustainable energy for rangelands in the Hindu-Kush Himalayas, Pilot Project completion Report, Submitted to Austrian Development Agency, Vienna, Kathmandu: ICIMOD.
2. Sharma, B and Banskota, K. 2009. Development of sustainable energy for rangeland in the Hindu-Kush Himalayas Baseline study Report on Household Livelihood and Energy Situation, Submitted to Austrian Development Agency, Vienna, Kathmandu: ICIMOD.

Water and energy, challenges and trends in energy in the central Asian republics[1]

Ruslan ISAEV

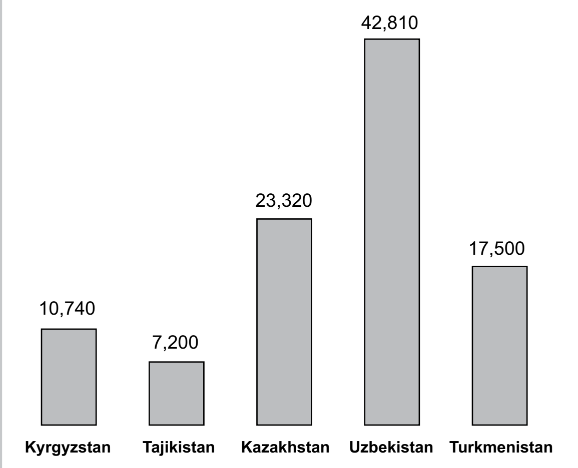
1. Water: a precious common good

Most of Central Asia's water resources are stored in more than four thousand glaciers covering an area larger than 4,000 km². Waters from their melting account for up to twenty-five percent of the total river flow and feed the Syrdarya, Amudaria, Chui, Talas, and Tarim Rivers, the largest rivers in the region. There are more than ten large water reservoirs with a total capacity of thirty billion cubic meters and dozens of smaller reservoirs used mainly for irrigation purposes.

While Tajikistan and Kyrgyzstan are the 'water towers' of the region, Uzbekistan and Kazakhstan are the biggest consumers of water. The river flow of Kyrgyzstan and Tajikistan is more than three times that of Turkmenistan and Uzbekistan combined. Compared with Kyrgyzstan and Tajikistan, Uzbekistan, Kazakhstan and Turkmenistan benefit more from water resources as their irrigated area of more than 75,000 km² considerably exceeds the irrigated area in Kyrgyzstan and Tajikistan. Despite this, Kyrgyzstan and Tajikistan bear the main burden for the maintenance of reservoirs and water transportation facilities supplying water to the lowland areas throughout the whole region.

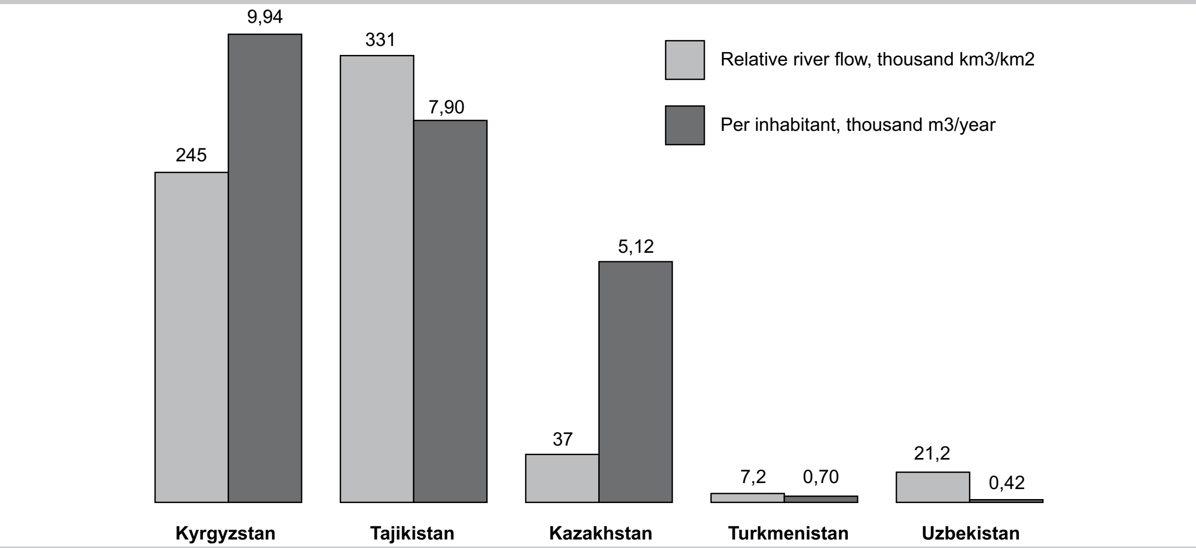
Issues regarding payment and the seasonal distribution of water give rise to disputes between the countries concerned. As in most parts of the world, water is considered a common good to be distributed among all states free of charge, while gas and oil resources are considered the property of the respective state. Turkmenistan, Uzbekistan and Kazakhstan thus sell energy resources to Kyrgyzstan and Tajikistan while the latter two provide water free of charge.

Area of irrigated land in Central Asia in square kilometers, 1998



Source: Turkmenistan 2003

Regional distribution of relative river flow and river flow per inhabitant



[1] *Based on the materials of CAMP Alatoo Synthesis Brochure 2008*

The regional average annual water consumption is 4.8 thousand cubic meters per person per year. This corresponds to twice the amount of Western countries. The main reasons are poor infrastructure with high rates of loss and the inappropriate use of water. Overall, the total supply of water is insufficient with 62 - 90% and 70 - 76% of the needs satisfied in urban and rural areas respectively.

2. Energy sources

Central Asia has large stocks of energy but it is unevenly distributed among the different countries of the region. The data on the explored reserves of energy resources in Central Asia is shown in the table at the bottom of this page.

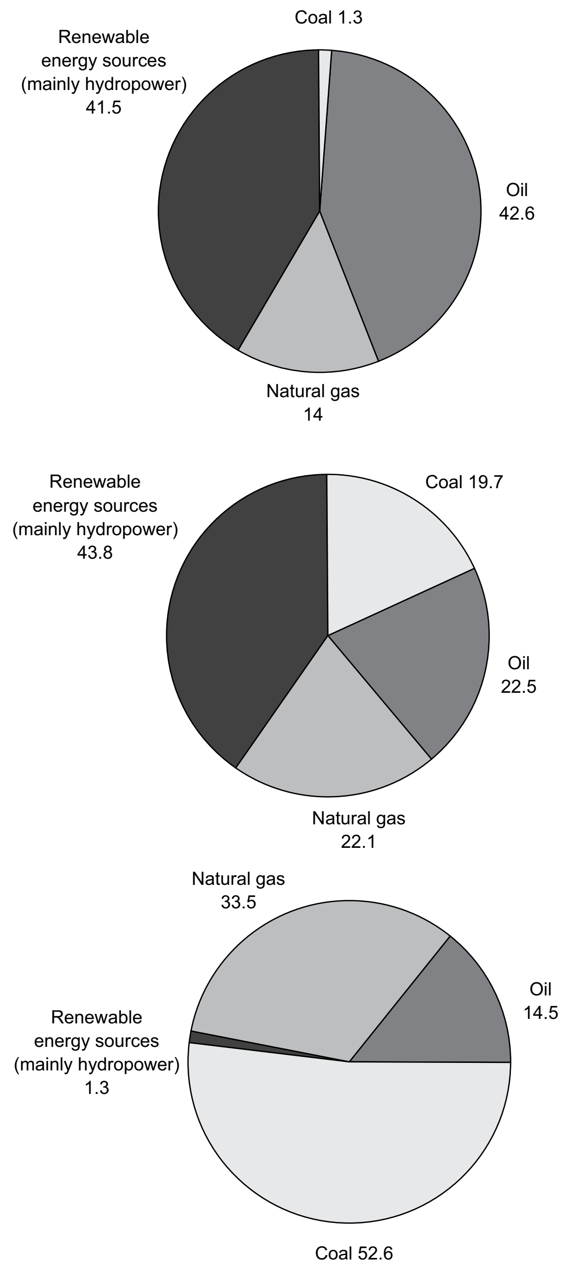
While Kazakhstan is extremely rich in oil and natural gas, the main hydropower resources are located in Tajikistan and Kyrgyzstan. The bulk of Kazakhstan's electricity production (52,900 GWh in 1998) is predominantly from fuel-burning power stations.

Approximately 7% of the electricity generated in Kazakhstan is produced by hydroelectric plants. Kyrgyzstan and Tajikistan combined produce only 31,400 GWh of electricity of which 89.6% is hydro-energy from the Nurek (Vaksh River, potential productivity 3,000 mega Watts) and Toktogul (Naryn River, potential productivity 1,200 mega Watts) power stations while only 5.4% is provided by the fuel-burning power stations located in Bishkek, Osh and Dushanbe.

Since 1992 power production has decreased in the region due to the deterioration of power production facilities and distribution infrastructure. Industrial power consumption has also decreased due to the closing of many factories. While aging power supply lines often break down, local people who steal wire in order to sell it as scrap metal sometimes cause malfunctions.

Due to increasing demand, consumption, and ongoing problems relating to the distribution of energy, many areas of Central Asia are experiencing and will continue to experience energy deficits and resulting higher energy costs. In the mountainous areas

Composition of primary energy supply for Tajikistan, Kyrgyzstan and Kazakhstan



Source: Human development report 2007/2008. In: www.laender-analysen.de/zentralasien 2008

	Coal billion tons	**Oil** million tons	**Gas** billion m3	**Uranium** thous. tons	**Water power** billion kWh/pa
Kazakhstan	34,1	4800	2000	601	27
Kyrgyzstan	1,34	11,5	6,54	-	52
Tajikistan	0,67	5,4	16,8	-	527
Turkmenistan	-	85	2900	-	2
Uzbekistan	1,95	82	1860	83,7	16
CAR	38,06	5183,9	6773,34	684,7	623

of the Central Asian states, mainly in Kyrgyzstan and Tajikistan, inadequate and deteriorating energy infrastructures have resulted in an increased demand for local fuels such as dung and wood, which are affordable but as yet unsustainable alternatives to coal and electricity. This scenario will ultimately negatively affect livelihoods since using dung for fuel and not fertilizer will cause soil fertility degradation and reduce agricultural productivity. Ultimately, the shortage of energy resources in many rural areas is the key limiting factor for their further development and the sustainability of future generations.

Central Asia is rich in renewable energy sources (RES) such as solar, wind, hydropower, and biofuels. The development of renewable energies will contribute to solving many of the critical problems presently facing rural areas, for example:

- Reliability improvement of power supply and organic fuel saving;
- Solution of problems of local power and water supply;
- Improvement of living standards and employment status of local population;
- Ensuring of sustainable development of remote areas in mountainous zones;
- Fulfillment of the countries' commitments relating to implementation of agreements on nature conservation.

Uzbekistan has considerable renewable energy resources (RES) totaling 51 billion tons of oil equivalent. With modern technology the potential level is of output is 179 million. This is more than 3 times the current annual power production output. Currently, hydropower accounts for a significant share in renewable energies in the power balance of Uzbekistan. The hydropower micro generation development program provides for construction of 15 small HPP with the total installed capacity 420 MW and average annual power generation 1.3 billion kWh.

In Kyrgyzstan, there are plans to use RES in resort zones and reserves, and also in places where traditional power construction will lead to degradation of farmlands, pastures and forests. For example, implementation of the Resolution of the Government of the Kyrgyz Republic on March 20, 2006 entitled "On phased transfer of cultural and recreational establishments of the Issyk-Kul oblast to solar energy" is currently underway.

In Kazakhstan, a project is under consideration relating to use of renewable resources of mountain rivers and wind corridors in the East Kazakhstan and Almaty oblasts. A complex of wind and HPP with total capacity up to 10,000 thousand MW could generate a minimum of 35 billion KWh a year. Based on studies to date, there exist approximately 453 potential power sites with a total capacity 1380 MW. There is an annual yield of animal and poultry waste products totaling 22,1 million tons dry weight, which is equivalent to 8,6 billion m^3 of gas. Annual volume of plant waste products is 17,7 million tons, which is equivalent to 14-15 million tons of fuel oil equivalent, or 12,4 million tons of residual oil.

The government of Tajikistan has placed among its priorities the energy needs of the population living in remote areas, far away from the centralized power supply systems, and they plan to solve the problem by installing power facilities on the basis of non-traditional renewable energy sources. The Government has developed and approved the Target Comprehensive Renewable Energy Use Program in Tajikistan for 2007-2015.

With assistance of the Supreme Science and Technology Council under the President of Turkmenistan, the Renewable Energies Development Strategy has been developed to provide for wide use of solar and wind power facilities. Experts of the "Gyun" NGO have developed projects of the so-called "solar villages" in which all life-support systems and waste utilization are carried out with the help of solar power systems.

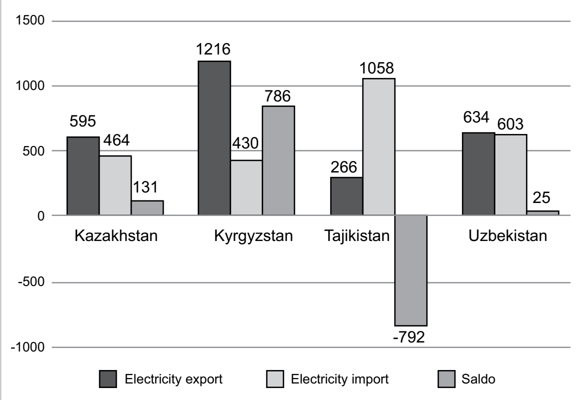
Application of renewable energy sources allows solving many economic, social and ecological problems in the region. Decreases in production of raw hydrocarbons, import restrictions and energy carrier price inflation create favorable conditions for development of non-traditional renewable energy sources (RES) and small hydroelectric power plants (HPP).

3. Water for food or water for electricity?

Before 1991 the Toktogul hydropower station took farmers' irrigation needs into account; from October until March a minimum of electric power was produced to save water for summer irrigation. With independence Kyrgyzstan and Tajikistan – now forced to be self-sufficient regarding energy procurement – began to use more water to produce electricity with their hydroelectric power stations. The new strategy demanded the accumulation of water during summer and the release of more water during winter when demand is at its peak. This shift caused water shortages for downstream users and finally led to tensions and conflicts, since agriculture ultimately exploits more than 90% of available water. Due to inappropriate water use and poorly coordinated water management, the rivers Amudaria, Syrdaria, Ili, Tarim, Nary and others dry out before reaching the large lowland basins, in particular the Aral Sea which is now a victim of desertification. This problem is further aggravated by poor quality irrigation channels and distribution facilities, causing water losses of around 20% during transportation.

Moreover, the traditional flooding irrigation method used in most rural areas consumes a lot of water: fourteen to sixteen thousand cubic meters of water per hectare. Alternative methods that could reduce this high water consumption by up to 25% are still out of reach due to their high expense.

Trading of electrical energy in Central Asia in giga Watt hours for 2002



Source: Worldbank.
In: www.laender-analysen.de/zentralasien 2008

The dispute over irrigation water has a long history. Currently the Isfara-Batken region is considered one of the most explosive parts of the Ferghana valley. Both a steadily increasing water shortage and a growing deficit of agricultural land may lead to a renewal of ethnic conflicts. This phenomenon has occurred at previous times, too. Recent conflicts occurred in 1969, 1974 and 1989. All together, they led to several thousand casualties.

Additionally, in order to improve their poor economic situation, Kyrgyzstan and Tajikistan are now forced to sell electricity to their neighbors. This imposes limits on domestic consumption and restrictive measures that burden the local population. Currently Kyrgyzstan supplies about 30% of the electricity it produces to Uzbekistan and Kazakhstan while Tajikistan exports 26% of its production. Remote mountain villages suffer the most by receiving electricity only sporadically.

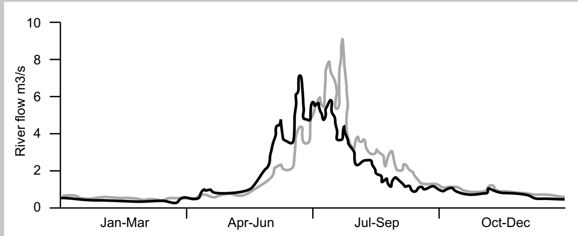
Taking the negative effects of climate change into account, the general Central Asian water deficit will most probably continue to increase in the future. This will be further aggravated by population growth, the increasing water use per person that comes with changes in lifestyle, and water withdrawals by Afghanistan from the Vaksh River in Tajikistan.

4. Climate change issues

Central Asia comprises of many arid and semiarid climatic zones. This makes the entire region particularly sensitive to environmental changes, in particular climate change. According to the latest report of the 'Intergovernmental Panel on Climate Change' (IPCC) concerning Asia published in 2007, climatic change is likely to have considerable negative impacts in the region. Experts foresee a pronounced warming of about 3°C until 2050, with dramatic consequences on water availability. The major expected impacts are increased desertification, decreased water resources, and an increase in natural hazards. It is further predicted that the degradation of natural resources will reduce living standards and contribute to increase poverty, diseases and migration.

The increase in temperature in Central Asia is leading to intensive glacier melting and consequently a temporary increase of water flow in some rivers. Over the last twenty years, more than one thousand glaciers have disappeared in the Pamir-Alai. Glaciologists forecast that snow and glaciers will continue to melt rapidly. The southern slopes will be the most affected with about 74% reduction of their glacier coverage, while northern slopes will lose about 32%. A recent study in the watershed of the Central Tien Shan massif has shown that over the last 40 years glacier surface has decreased by 28%, most of which took place in the last two decades.

River flow of the Sokuluk river



River flow in 2003 (grey line) and under scenario 2 of climate change with an assumed increase of temperature of 2°C and a glacier reduction of 13.7% (black line). Ershova et al. 2008

The modeling of river flow in the same watershed (Sokuluk) forecasts the maximum (peak) water flow shifting from July to June. The IPCC report 2007 predicts a decline in summer precipitation for Central Asia leading to the expansion of deserts and semi-deserts as well as periodic severe water stress conditions putting agriculture in a very sensitive situation. Severe droughts, floods, landslides, soil degradation and even storms are expected, which will affect the overall population and the respective economies. Currently degraded vegetation cover affects 77% of the land resources, about 9% is affected by salinisation of soils due to inappropriate irrigation practices and about 6% suffer from water erosion.

Climate change: a major challenge for development

François MOISAN

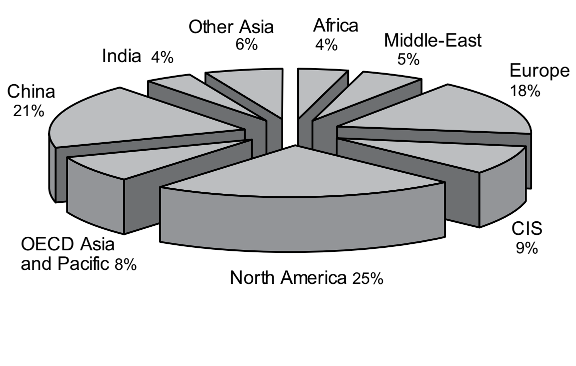
"*Scientific researches and figures drive the international negotiations and scientists call upon the government to take actions*."

The concentrations of CO_2 and other greenhouse gases have increased sharply, particularly in the last part of the 20th Century. There is a strong correlation between CO_2 and temperature; temperature increases with CO_2. IPCC estimated an increase of 1°C in average global temperature in the last century. The increase in temperature varies from region to region.

IPCC has made some scenarios on "what could happen in future". According to their report, temperature will increase (up to 4°C) in the Himalayan and Central Asian regions. Therefore, climate change and global warming poses serious drought threats in Central Asia. Melting of glaciers in the Himalayas will impact 9 river basins and 1.3 billion people. It may contribute to 'Glacier Lake Outburst Flood' (GLOF) in many parts of the region.

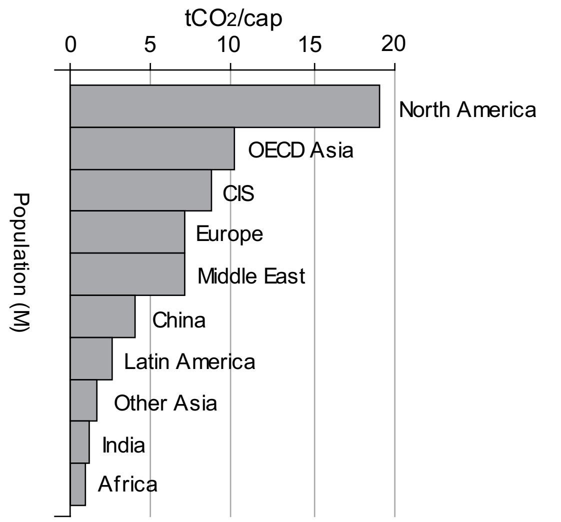
The developed countries and China are mainly responsible for the greenhouse gases emissions. Distribution of world CO2 emissions from energy use (2005) is shown in the chart below:

Figure 1: Distribution of world CO_2 emissions from energy use (2005)



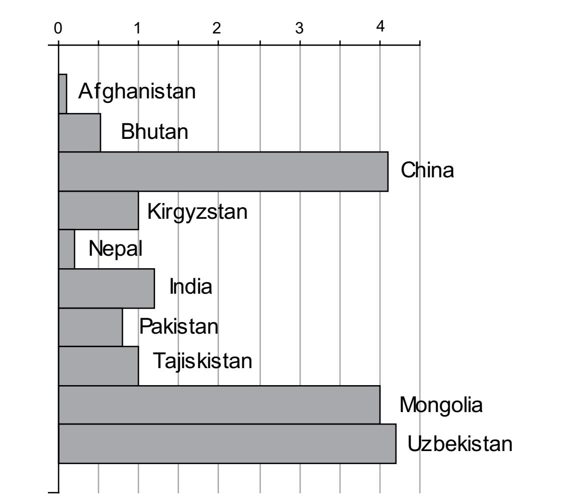
If we look at the emissions per capita, there are strong discrepancies in different part of the world. USA, China, Russia, India and Japan are the major emitters of CO_2 in 2005, in respect to energy use.

Figure 2: Energy related CO_2 emission per capita



Similarly, even in Central and South Asia there is large discrepancies and variance in energy consumption. The per capita emission of China, Mongolia and Uzbekistan is as high as 4.1, 4 and 4.2 tons of carbon dioxide. In contrast, per capita emission of Afghanistan and Nepal is as low as 0.1 and 0.2 ton of CO_2, respectively.

Figure 2: CO_2 emission per capita in Central and South Asia



Mr. Moisan concluded by saying, "*Acting to mitigate emissions is urgent, but adaptation will be necessary*."

Decentralised rural electrification

Energy is a mean to fight poverty; it is a basic requirement for development. Out of 6 billion people in the world, about 2.5 billion have no access to electricity and 1.8 billion of them live in rural areas. Extension of power grid to isolated rural areas is not financially and technically feasible. Therefore, decentralised rural electrification (DRE) is a solution to bring access to energy to such areas.

Government sponsored development programmes on electrification are mainly focused in cities, towns and other urban centres, whilst the remote and inaccessible villages are highly neglected and marginalized. Rural communities still rely on traditional energy resources, mainly biomass which leads to deterioration of the fragile ecology.

In mountain areas, the villages and hamlets are highly scattered and isolated. To connect them with the state's power grid is not feasible, because it requires huge capital investment which is beyond the budget of government. Besides, the transmission lines are very long, resulting in poor voltage regulation and high distribution losses. Therefore, decentralized power generation is viable alternative for rural and far-flung areas. The repartition between DRE and grid solutions is usually determined through economic analysis.

Electricity must not be used only for lighting (domestic and public) but also for other purposes. Productive use of energy helps to alleviate poverty and improve the standard of living. End-use machines or additional devices are attached to the Micro Hydro or Photovoltaic in order to initiate small and medium enterprises in the villages. As a result, it creates new opportunities for the villagers and farmers to generate extra income.

The renewable energy technologies like Micro Hydro, solar photovoltaic home-lighting system and solar lantern have replaced kerosene lamps, candles and gas lamps, thus reducing the indoor air pollution and other health hazards.

As a consequence, DRE contributes to:

- Availability of energy services to create economic activities and eradicate poverty
- Bring electricity in schools to improve education and gender equality
- Bring electricity in health centre and reduce pollution in houses, thereby reducing child and mother mortality
- Mitigate climate change and protect our environment

Speakers

The Working Session on Decentralised Rural Electrification (DRE) was chaired by Ms. Dominique Campana, Director of International Affairs, ADEME (France).

The first presentation was given by Mr. Andy Schroeter, Director of Sunlalob Renewable Energy Ltd, Laos. He shared Sunlalob's experience on "Solar Lantern Rental System and AC Village Hybrid Grids (VHG) for productive use". He focused on the importance and benefits of private energy provider and private-public partnership for off-grid and remote areas, and Solar Lanterns and Village Hybrid Grids: Paying for the service, not the hardware. In his conclusion, he said "We must go beyond improving living conditions with electricity towards increasing income with electricity".

Mr. Jigmet Takpa, Director, Ladakh Renewable Energy Development Agency (LREDA), Leh gave the second presentation on "Energy situation in Ladakh and potential renewable energy source". The energy consumption per household, renewable energy sources, status of electrification and power generation were presented, with special focus on solar energy. Ladakh has solar intensity of 6-12kWh/m2/day with more than 300 days of cloud free in a year. Solar Rural Electrification Programme of the government has covered 39 un-electrified villages in Leh district, from 2001 to 2008. Other schemes and programme of the government for solar pumps, solar cookers, and hydro power plants were also presented. Moreover, Ladakh has potential for wind and geothermal energy.

It was followed by a joint presentation by Ms. Mibi Ete, Ladakh Ecological Development Group (LEDeG), Leh and Ms. Frieda Prochaska, Bremen Overseas Research and Development Association (BORDA), Germany on "Micro Hydro Units in Ladakh - Reasons behind Success and Failure". Ms. Mibi presented the approach and strategy of LEDeG in planning, implementation and management of the community based micro hydroelectric power units in Ladakh in Jammu & Kashmir state of India. Capacity of the Micro Hydroelectric Power Units ranges from 5kW to 25kW. To provide an answer to the queries related to success and failure of the MHPUs, a study was conducted in 32 project sites, and the findings were presented.

The fourth presentation was jointly presented by Mr. Ralph Pfoertner and Oliver Haas, Integration, Afghanistan/China. "Quality Electricity Plus - cases from GTZ SHP Tibet and GTZ ESRA Afghanistan", it focused on improved and productive use of energy for poverty alleviation. They shared their experiences from Tibet and Afghanistan on 'Sustainable Operation and Maintenance' of Hydro projects, with some case studies. The installed capacity of the power plants ranges from 20kW to 320kW. The 'private leaseholder model' ensures smooth operation of the system.

The final presentation was presented by Mr. Sonam Jorgyes, Director of LEDeG, on '100kW solar photovoltaic power plant'. The power plant is installed at Tangtse in Durbuk block of Leh district, in Jammu & Kashmir state of India. The power plant supplies electricity to 408 households in 10 hamlets through a grid system. The silent features of the plant, and minimum and maximum loads observed in 2005-07 were presented. The implementation methodology, financial arrangements, and impacts (financial, environmental and social) were presented, besides, LEDeG's plan for sustaining the power plant. He concluded that smaller size (up to 30kW) solar photovoltaic power plants are more successful and have high potential for replication.

The solar lantern service of Sunlabob using commercial charging stations in the villages

Andy SCHROETER

Summary

Village entrepreneurs rent large solar charging stations that are set up at a central place in the village. They use them to recharge portable and exchangeable lanterns and other equipment (mobile phones, radios, laptops, etc). The village households pay a charging fee that covers all costs.

This configuration allows to take advantage of economies of scale on the charging and control equipment. The resulting recharging fee for the lanterns is comparable to kerosene costs of households for lighting.

Each lantern has an integrated microprocessor that gives the lantern a unique identity and monitors and safeguards its battery. During each recharging the charging station collects data on the use and status of the lantern. The data is analyzed for ensuring high efficiency of all equipment, and for trustworthy and reliable carbon trading.

Investments are through private channels for the charging stations, and public grants into revolving funds for purchasing the first batch of lamps for launching the village entrepreneurs. This results in a PPP for providing electric lighting among poor households in remote rural villages.

Challenge

Solar lanterns are now being widely propagated as a solution for lighting in remote villages away from the grid. However, experience shows that the lanterns fail much earlier than would be expected from the life expectancy of solar equipment. This is due to cheap low quality components being used in order to cut costs for the lanterns and thereby make them affordable for rural households. Furthermore batteries are irregularly charged, and households engage in "hotwiring", ie. try to use the charge for operating other equipment. Because of this the batteries fail too early.

Independent solar lanterns with own panels therefore are still uneconomical for rural households in the long run. This has resulted in solar lighting still not making a broad breakthrough in poor rural areas. Kerosene still rules the lighting market away from the grids.

The challenge therefore is to achieve an operational system for solar lanterns that can….

1. ..use state-of-the-art charging equipment and tamper proof units to exploit the full life expectancy of the components
2. ..tightly control the use of and charge status of the lanterns and monitor the life cycle of their components, thereby increasing their real on site efficiency, and
3. ..thereby reduce costs per hour of light and thus to be able to commercially compete with kerosene lanterns at household level.

With such innovations solar lighting can make a breakthrough in the vast numbers of low income poor rural households.

Sunlabob's response

Sunlabob has responded to this challenge by developing a package whereby a village entrepreneur operates a large solar charging station rented from Sunlabob. The entrepreneur then charges portable lamps belonging to him/her, which can circulate in the households of the villages. For each recharging the entrepreneur collects a fee. All collected fees together cover all the costs of operating the whole system on a commercial basis. For the households the recharging fee is a regular small expense just like buying kerosene at the village shop. But with these rechargeable solar lanterns they get more and safer light at lower costs than from kerosene.

A fully operational system in a village comprises of:

- one large solar array
- one battery charging station
- 24-144 lanterns (depending on size of solar array and battery charging station)
- an electronic system control unit

Technical details

The lantern unit:

The lantern unit is a light bulb with its battery. It is portable and can be taken home, hung up, or stood on a table, etc. It is sealed in a robust and tamper-proof casing.

The lantern unit's internal microprocessor adds up the time the lantern has been in use. After 9 hours of lighting operation have elapsed, a slowly flashing

LED warning light informs the user that one hour of operation is left. After another 30 minutes, the LED starts flashing at a higher frequency to indicate the upcoming shutdown. After a total usage of 10 hours, the Lantern Unit shuts off and cannot be turned on again by the customer.

If the lantern unit is used as a power supply, e.g. to charge a cellphone, and a low voltage condition is detected (flat battery), the integrated low voltage protection feature disconnects the power outlet and switches off the lamp.

During the entire period between chargings, the lantern unit's power receptacle cannot be used for charging the unit's battery. This ensures that no unauthorized charging may occur.

In order to prepare for charging, the lantern unit is connected to the System Control Unit. Once connected, the Lantern Unit can be unlocked by choosing the respective option on the SCU's display. At the same time, the SCU reads the number of hours the Lantern Unit has been used since the last charging and writes it to the charging log, along with the lantern unit's unique ID and the current date and time.

The lantern unit can now be connected to the Battery Charging Unit until its battery is fully charged. While in charging mode, the Lantern Unit's internal controller prevents switching on the lamp, and also interferes with any attempt of power extraction through the receptacle that exceeds a certain period of time. This approach ensures that only fully charged Lantern Units are handed out, but does not interfere with the operation of modern charge regulators that may probe the battery by discharging it for short periods of time.

Once the battery is fully charged, the Lantern Unit can be prepared for handing out to the next household that wants to exchange it with a spent one. Before the Lantern Unit can be given to a household, the SCU needs to be plugged in again to activate the Lantern Unit for lighting operation. At the same time, the SCU records the Lantern Unit's unique ID and writes it to the activation log, along with the current date and time.

The system control unit

The SCU is located at the charging station. It is used to activate the Lantern Units for either charging mode or for lighting mode by the households, and it is also used to collect any data acquired since the last recharging.

The SCU currently uses an integrated SD storage module to store the log files and firmware updates of the associated Lantern Units. It is also used to store the SCU's firmware updates and configuration data.

The size of this storage module can be increased to accommodate the needs of system setups with large numbers of Lantern Units per SCU.

Management software

To facilitate the handling of data collected by many System Control Units (SCU) in many villages, the Sunlabob Lantern Recharging System comes with a graphical Management Software. The software can be installed on a PC or Notebook computer running either Linux or MicrosoftWindows (Windows 2000, XP, Vista or later) operating systems. To connect the computer with the System Control Units in each village, a USB Port is required.

For easy processing of the acquired data, e.g. with the help of spreadsheet software or accounting systems, the rental and activation log files can be displayed, copied to the PCs clipboard or saved as text files.

With the help of the Management Software, firmware updates for the Lantern Units and the SCUs can be transferred to the SCUs. The software is also used to modify configuration settings of the System Control Units.

The scenarios can always be modified, if necessary. Operating times could be changed if a different battery or lamp is used, warning modes can be adjusted or the protection scheme may be altered to accommodate different power supply modes. All this can be done by simply uploading a new lantern firmware with the help of the SCU.

The management software can collect data from a large number of lamps distributed over a very large area. This data can be analyzed in many different ways, ie. number of charges and their fluctuations in time, distribution of lamps, diverse intensity of usage in various areas, frequency of switching on and off, average time of switched on light, etc. etc.

Operational details

The village entrepreneurs who rent the charging stations from Sunlabob are in a franchise agreement with Sunlabob. This franchise encompasses:

1. The installation of the charging station, including the SCU.
2. The regular servicing of the charging station
3. Sale of Lantern Units, and of replacements for their components
4. Regular trainings for maintaining quality and implementing emerging technical advances

5. Operational advice
6. Business advice
7. Assistance in local marketing, through PR materials, demonstrations and campaigns
8. Assistance in accessing soft loans etc.

Normally the rent pays for these services. Various programs funded by public agencies may pick up some of the costs, eg. the trainings, etc.

Market

Benefits for households

Village households are the final clients of this product and its services. They will always compare solar lanterns with the kerosene lanterns they know. The small but regular payments of households for kerosene add up over a year to one of their major cash expenditures. The solar lanterns should achieve a reduction of this budget item for a typical poor household.

In effect the operations result in the sale of hours of light as opposed to the sale of equipment. This is the same as when a household is connected to the grid.

Households report that they very much prefer lights that avoid the stink and smoke of kerosene. They also say that with kerosene there is the constant concern with the fire hazard.

The operational procedures with paying recharging fees is very near to the established behaviour of regularly buying small amounts of kerosene from the village shop. The financial flows in the households are the same too. This allows for easy adoption.

This direct competition with kerosene-based lighting is the challenge that the solar lanterns are picking up. After being able to demonstrate this in an area, the resulting demand can be huge as there are very many households using kerosene for lighting.

Benefits for village entrepreneurs

Renting and operating a recharging station is a sustainable village based enterprise, technically and operationally safeguarded by a franchise arrangement with Sunlabob.

The village entrepreneur may not make a living just from operating a charging station, but it will be a regular and reliable income that can fit with other income streams.

The village entrepreneur will be linked into the franchise network of Sunlabob and through that have exposure to other technologies and services that s/he may want to explore and develop in the village, eg. operating a TV/Video or even projector with screen, operating coolers, operating a laptop with GPRS internet connection, producing bottles of UV-sterilized water for drinking, etc…

Carbon

The software allows to unambiguously attribute each single solar recharging to a particular replacement of kerosene. This is a breakthrough for such highly dispersed usage of kerosene. It provides a possibility to bulk all these minor uses of kerosene into deals for saving carbon, thereby further reducing the charging fees and therefore letting households benefit directly from the carbon savings they achieve.

Risks

The most serious risk are programs and projects that subsidize solar lighting or provide it free of cost to communities. Experience shows that after the agency leaves the equipment sooner or later begins to fail, with villagers then saying that solar technology doesn't work. Convincing such villagers to try it again on a rental basis of for a fee has been difficult in the past.

Kerosene sellers will lose business and may retaliate. However this has so far not been experienced. Often the kerosene selling village shop ends up renting the charging station.

A further risk is that a village gets access to the grid, at which time the households may want to switch. This risk is mitigated by the fact that a) often the installation fees for a household connection are too high for the poorest households who are the ones targeted with this service, and b) the whole equipment can be dismantled and set up in another village.

Global potential

The presented operational procedures and technical solutions are replicable worldwide anywhere where…:

- there is sufficient sunlight
- there is a population organized in villages or if dispersed throughout the landscape regularly comes to certain points, eg. schools, market, etc.
- kerosene is expensive at the household doorstep (ie. about 1.5 usd per liter or more)

The potential market in rural areas worldwide is therefore vast.

Investment opportunities

When exploring the financing of ventures with charging stations and solar lanterns the strong public interest in rural electrification must be taken into account, particularly in remote areas and particularly for poor households.While the objective must always be to launch and sustain commercially viable village enterprises and the backup franchised services by private companies, there is also a strong case to be made for public involvement in launching such ventures.

However, public financial involvement must be designed to encourage private investments into commercial operations. Subsidies, if badly designed, can be counterproductive.

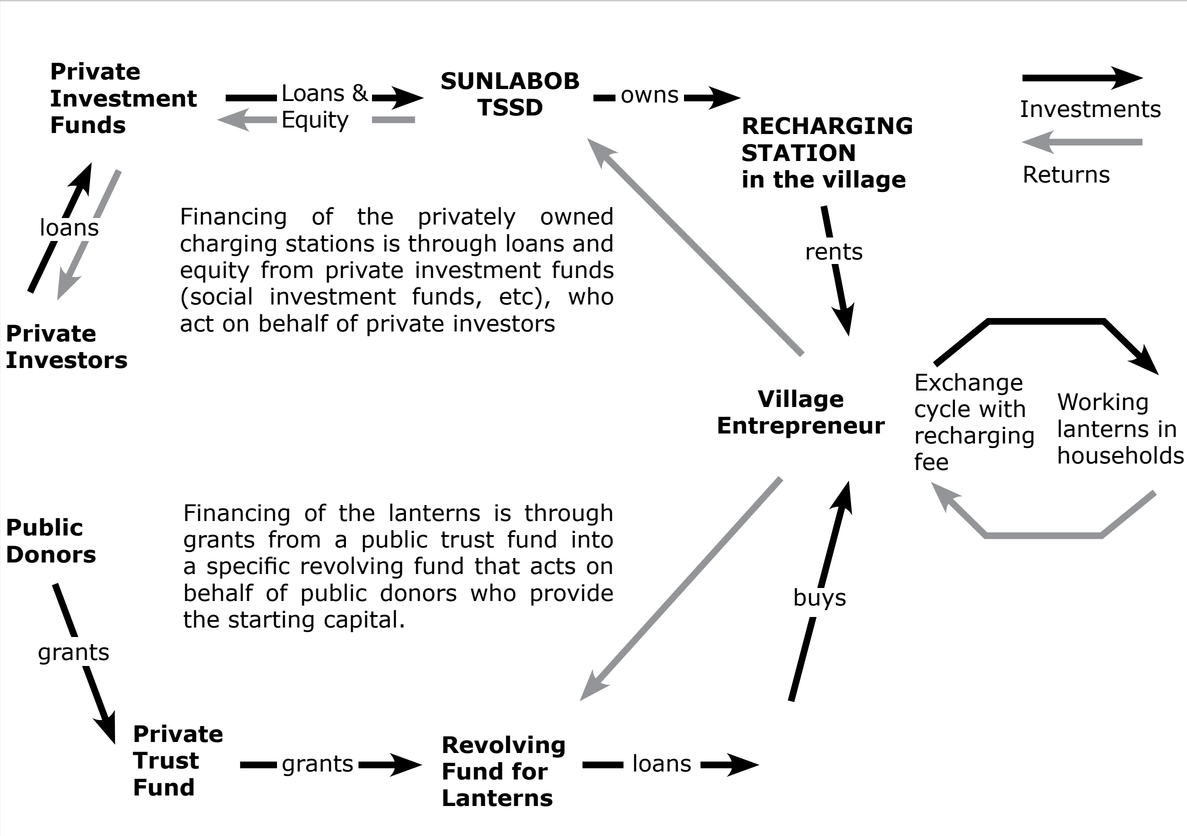
Public and private investments can mutually leverage each other, where each one on its own may not achieve the intended effect. It is suggested that private investors (eg. social investment funds, eco-investment funds, carbon investment funds, etc.) can invest in the charging stations to be rented out, whereas publicly launched revolving funds can provide the first batch of lanterns to start up the businesses of the village entrepreneurs. See figure 1.

Note that after the initial investment by the public, the launched village enterprises are expected to generate enough income to expand and continue their operations through the revolving fund without any further investments by the public.

Of course private investment funds can also invest into lanterns and the public can also invest in charging stations to be rented out. This is sometimes required to balance out the investments on both sides (to be later evened out again).

In effect this leads to a Public Private Partnership in providing solar lighting to poor households in remote villages.

Figure 1 **Private-Public interaction for mutual leverage of resources and operations for providing lighting in remote villages**



Determinants of success and failure of community based micro hydro project

Mibi ETE, Frieda PROCHASKA

Abstract

Ladakh Ecological Development Group (LEDeG) has implemented more than 70 community based micro hydro projects in Leh and Kargil districts of Ladakh ranging from 0.5kW to 30kW. The initial project was implemented to address the lighting needs of project villages. However, for the last five years, micro-hydro projects were utilized to support income generation measures. Though micro-hydro is a simple and proven technology, yet almost one-fourth of the units installed by LEDeG have failed. This study aims to identify the factors that are responsible for the failures and successes of micro hydro project in Ladakh. For the study, 32 micro hydro sites consisting of 16 failure and 16 successful cases were analysed. The study adopted both quantitative and qualitatively methodologies. For the quantitative analysis, data was collected from 90 respondents and the factor analysis method was used for data analysis. Focused group discussions and interviews were conducted with different stakeholders. The study indicated that for its success, 60% of the variances in variables could be explained by two factors (1) proactive villagers (2) good management. While 67% of the variance in the failure factor could be explained by three factors (1) lack of good planning (2) village dynamics (3) inefficient management. The relative weightage and the nature of the factor contributing to both the success and failure were also quite different. Overall, in both success and failure cases, the main factors responsible were social and management reasons, not technical reasons.

Acknowledgement

The study was conducted by LEDeG, with financial support from Bremen Overseas Research and Development Agency (BORDA). We would like to thank the villagers and all those who participated in the study and the student of SP Jain Institute for conducting the survey. Special thanks to Frieda Prochaska for compiling the paper.

1. Background

Ladakh region consist of two administrative districts of Jammu and Kashmir State in India. The region is scattered over an area of 45,000 km² bordering Pakistan to North and Tibet to east. The study area Leh is located at latitude 37°75′05′′ to 37°87′29′′ North and Longitudes 73°10′66′ to 73°99′99′′ East. The region experiences a severely cold winter with minimum temperature as low as -40◦C. Ladakh on average receives an average rainfall of 55 mm per year and the cloud free days range from 250-300 days in a year. The annual average global solar energy on a horizontal plane in the region varies from 5530 to 6360 Whr/m²/day.

Remote villages of Ladakh have for long been deprived of electric power. Government and non-government organizations have introduced various decentralized options for electrification like small diesel generators, solar home lighting systems, and micro-hydro projects to address the electrification problem of remote villages. Among all these options, micro-hydro and solar home lighting system have experienced wide-spread success across different parts of Ladakh. For the success of the micro-hydro, Ladakh Ecological Development Group (LEDeG) has played a key role. LEDeG in collaboration with Bremen Overseas Research and Development Agency (BORDA) has been promoting environment-friendly decentralised basic need services (DBNS) in the Himalayan region for the last two decades. Under this collaboration, with support from various national and international organizations like European Union, Groupe Energies Renouvelables, Environnement et Solidarities (GERES), Ministry of New and Renewable Energy (MNRE) and so on, LEDeG has installed more than 70 units of Community Based Micro Hydro (CBMH) projects in the range of 0.5 kW to 30kW.

2. Context and study objectives

Although LEDeG has successfully installed more than 70 community-based micro hydro projects in the region, many projects met with failure. Technically, if installed professionally and successfully, there should not be any reason why the micro-hydro should fail in a short span of time. It is a simple and proven technology, tested for over a century in different parts of the world. From a social and management perspective, for the success of any developmental intervention, the presence of a need and the affordability of the option provided are the key factors for its success. In the case of LEDeG's hydro project villages, the need for electrification was apparent from the fact that there was no electricity service in the villages and it was usually the villagers who requested

LEDeG to install the micro hydro. Once installed, the fee collected was either minimal or none at all in some cases. LEDeG's intervention fulfilled not only the above cited key social and technical factors for success, but many other factors such as capacity building, technical support, local ownership etc. However, despite the presence of many favourable conditions for the success of the micro-hydro unit in Ladakh, LEDeG has faced many failures. These failures and their repetition over the years have raised important questions. Why are some hydro-projects successful, while many others meet with failure, especially when the same hydro- technology is applied in similar villages or contexts? In the light of such field base experiences, this study was commissioned to understand the determinants of the success and failures of community based micro-hydro projects in Ladakh. More specifically, the objective of the study was (1) what are the factors responsible for success of micro hydro project in Ladakh? (2) What are the factors responsible for the failure of micro hydro projects in Ladakh? By considering Ladakh as a case study, this study also aims to get a deeper insight into reasons for success and failure of community based energy interventions in general.

3. Methodology of the study

Data collected from primary and secondary sources have been used. The secondary data used was retrieved from LEDeG project documents and database, and reports published by various organizations working for development and promotion of renewable energy in different countries. The primary data had been collected in April 2007 of 32 different cases (16 success and 16 failure cases). The total number of respondent was 90. The respondents were clustered as consumer, Electricity Management Committees (EMC) and operators of hydro power unit.

To quantify the determinants of success and failure cases, the factor analysis method[1] has been adopted. Respondents were questioned as to the degree of impact from 1= very low impact to 5=very high impact. Statistical software SPSS was used for data quantitative data analysis. Various statistical theories were used to group these variables into factors, calculating their weightages and contribution to either success or failure cases.

The quantity method and the result derived were supplemented by detailed case studies of each of the 32 cases. Group discussions and interviews were held with various stakeholders such as villagers, LEDeG staff, technician, decision makers and women groups. Discussions and interviews were held at two stages, in the first stage, potential variables/factors for success and failures were listed and in the second stage, the identified factors through quantitative analysis were discussed and analysed. On the basis of the initial interview and discussion the variables identified for success and failure are presented in Table-1 and Table-2.

4. Results

Table 1: Variables for Failure

No.	Variable
1	Unequal income distribution
2	Village politics / Differences among people
3	Water dispute
4	Untrained operator
5	Change of operator
6	Availability of alternate energy sources
7	Unit not meeting the village demand
8	Non existence/problems among EMC members
9	Natural calamities
10	Seasonal changes / Water shortage
11	Absence of initiators / Active persons
12	Land owner creating problems
13	Inefficient monitoring of MHU
14	Misuse by villagers
15	Problems in tariff collection
16	Technical problems with equipment
17	No funds for maintenance & repair

Table 2: Variables for Success

No.	Variable
1	Introduction of income generation schemes
2	Supportive attitude of villagers
3	Proper training facilities for operator
4	Efficient functioning of EMC
5	Proper equipment maintenance by LEDeG
6	Proper equipment maintenance by operator
7	Proper equipment maintenance in off-season
8	Availability of appropriate energy mix
9	Timely collection of tariff
10	Proper management of funds
11	Availability of perennial source
12	Initiative by villagers
13	Availability of funding
14	No alternative power source

[1] *To mention just a few steps of the statistical analysis: calculation of mean of impact, test of statistical significance, test of correlation between variables, factors are derived from variables, their percentage of responsibility has been calculated*

The above identified variable was analysed further using a statistical method called Factor Analysis. With the help of this method, five main reasons for success and failures were extracted. The five factors for success explain 95.7% of the variability, while 91.2% of the analysed failures variability is explained by the reported five factors. Table 3 shows the distribution of the 14 reasons for success and the 17 reasons for failure according to the extracted factors. In addition it shows the percentage contribution of each of the five factors to the analysed projects success or failure.

Table 3: Extracted factors for success (out of 14 reasons) or failure (out of 17 reasons)

Success of MHU

Factor	Variables	Resp
Proactive villagers	Supportive attitude of villagers Initiative by villagers Introduction of income generation schemes Proper funds management	33.5%
Effective management	Proper operator training Efficient functioning of EMC Availability of funding Proper maintenance of equipment in off-season Timely collection of tariffs Proper maintenance of equipment by operator	27.3%
Good planning and support from LEDeG	Proper maintenance of equipment by LEDeG Availability of perennial source	14.5%
Use of appropriate mix of power	Availability of appropriate energy mix	11.7%
No alternative power source	No alternative power source	8.7%
	Total	95,7%

Failure of MHU

Factor	Variables	Resp
Lack of good planning	Technical problems No funds for repair Water dispute / water shortage Inefficient monitoring of MHU	27.5%
Village dynamics	Dispute amongst villagers Land owner creating problems Unequal income distribution	21.3%
Inefficient management	Problems in tariff collection Absence of initiators/ active persons Non existence/ problems among EMC members Misuse by villagers	18.5%
Disinterested villages & improper maintenance	Change of operator Untrained operator Availability of alternative energy sources	12.7%
External factors	Natural calamities Inability of unit to meet the village demand Seasonal change	11.2%
	Total	91,2%

The Quality Electricity Plus strategy

Ralph PFOERTNER, Oliver HAAS

The 'QUALITY ELECTRICITY PLUS' strategy represents a new approach to conventional electric supply strategies in rural areas. It aims to increase the poverty alleviation impact of rural electrification by adding components or activities which enable rural poor households to participate in the productive or leisure use of electricity. 'QUALITY ELECTRICITY PLUS' stands for regular and stable supply of electricity, good maintenance services at affordable prices and special tariffs for poor households.

The positive impacts of electricity use on rural households in general and especially on poor households can be enhanced by a broader and more comprehensive view and concept of rural development and its interrelations and linkages with electricity supply and consumption. This broader view applies for initial electrification as well as for network improvements of rural areas with a certain number of poor households.

Poor households need special development programmes that include electricity supply to initiate structural changes in their living conditions and well-being. The best way to enhance opportunities for women's and men's participation in designing and implementing energy policies is, first, a gender-specific demand analysis at village and household level that enables women and men to voice out their problems, the self perceived causes of their poverty and solutions to these problems.

A Steps towards a pro-poor electricity supply approach

In order to build up a coherent pro-poor rural electrification approach, several steps are necessary before implementing the QUALITY ELECTRICITY PLUS strategy:

• *'Pro-Poor Policy' decision by the responsible Government Body (GB)*

First of all the responsible governmental authorities should formulate a policy decision as to a future pro-poor rural rehabilitation and electrification approach for villages defined as poor. These officially selected poor villages should be allowed preferential power supply conditions with regard to tariffs, connection fees etc. This preferential treatment should continue until these villages reach a predetermined economic standard.

The pro-poor policy decision will not hinder market oriented electricity supply in all other villages, counties, etc. which are not defined as poor. With such an approach the government demonstrates its social responsibility its solidarity and concern on the poor.

• *Creation of an interdisciplinary working group to formulate the framework for a pro-poor approach and a 'QUALITY ELECTRICITY PLUS' Strategy*

An interdisciplinary working group should be installed to clarify the objectives and possible frame conditions of a pro-poor 'QUALITY ELECTRICITY PLUS' approach. Special payment conditions for selected poor villages and further guidelines for implementing a pro-poor approach in rural electrification/rehabilitation is formulated by this working group.

• *Appointment of QEP+ representatives at county or village level*

When the guidelines for implementing a pro-poor approach are agreed upon, interested, mo-tivated and competent QEP+ representatives are appointed to represent the GB in further meetings. As horizontal cooperation between different government departments and private and semi-private agencies is not very common, cooperative activities between the involved agencies and government departments will be stimulated and practised.

• *Training of QEP+ representatives*

It can be assumed that training at county level will be offered for different representatives of different government departments (agriculture, road construction etc.) in order to focus better on present development needs of poor villages and households. The QEP+ representative should participate in these trainings.

• *Potential demand and opportunities analysis*

A combined and common analysis of potential demand, resources and opportunities has to be carried out in poor areas with the participation of concerned village leaders and households. The objective of the analysis is among other things to forecast future electricity demand and use and appraise possibilities for 'Quality Electricity PLUS' packages as well as select the best rehabilitation/electrification option for the concerned villages. In minority areas detailed electricity demand and absorptive capacity assessment is necessary and recom-mended to define the electricity/energy needs of these communities.

• *Integrate Quality Electricity PLUS Packages into the 'village development plan'*
At the county government level, 'poor village development plans' will have to be designed with the respective representatives of poor villages. The findings from the demand and potential analysis by the GB should be discussed and adapted with the County Government to be an integral component of the comprehensive 'poor village development plan'. Before designing final 'Quality Electricity PLUS' packages, households should be given the opportunity to voice out their concerns and experiences with respect to access to electricity and future demand. Gender disparities in electricity needs and electricity use have to be taken into consideration.

Very often it is not electricity which is the main problem. Very often lack of energy in general makes specially the situation of women in rural areas more complicated than the situation of men. Since development is about additional choices for people who would like to improve their conditions, inputs and packages have the most chance of success when women' and men's priorities and interests are met.

The QUALITY ELECTRICITY PLUS strategy could be implemented according to four principal approaches. In implementing these approaches, a wide range of packages/measures could be identified.

B Approach 1: Improvement of the use of Quality Electricity

To improve access to electricity for poor households, a number of options on the supply side are possible:

• *Payment of rehabilitation/connection fees stretched over a longer period*
Objective: Access to electricity can be afforded by the poor.
As was reported by customers and electricians, the payment of electricity rehabilitation/connection fees in one instalment is a heavy burden for poor households. This very often prevents them from participating in the rehabilitation programme and makes the first connection to the grid very expensive, too. Either rehabilitation/connection fees should be much more subsidised or the payment of the fees should be stretched over several years. A political decision in a pro-poor supply approach for subsidies is legitimated as a measure for redistribution of wealth[1]. This will give a psychological signal "We care".

• *Lifeline rate for poor households*
Objective: Consumption of electricity can be afforded by the poor.
As rural tariffs in most counties are still higher than urban ones, poor households with a restricted electricity budget pay more for a very low consumption. A lifeline rate for poor households might ease the situation for these households and result in an increase of well-being.

• *Flexible billing system*
Objective: Bills can be paid by the poor.
Poor households mostly depend on agricultural and livestock production. Their cash income is linked to the sales of agricultural or animal products and therefore not available the whole year round. A flexible legalised billing system would allow poor households to cope better with the financial requirements of paying the electricity bill.

• *Training of selected villagers as village electricians*
Objective: Electricity can be handled in rural area.
The withdrawal/lay off of electricians from the village level is very detrimental especially for remote and non-rehabilitated villages, because problems in electric installation will happen more frequently than in rehabilitated villages. Therefore training of selected farmers as village electricians is suggested to enable villages to help themselves when minor electrical problems occur.

• *Promotion of other energy appliances together with electricity*
Objective: Other electricity sources are promoted.
Good quality electricity cannot alone solve the energy problems of the rural poor. In the absence of grid supply other electricity sources as wind or solar energy, or renewable appliances (for example solar water heaters) are steps on the energy ladder and should be pro-moted.

• *Customer services to promote electricity use*
Objective: Information is available with rural consumer groups.
The information level in rural and especially poor areas concerning the variety, use and maintenance of electric appliances is still very low. Information and demonstration services related to electricity use for poor customers are recommended (for example including the promotion of appliances for renewable energy use and energy saving bulbs etc.).

[1] The high start-up costs are only one of several obstacles to electricity use among poor people. Another obstacle is the combination of factors making or leaving poor people poor. Without increasing the productivity of agricultural work or creating new jobs by allocating smaller and larger industries to poor areas, electricity supply will not on its own help poor households. Credit for high start-up costs (households will even not apply for the credit because they don't know how to pay it back) is only valuable if the effects of a better electricity supply are combined with the use of electric machinery for productive use (see recommendations package 4). Lighting might pay immediately through improved working conditions and productivity in home industries if those opportunities are available or could be generated. In short, credit for the start up costs will not help without a package of additional measures.

• *Tailored electricity supplies for remote areas*

Objective: Electricity sources and supply system fits best to the actual demand.

Cost recovery is an important argument against electrification/rehabilitation of remote and poor areas because of their low electricity consumption. So instead of serving all remaining villages from the public grid, other distributed electricity supply options might be cheaper and could assure an adequate electricity supply as well. To cater to the needs of the rural poor who live in remote areas, individual solar panels, wind systems and bio-fuels can solve the lighting problems of mobile households and as well allow TV watching. Although electricity generated from solar or wind power may still be more expensive than electricity generated from fossil fuels, village renewable energy systems (wind, water or solar powered) can be easily installed in remote areas and can avoid the high investment costs of extending the grid. However the productive or commercial use of electricity will be limited with renewable energy technologies. A detailed study should contribute to such solutions.

C Approach 2: Quality Electricity PLUS credits and loans

In this approach the emphasis is laid on additional financial support for poor households[2]. Credits and loans for poor farmers and their wives will allow the purchase of processing machines in regions where agricultural products can be processed or equipment can lead to improved productivity in both households and farms. Preferential conditions (e.g. low interest rate/cost, medium to long term, six months grace period to generate income for repayment first) should be introduced with the purchased equipment or machinery serving as collateral.

• *Package 1: Quality Electricity PLUS credit for time and energy saving household equipment for women*

Objective: Well-being of poor households is improved and physically demanding work for women is reduced.

This package will therefore target rural women who wish to improve their productivity to cope with the triple daily workload (household, farm, and children). The package will provide favourable credit facilities and training vouchers[3] for time and energy saving household equipment and its use (energy saving cooking devices, electric washing machines). Courses such as how to build your own biogas plant, improved cooking stove, etc will be offered. Local banks will provide standard Quality Electricity PLUS consumer credits and distribute vouchers for special energy saving training.

• *Package 2: Quality Electricity PLUS housewives consumer credits programme for electric appliances to improve household productivity (as part of improved farm productivity)*

Objective: Housewives are enabled to earn additional income at home to supplement their limited farm income.

This package will therefore target rural housewives who wish to purchase by instalment, through favourable investment loans or through low cost lease arrangements electric productive household or cottage industry appliances (home sewing, weaving or knitting machines, hair dressing etc.) including free training vouchers for sewing, tailoring, knitting or other related skills. This package could also be offered to a group of women who jointly establish a "village cottage industry unit" in the immediate neighbourhood and act as a subcontractor to larger textile industry (shelter with electric facilities and equipment, see also package 7).

• *Package 3: Quality Electricity PLUS credit for income generating machines and equipment for underemployed or poor farmers*

Objective: Farm productivity is increased and off-farm income opportunities for poor farm households are created.

This package will target low-income farming households, which have no access to income generating machines and equipment due to lack of investment capital and skills. The package will provide favourable credit facilities, skill training vouchers and information on local market opportunities for self-employment and income generating activities (processing of agricultural produce, technical or other services). The package should assist poor farmers to improve their farm productivity and facilitate off-farm income with electric powered equipment and machines (water pumps, threshers, welding or machinery repair tools, etc.).

• *Package 4: Quality Electricity PLUS credit for basic appliances (TV, washing machine, water pump, etc.) for newly married young rural couples*

Objective: Start-up of newly created rural households eased and migration reduced by providing more attractive rural living conditions.

This incentive package will target newly married poor rural couples to ease the establishment of

[2] These programmes are meant for poor people who are able to work but lack opportunities and choices. Poor households in which household members are handicapped or ill need other support programmes to change their situation.

[3] There is extensive international experience and "best practice "available on the efficient use of training vouchers to stimulate training demand, see documents of Donors Conference on Business Development Services in Hanoi/Vietnam, 2000.

their own household and income generating activities (farm and off-farm) with a "rural family starting loan" and if necessary skill training vouchers. In some areas the loans could be converted into grants if the young couple is able to successfully establish their business and livelihood within five years. Based on regional government policy, loans would be channelled through local banks. Local electricity suppliers could boost their PR by handing over electric appliances as gifts at special 'Young couples days' and by distributing skill training vouchers.

D Approach 3: Quality Electricity PLUS training

In this approach the emphasis is on additional training and information efforts. Training and provision of information on new agricultural techniques creates opportunities for new income sources and increases the income of the poor, thus they are able to invest in labour saving electrical appliances or create new job opportunities for rural self-employment. All types of learning processes (distance learning by TV, vocational or on the job) should be supported to enable the effective use of the electric equipment, new technologies in agriculture, etc. This training should lead to additional demand-based services and income generating activities.

- *Package 5: Quality Electricity PLUS improvement of education by equipment and TV programmes for schools in remote areas and among minority nationalities*

Objective: Pupils in rural areas are more competitive in the future labour market and the use of electric appliances for education is promoted.

This package will address the efficiency and quality of the formal learning process in all schools benefited from the electricity programme in providing and training the teachers in using electric lab or science equipment, video tapes and programmed TV learning software for the benefit of the pupils. Equipment and training of the teacher will be provided or facilitated jointly by local government budgets and the local power supply agency to foster the "Quality Electricity PLUS" policy of both national and local government.

- *Package 6: Quality Electricity PLUS applied language courses via TV or VDO/VCD for minority nationalities*

Objective: Competitiveness and mainstream social requirements of minorities improved.

This package will target those households that have benefited from the rehabilitation programme and wish now to make more effective use of the good electricity by distance and self-learning efforts. Programmed language courses (Chinese, English, main minority languages) provided on TV or VCD discs (marginal registration fee) to poor households sponsored by the local power supply company and TV channel could provide the younger generations of minority nationalities with new employment opportunities and professional challenges.

- *Package 7: Quality Electricity PLUS training in own business start-up.*

Objective: All kinds of initiative among potential entrepreneurs to start their own businesses are encouraged.

The package will support potential micro-entrepreneurs through media based market information, viable business information and entrepreneurship training – either by distance learning or local courses with additional tutoring by TV instructors. Training vouchers will be provided against marginal fees. Successful participants with viable business plans will be promoted through TV/radio and will be facilitated by local banks (international best practice: 'CEFE' training package). TVE management staff could act as mentors to guide the business starter or facilitate first contracts.

- *Package 8: Quality Electricity PLUS group initiatives for off-farm self – employment and new business opportunity training and credit programme*

Objective: Groups of business starters are encouraged.

The package will target groups of un- or under-employed but mature village youths to encour-age them to attend jointly a small business creation or entrepreneurship training course. Some members might also wish to attend further skill training if the business to be started is jointly confirmed. This will be supplemented by group "start-your-business" loans from gov-ernment banks for small productive village units using electric appliances including related skill training vouchers at low cost (tailoring, garment, power loom weaving, pottery, bakery, TV, agricultural equipment or bicycle repair centre, car garage, other mechanical services). Those units could also act as subcontractors or suppliers for TVEs or larger industries. TVE management staff could act as mentors to guide the business group starter or facilitate first contracts.

E Approach 4: Quality Electricity PLUS additional infrastructure

The emphasis in this approach is to combine with other infrastructure measures to create synergetic effects for rural households. Electricity rehabilitation programmes should be supplemented by additional infrastructure improvements in poor counties such as roads to facilitate access to markets, decreased transportation cost for processed agricultural produce and services or to provide piped water to households to save time, reduce workloads and increase productivity.

- *Package 9: Quality Electricity PLUS water supply (tap water and irrigation) in remote areas*

Objective: Benefits from synergetic effects of improved electricity supply due to rehabilitation and better water supply are used to increase productivity at both levels: household and farm.

As a joint effort between local power supply and physical infrastructure development agencies, this package will reduce the work load of household members, for example in carrying water from public wells for use in an electric washing machine; it will also allow farmers to apply spray irrigation for vegetable growing and the use of water pumps to irrigate farm land for more intensive and more productive crop farming. Both farm women and their husbands could then apply for other Quality Electricity PLUS loans and training packages as well.

- *Package 10: Quality Electricity PLUS road connections to markets/towns*

Objective: Remoteness of 'poverty niches' to enable rural isolated households to have easier access to markets and towns reduced.

This package is again a joint effort of local power supply and physical infrastructure development agencies with the participation of the local population, which will benefit from those new or improved access roads. Roads (in mountain areas there could also be lifts/bridges) have manifold advantages for rural households: faster purchase of household and farm inputs, easier sale of farm products at town markets, better access to public services such as schools, hospitals and government offices.

This package would make other Quality Electricity PLUS loans and training packages more viable for rural households in remote areas and would reduce their remoteness as one main reason for poverty.

All packages should be integrated into the future poverty alleviation strategy and the development plan to be designed by the county governments and respective departments for the remaining poor villages and households.

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An abstract on a 100kW solar photovoltaic power plant at Tangtse (Durbuk) by LEDeG

Sonam JORGYES

Present electricity power situation in Leh

The total number of hamlets in Leh district is 132, out of which over 50 are electrified. There are mainly two hydro power stations with an installed capacity of 7MWs that supplies electricity to the main town of Leh and villages nearby. There are also a number of micro hydroelectric power units installed by the government and LEDeG in the remote villages. The other source of electricity is 30 diesel generator sets with capacity ranging from 50KVa to 750KVa. These Diesel Generator sets are mostly installed in the progressive villages and towns.

There is a huge problem with distribution and transmission through power grid systems due to scattered nature of the villages and hamlets. The transmission lines are very long, resulting in poor voltage regulation and high distribution losses. Connecting to the grid requires huge capital investments, which is financially not feasible. Therefore, decentralized power generation is the best alternative for rural and far-flung areas of Ladakh.

About the project area (Durbuk)

Durbuk is one of the six administrative blocks of Leh district. It comprises of five revenue villages spread over 24 hamlets. Durbuk block is the smallest in terms of population of about 6000 and by far the most backward area in the whole region. It constitutes the north-eastern part of the district and shares the border with Tibet Autonomous Region. Being located on the India-China border, the development of the block has strategic and political importance. The block headquarter is located at Tangtse which is about 120Kms from Leh, at an altitude of 14,500 feet above sea level.

There is no possibility of connecting the area with the power grid in Leh. Apart from solar energy, no other viable resource, renewable or otherwise, is available. Before LEDeG's intervention, the villagers were receiving electricity from a 250kVa diesel generator. The DG set was installed and managed by the Power Development Department (PDD) of the state government. There were regular breakdowns and hence, highly unreliable. Moreover, the diesels are transported across the difficult terrains of Himalayas, which makes it very expensive and unaffordable.

Technology

Durbuk, like other parts of Ladakh is blessed with an abundance of sunlight and high solar radiation. Harnessing solar energy into consumable electricity is highly effective and useful.

Salient features of the SPV Power Plant

1) Plant Capacity
- No. of units installed = 4
- Capacity of each unit = 25KWp

2) Array Details
- No. of Solar Modules = 1360
- Capacity of each Module = 75KWp
- Total Array Capacity = 102KWp
- No. of Module/Unit = 340
- Manufacturer = TATA BP Solar India Ltd.

3) Battery Banks
- No. of Battery Banks = 4
- No. of Battery Cells = 480
- No. of Cells/Battery Bank = 120
- Capacity of Battery cells =1000Ah at C10
- Manufacturer = M/s Southern Battery Company

4) Charge Controller
- No. of Charge Controller = 4
- Capacity of each charge controller = 25KWp
- Manufacturer = M/s Pulse Power Co.

5) Inverters
- No. of Inverters = 4
- Capacity of each inverter = 25KWp
- Manufacturer = M/s Pulse Power Co.

6) AC Feeders Panels
- No. of Outgoing Panels = 4

Minimum and maximum load observed by the SPV power plant in 2005 and 2007

Solar Plant Parameter	Value	Units
Rated Capacity =	100	kW
Min. Load Observed		
in 2005 @ start of plant =	38	kW
in 2007 @ present =	39	kW
currently in Summer =	39	kW
currently in Winter =	42	kW
Max. Load Observed		
in 2005 @ start of plant =	42	kW
in 2007 @ present =	45	kW
currently in Summer =	43	kW
currently in Winter =	45	kW
Nos. of Battery Banks =	4	
Batteries in each Bank =	120	

Target group

For ensuring socio-economic development of the region there was a need to improve the energy situation. Providing the basic needs of lighting/electricity for other development activities, this ultimately ameliorates the standard of living of people of the area.

There has been an attempt by the State Govt. to meet the energy requirement by installing a 250kVa diesel generator at Tangtse which supplies electricity for 3-4 hours in the evenings. The DG set supplies power through a network of transmission lines extending over 19kms to the villages of Kargyam, Shachukul, Tharuk and Durbuk. The outlying villages specifically those around Pangong Lake comprise of Chushul, Maan, Merak, Lukung and Phobrang have been provided with solar home-lighting systems and solar lanterns.

Energy Generation Detail of 4x25KWp SPV Power Plant Tangtse w.e.f. 26/2/2005

S.No.	Month & Year	Unit 1 (Kwh)	Unit 2 (Kwh)	Unit 3 (Kwh)	Unit 4 (Kwh)	Total
1	March to May 2005	6122	4925	5822	5536	22405
2	June 2005	1536	1404	1347	1266	5553
3	July 2005	1413	759	990	1204	4366
4	August 2005	1140	1367	1230	1277	5014
5	September 2005	964	1394	1301	1295	4954
6	October 2005	1440	1694	1326	1450	5910
7	November 2005	1556	1737	1442	1543	6278
8	December 2005	1555	1842	1493	1565	6455
9	January 2006	1345	1608	1233	1355	5613
10	February 2006	1308	1450	1243	1202	5203
11	March 2006	1780	1867	1530	1679	6856
12	April 2006	1378	1503	1190	1305	5376
13	May 2006	1628	1667	1432	1568	6295
14	June 2006	1302	1612	1346	1433	5693
15	July 2006	1442	1598	1369	1375	5784
Cumulative generation up to 31/7/2006		25909	26494	24294	25053	101755 units.

SPV power plant has completely replaced the 250kVa Diesel Generator and it is now supplying electricity to 10 hamlets in the block using the same transmission lines.

- No. of hamlets covered = 10
- No. of domestic consumers = 379
- No. of commercial consumers = 29
- Total consumers = 408

Implementation methodology

1. The project was successfully conceived and implemented by LEDeG, with technical support from TATA BP Solar India Ltd.

2. It used a participatory, bottom-up approach since the conceptualization of the project. All the villagers were involved in the activities of the project, including operation and maintenance of the systems. The power plant is now run and maintained by the REDCO, a local institution formed under the project. The project demonstrates the efficacy of bottom-up approach in rural development. This is not only be of great value to the villagers in the implementation of the future activities but also to convince the officials at various levels i.e. block, sub-division, district etc. for using participatory approach in all such activities at the official level.

3. Meetings were held with villagers/beneficiaries at the time of project design documentation; it was headed by the Councillors, Sarpanchs and Naib Tehsildar. They welcomed the concept and expressed their consent to participate in the management process of the plant.

4. LAHDC and the District Administration played important roles in financing and supervision of the project. They were also actively involved in the proper execution of the project activities.

5. In addition, there was a high-powered project steering committee with the Chief Executive Councillor, LAHDC as Chairman and representative of MOEF, MNRE, ICEF and all members of Project Advisory Committee as members to take important policy decisions. The Committee met at least once every six months. The Executive Director of LEDeG and representative of TATA-BP were the joint conveners for the committee.

6. Order for design, manufacture, supply, erection, testing and commissioning of 4x25KWp stand alone SPV Power Plant was placed with M/s TATA BP Solar India Ltd, Bangalore with 10 years Comprehensive Maintenance Cost, amounting Rs.3.00lacs (Rs.3,00,000 per annum) on 22nd June 2004.

7. TATA BP completed the installation of the plant equipments in the month of December 2004 and started testing of individual 25KWp units.

8. On 26 of February 2005 the SPV Power Plant was test commissioned and supply of power was made to the grid area by replacing the 250 KVA DG set. Since then, power is being supplied to these 10 villages/hamlets of Durbuk block falling under the grid area without any breakdown.

9. As per advice of Shri S. P. Gonchaudary, Director WBREDA and Chairman JIB of MNRE, M/s TATA BP was asked to carry out the following tests: -
  a) Maximum bank voltage during charging condition
  b) Battery bank voltage under fully charged condition
  c) Maximum charging current under deep discharging condition
  d) Peak charging current
  e) Inverter voltage trip set point
  f) Inverter restarts voltage
  g) Output voltage and frequency of inverter

10. Solar Power Plant has been supplying uninterrupted power supply to the grid area w.e.f. 1st March 2005 and daily generation and supply of power has been recording.

11. Power transmission and utilization features in the region have been improved through the following measures:
  a) Replacing the higher rated Transformers on the H.T. lines (which were originally used with the 250 KVA DG set) by lower rated ones to minimize the core losses.
  b) 100W incandescent tubes and bulbs were replaced with 14W Compact Fluorescent Lamps (CFL)
  c) Correcting internal wiring, faulty holders, switches in many households

Financing

The total expenditure incurred in the 100kW SPV power plant was Rs.3.28 crores. However, the whole project budget including other activities and components was Rs.772,58,600/-

Contributing organization	Amount (in Rs.)
India Canada Environment Facility (ICEF)	348,48,100
Ministry of New and Renewable Energy (MNRE)*	177,90,000
Ladakh Autonomous Hill Development Council (LAHDC)	170,20,500
Ladakh Ecological Development Group (LEDeG)	19,00,000
Beneficiaries	57,00,000
Total	772,58,600

** MNRE was previously known as Ministry of Non-conventional Energy Sources (MNES)*

Results

1. The 100kWp SPV plant has totally replaced the 250kVa diesel generator. The DG set lies dysfunctional since the commissioning of the solar plant. It is supplying uninterrupted electricity to 10 hamlets, including 397 households and 29 commercial units. A total of 408 families receive electricity for 4 hours in the evenings.

2. Formation of Renewable Energy Development Cooperative Limited or REDCO. It is a local institution registered as a society, formed to take over the functions of managing the solar power plant from LEDeG after its formal commissioning in June 2006. It consists of 15 elected members (including Councillors of the Durbuk and Chushul constituencies) who take decisions regarding identification of beneficiaries and other project activities. REDCO is mainly responsible for:
- Operation and maintenance of the SPV power plant
- Decisions related to the functioning of the plant
- Timely collection of monthly electricity tariff from the consumers
- Ensuring supply of regular electricity to the consumers

3. Power transmission and utilization features in the region have been improved through following measures:
   a) Replacing the higher rated transformers on the High Tension (HT) lines (which were originally used with the 250KVa DG set) by lower rated ones to minimize the core losses.
   b) 100W incandescent tubes and bulbs were replaced with 14W Compact Fluorescent Lamps (CFL)
   c) Correcting internal wiring, faulty holders, switches in many households

Financial impacts

1. The SPV power plant at Tangtse has been functioning successfully since March 2005 and it is enabling the Power Development Department of government to save up to Rs.18,59,800 annually through diesel, transportation and Operation & Maintenance. That also includes costs of Engine Oil, Coolant and Operators' Salary and other miscellaneous expenses.

Average consumption of diesel:
48,000 litres per year
(= Rs.16,38,300 per year @ Rs.34 / liter)

Average maintenance cost: Rs.2,21,500 per year
Total: Rs.18,59,800 per year

2. Whereas, the cost of the SPV Plant, inclusive of cost of replacing the batteries after 5-6 years is Rs.3,60,00,000.

Environmental impacts

1. The plant will have no adverse environmental impact. By replacing the diesel station it will not only save nearly 48,000ltrs of diesel every year but also improve the status of environment by eliminating the harmful gases which the diesel station emits into the atmosphere.

Emission of pollutants from the use of high speed diesel (based on per year consumption of 48,000 liters / year)

No.	Gases	**Emissions** in tones/year
1	Carbon dioxide	126.06
2	Nitrous Oxide	2.76
3	Hydrocarbons	0.24
4	Sulfur Dioxide	0.14
5	Carbon Monoxide	3.90

Social impacts

1. Enhance quality of life and improve living conditions of the people.

2. By adopting a participatory approach in which women will take an equally important part, the project will strengthen the role of women in the socio economic activities of the area.

3. Photovoltaic will also enable the children to study for longer hours without spoiling the eye-sight.

4. Similarly women are able to engage themselves in the production of handicrafts with comfort and ease.

Sustainability

1. To uphold successful operation, maintenance and sustainability of the project a local institution called 'REDCO' is formed.

2. The project envisages a participating approach involving the villagers in all the activities of the project including operation and maintenance of the systems through Electricity User Committee, demonstrating the efficacy of bottom-up approach in rural development.

3. Capacity Building of REDCO and EMC through:
   a) Facilities for testing and repair by LEDeG at Leh
   b) Training and building up of Rural Technicians with assistance of LEDeG staff to install and maintain the systems.
   c) Setting up of the aforementioned 'REDCO' not only to monitor and maintain the systems but also to ensure prompt revenue collection and management.
   d) Build up the capacity for institutional and technical management for sustainable development primarily by building capabilities in Solar Energy operations and maintenance and financial management of the system in the medium term and conceptualize such projects in the long term sustainable development.

4. Savings accrued to power house consequent upon the stoppage of Diesel Generator and revenue collected from the consumers @Rs.50 per household over a period of 5 years i.e. Rs.9.95 million will not only help offset the recurring expenditure but also enable allocation of Rs.2.05 million to corpus fund for investing on replications and sustainable development.

Lessons learned

1. The systems which are sophisticated are difficult to handle.

2. Rely on external organization like TATA BP to rectify the technical problems and unprompted actions from them.

3. Invertors and batteries are more prone to errors.

4. Load becomes uncontrollable with the introduction of new appliances and technologies like TV, radio, computers.

5. Low voltage causes damage to CFL bulbs, which is not easily affordable for a common man. A price of a CFL bulb is Rs.120.

6. The main purpose of the plant is to provide the basic requirement of lighting. We have to constantly check the load or discharge. The uses of electrical appliances are discouraged and because of that it is also a huge constraint.

7. The villagers pay the same amount of tariff (Rs.50 per month) as earlier, when DG set was functional. The plant suffered only one day of breakdown since its commissioning in 2005.

Replicable

1. Smaller size SPV power units (upto 20kW) are highly successful and there is a high potential for replications.

2. There is a need to do a serious analysis of the existing SPV power plants before replication of bigger size units.

3. Otherwise, technically, solar photovoltaic technologies are highly feasible, viable and can be easily replicated. The success with solar home-lighting systems and SPV units were experienced by LEDeG over the years.

Discussions and outcomes

In the seminar, two main implementation models of decentralised rural electrification were presented. These are Public Private Partnership (PPP) and government sponsored schemes.

a) PPP market model is based on:

- Investment in infrastructure (e.g. charging stations) through private channels
- Investment in end use devices (e.g. solar lanterns) through grants from a public trust
- Operation and maintenance assumed by the private sector
- With a business model which leads consumers to pay for the service, but not the hardware

b) Government policy scheme is based on:

- Investment in infrastructure by the government or a donor agency
- Enhancing local capacity building through village appropriation and trainings

In both the models, developing local productive activity and small and medium enterprises for income generation is included.

Some NGOs model also include, in addition to the second model:

- End-users contribute in the project through cash and kind
- Village Electricity Committee manages the system once it is commissioned
- Monthly tariff is collected from the consumers to ensure sustainability.

Discussions have been centred on the advantages and disadvantages of the two models with three main questions to address. These are:

- Is it sustainable?
- Is it replicable?
- What kind of poverty are we dealing with?

All presentations and the survey pointed out the high positive impact of project management and governance:

- Involving households and consumers
- Creating Village Committee to manage the systems
- Involving all stakeholders in a win-win cooperation into the project
- Dealing with economic and cultural differences
- Finding the best way to use electricity

It has been finally highlighted that managing a DRE project involved 30% of technical issues and 70% of management issues. Operation and Maintenance is also a strategic issue to be addressed as well as rebound effect: how to deal with increasing needs of comfort and equipment when the power capacity is limited?

Mr. Andy Schroeter said at the end of his presentation that "In rural electrification, the most important part is to create a sustainable operational scheme and to make the service affordable to the end-users".

Climate change impacts and adaptation

Climate change is a reality today, and some of the best evidence comes from mountain areas. In the cold desert mountains of Asia, that encompasses a vast area from Central Asia to Hindu Kush Himalayas, impacts of global climate change have been increasingly visible. Since the last couple of decades serious changes pertaining to precipitation, water runoff, agriculture and extreme weather events are increasingly visible. These changes are brought about by various factors amongst which the main accelerating factor is climate change. The most prominent impact reported by most researchers and locals is the rapid reduction of glaciers. According to Dyurgerov and Meier 2005, Himalayan glaciers are receding faster than the world average. The IPCC fourth assessment report states that in the coming decades many glaciers in the region will retreat while small glaciers may disappear altogether.

Besides being the first to be impacted by climate change owing to the vulnerability of the ecosystems in this region, another challenge faced by the mountain people is the lack of adaptation possibilities to the changing situation. However, there is lack of knowledge on the short and long term implications of climate change on water (both surface and underground water), agriculture/horticulture, etc.

Therefore, the objectives of the two sessions on climate change impacts & adaptation was mainly for the following:

- To address and discuss these critical issues and concerns which on the global forum have been either neglected completely or not given much importance.
- And to seek solutions to overcome these gaps and shortcomings

Speakers

The first presentation was a joint one by Dr. S. N. Mishra (Meteorological Department, Leh) and Ms. Tundup Angmo - Climate Change Coordinator, Groupe Energies Renouvelables, Environnement et Solidarités (GERES), India on "Impacts of Climate Change in Ladakh, Lahaul & Spiti". The presented study on impact was a combination of the scientific analysis and perceptions of the people. There was a good consistency in the findings of temperature and precipitation; and people's perception on changes pertaining to the temperature and precipitation, compared to over 35 years back in Leh. However, data for other regions were not available.

Second presentation was on "Impact of Climate Change on Mountain Women's Livelihood & Workload & Challenges" by Ms. Yankila Sherpa. The focus here was that mountain women are most vulnerable (housework & livelihood activities) to climate change impacts, especially due to the increase in terms of the time spent and drudgery in collecting fuel wood & water. Few examples of initiatives taken by the mountain women of Nepal for mitigating impacts of climate change, especially in tourism, sector were given.

The third presentation "Building Community Resilience towards Climate Change Adaptation through Awareness & Education" by Ms. Rashmi Gangwar, CEE (India) stressed on the role of awareness raising and communication tools to reduce the carbon footprints of individuals. The awareness campaigns were mainly for children as they are able to influence adults and since they are the future generation who will be the future decision makers.

In the second working session, the first presentation was by Mr. Chewang Norphel (LNP, Leh) on "Artificial glacier high altitude water conservation technique": This is a simple, local specific technique to enable a community to adapt with the decreasing water availability due to glacier retreat and decreasing snowfall as a result of global warming. Besides providing additional water for irrigation the artificial glacier has other environmental (e.g. recharging underground water aquifers) and economical benefits; and has high potential for replication in similar geo-climatic regions.

The second presentation was on "Integrated approach for Climate Change Adaptation" by Mr. Gehendra Gurung (Practical Action), Nepal. He stressed that the erratic patterns of precipitation (proved by data) was causing more frequent disasters (flash floods, draughts, etc). Since most people are farmers it was important to provide alternative choices of new crop species and varieties accompanied by the effective water management, pest control, etc for adaptation. An effective water management is crucial as glaciers are retreating, springs are drying up and rainfall patterns are changing.

Mr. Jigmet Takpa presented "Climate Change Adaptation in Changthang". He presented some of the perceived impacts of climate change in Changthang first and then presented the Micro Level Planning (MLP) for each village in Changthang. This was done with active community participation in order to form a guiding document for village panchayat towards policy implementation in the future.

The last presentation was on "Pastoral Adaptation in Mongolia" by Ms. Anna Schulze (Robert Bosch Foundation), Germany. The focus of this presentation was on how the land policy and legislation were impacting the adaptation potentials of pastoralists. The crucial point was how the access to vast area of land is essential to enable pastoralist to carry out risk management strategies.

Impacts of climate change in Ladakh and Lahaul & Spiti of the western Himalayan region

Tundup ANGMO, S. N. MISHRA

Introduction

The cold desert regions of Ladakh and Lahaul & Spiti are an isolated, inhospitable terrain that lies in the western Himalayas sandwiched between Pakistan and China. The region typically has average weather conditions characterized by extreme seasonal temperatures ranging from +40 to -40 degree Celsius, meager annual rainfall (10-100mm) during summer season, high wind speed movement, heavy influx of ultraviolet and infrared radiations and low atmospheric pressure.

Over the last few years, impacts of global climate change have been increasingly visible in Ladakh and Lahaul & Spiti. Rainfall and snowfall patterns have been changing; small glaciers and permanent snow fields are melting affecting water runoff in the rivers/streams, and rise in temperature and humidity inducing favorable conditions for the invasion of insects and pest aggression.

The impacts of climate change are being felt most seriously in such extreme regions because on one hand they belong to the most vulnerable ecosystems and on the other hand, people living in these regions often lack the possibility to adapt to the changing conditions. Data obtained from the meteorological department (Air Force Station, Leh) clearly indicates that there is rising trend of min temp at Leh by nearly 1º C for all the winter months and nearly 0.5ºC for summer months in last 35 years. There is clear declining trend in precipitation from November to March i.e. reduction in snow fall.

Context

In this region small glaciers and snow melt water play a very important role in the sustenance of life as they are the only source of water, be it for irrigating the field or for any other domestic purpose. The most critical factors for extension of glaciers are extremely low temperatures complimented by heavy snowfall during peak winters which in the older days was favorable. However, over the past 35 years due to changing temperature and precipitation, small glaciers in the region are retreating at a much faster pace than imagined especially since the rising temperature trend is sharper in min temp of winter months and the declining trend in precipitation is sharper for the winter months. The winter precipitation is of utmost importance as 70% of the total precipitation (in the form of snowfall) over the entire year takes place in the winter months.

In the long run, glacial retreat translates into drying up of natural springs, streams; depletion of underground water hence decreased water availability challenging the very existence of the mountain people. Impact of climate change on water availability is already reported in various parts of the region. The main Indus River which runs through Ladakh has comparatively less water, in Spiti the main Kaza stream has completely dried up, four households in Langsa (Spiti) had to migrate permanently to Kaza due to water shortage problem, natural springs and streams in Kargil and Leh are having less water discharge.

Area of study

In Jammu & Kashmir two districts i.e. Leh and Kargil and in Himachal Pradesh the district of Lahaul & Spiti were covered.

Methodology

An amalgam of three approaches was used for assessing the impacts of climate change on the local livelihoods and environment in the cold regions of Ladakh and Lahaul & Spiti. These three approaches are:

a. Analysis of meteorological data (Temperature and Precipitation)
To ascertain whether a warming in this region was actually taking place, it was first considered a priority to get data on temperature for at least 30 years. Collaboration with Dr. S.N. Mishra, Head of the Meteorological Department of the Indian Air Force was made and monthly data for mean minimum and maximum, absolute minimum and maximum temperatures as well as monthly precipitation data could be analysed for the past 35 years for Leh town. Unfortunately meteorological data for other places of the four areas were not available.

b. Interviews with villagers and prominent persons (especially aged people)
An overview about observed changes in the different areas and villages compared to 20-30 years ago was then obtained. For this purpose field workers from several Ladakhi NGOs were asked to compile a list of villages within their working area where either

they themselves had perceived changes over the past years or where they had heard about changes in environment or livelihood that could be related to Climate Change. Interviews were then held with aged people from some of these villages. Additionally aged people in the headquarters of each area (Leh for Leh district, Kargil for Kargil district, Kaza for Spiti sub-division and Keylong for Lahaul sub-division) having a large store of knowledge with respect to changes over a longer period of time. These interviews with aged people were complemented with the information obtained from governmental officials (agriculture and horticulture department) and researchers such as from DIHAR (Defence Institute of High Altitude Research) and SKUAST (Sher-E-Kashmir University of Agriculture Science and Technology).

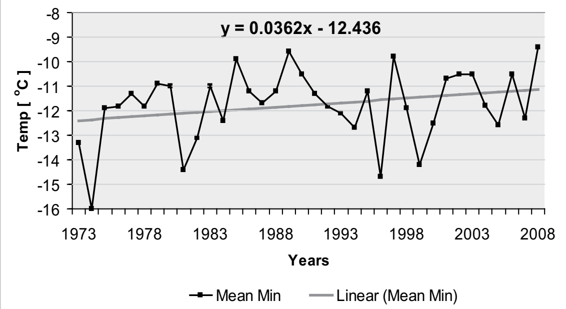
c. Broad survey about temperature and precipitation changes among 200 villagers older than 35 years

Questions related to changes in temperature and precipitation over the last 20-30 years was included in the climate change awareness baseline study. These questions were asked specifically to those villagers above 35 years of age and were conducted in all the three districts (i.e. Leh, Kargil, and Lahaul & Spiti) in a total of 30 villages. The aim of this approach was to obtain a clear picture with respect to changes in these two key parameters of Climate Change and to cover the whole area.

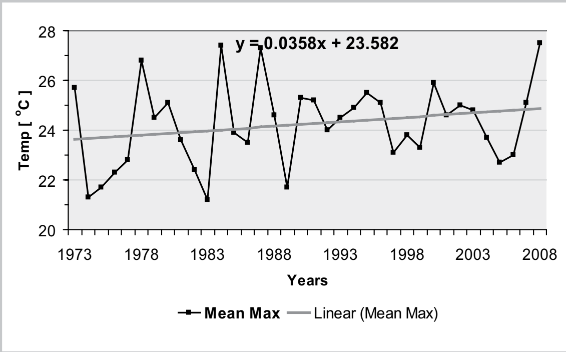
a. Analysis of meteorological data (temperature and precipitation)

To ascertain secular trends, mean Min temp for winter months and mean max temp for summer months from 1973 to 2008 for Leh airport have been analyzed. For peak winter months and peak summer months, mean max temp and mean min temp has also been analyzed. Trend analysis for precipitation data (1973-2008) for Leh has been carried out for all months to ascertain, if there is any significant change in precipitation data.

Mean Min Temp and trend: DEC (1973-20008)



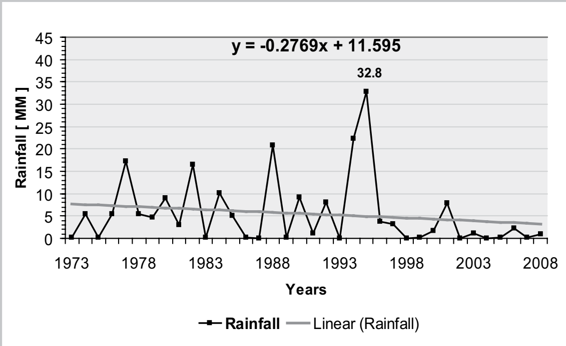
Mean Max Temp and trend: JUN (1973-20008)



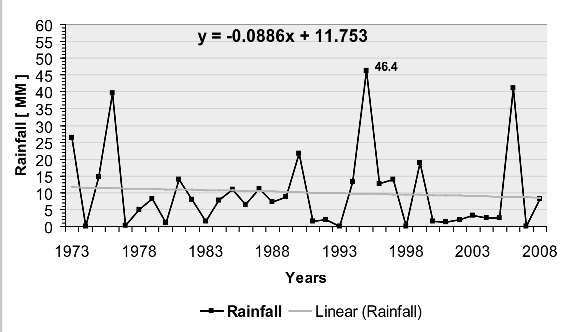
Summary of findings for temperature data analysis:

- The Max temp for summer months shows rising trend of nearly 0.5ºC in last 35 years.
- Analysis clearly indicates that there is rising trend of min temp at Leh and the rise is of the order of nearly 1º C for all the winter months
- Though, the rising trend is sharper in min temp of winter months.

Rainfall and trend: DEC (1973-20008)



Rainfall and trend: AUG (1973-20008)



Summary of findings for precipitation data analysis:

- There is clear declining trend in precipitation amount from Nov to March (reduction in snow fall).This is the season for 70% occurrence of precipitation over Ladakh and mostly in the form of snow.
- Jan trend is rising due to one extreme event of snowfall during Jan 2008.
- During summer season, no significant change noticed in precipitation amount as it accounts for 30% of annual precipitation and in the form of rain.

b. Findings/ Impacts of Climate Change:

A summary of the impacts perceived by villagers and experts from the development field is given below:

1. Temperature:
Most people interviewed in villages said that winter temperatures have been increasing (2008 being an exception) and that the duration of the cold period (winter) has been decreasing. Likewise, the warm period i.e. summer is getting longer; hot temperatures are perceived even in April. This was validated by the climatic data analysis for Leh and the baseline survey questions on changes in temperature conducted with people above 35 years of age.

2. Precipitation:
As per data obtained from meteorological department, Air force station, there is definitely less snowfall in winter than previously, but there is no significant change in summer precipitation (rainfall). This was validated by local people who said that rainfall in summer has become unpredictable sometimes (no rain at all and then very heavy rainfall) and untimely which is further harmful for agriculture and fruit trees.

3. Glacier extension:
Even though there is no long-time study on glaciers in Ladakh and Lahaul Spiti, people gave many examples of retreating glaciers like Gyung-Kangri, Stok-Kangri, Kang-Yangtze, glacier above Dhomkar, Hemis Shukpachan (in Leh), Kanamo glacier, Lhari Ghaman glacier (Spiti). Interviewees said that because of less snowfall, the glaciers were not being fed as much as before and warmer winter temperatures were further accelerating the speed of its melt.

4. Water availability:
Water availability is apparently one of the gravest / serious impacts of climate change in this Trans Himalayan region which is mainly dependent on glacier melt water for irrigation and domestic purposes. Most interviewees especially in Spiti and Lahaul reported less water availability either in the river/ streams or the natural springs that are fed by glaciers. Some examples are:

4.1. The main Spiti stream which separates the old Spiti town from the new town is completely dry. Earlier people could not cross it at all as there was water flowing throughout the year but now people use it as a shortcut/footpath to reach the other side.

4.2. Likewise Langsa, Kibber, Dimul which are the upper lying villages in Spiti faced critical problems with water supply in 2004-2005.All the natural springs had dried up and there was not even sufficient water for drinking. As a result 4-5 Khangbu (younger brother's) households in Langsa had disbanded everything and migrated to Spiti.

4.3. In Zanskar, the entire village of Shum Shadey has migrated to Chumik-Gyatsa (which means literally mean "land of hundred natural springs") as the glacier that fed the village completely melted.

However, in some villages in Leh and Kargil it is unclear as within the same village, some say that there is more water; others say that there is less water. Many other factors could influence this, such as cultivated area as compared to past years, increased water consumption due to higher living standards, introduction of water intensive crops, etc.

5. Agriculture/Horticulture:
Again many factors other than Climate Change can influence this and some people interviewed were also aware of this: gain of knowledge, other varieties of seeds, use of fertilizers, changes in water availability, changes in varieties due to rise of market possibilities (military, tourism).

An interesting point could be changes in flowering and maturing of apricot trees, since they are less influenced by the above mentioned other factors. All respondents in the four regions mentioned that apple cultivation has shifted to a higher altitude. Earlier apple was found only in lower regions (Kullu in H.P and Sham in Ladakh) at an altitude of 9,000 feet but now it is found at a height of 12,000 feet. Another point is the appearance of pests and insects on plants, something that has not happened before. Changes in the time when they start seeding barley/wheat are difficult to establish, since most farmers rely on the traditional calendar to decide when to start.

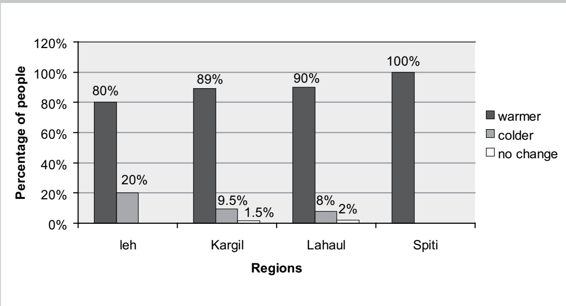
6. Wildlife:
Some changes in migration patterns of birds have been noticed in villages and also at Tsomoriri (as reported by WWF and wildlife warden). The number of black necked cranes around Tsomoriri lake have increased; this could be because of warmer conditions plus other factors such as increased participation of the community in its preservation. However, some other migratory birds like the geese, Brahmini duck have stopped migrating outside; they are found in this region throughout the year.

7. Others:
Chadar trek is getting shorter (Jan-Feb. instead of Dec. to March) and Tsokar Lake starts melting beginning of March instead of middle of April which makes it difficult for the nomads to cross it with their cattle. Likewise, the Tsomoriri and Pangong Lake are rising due to increased melting of glaciers and this is evident from the fact that the roads close to it are completely submerged under water.

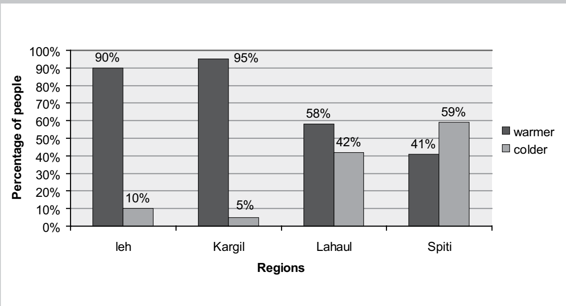
c. Baseline Report Findings:

Total 30 villages in four regions (Leh, Kargil, and Lahaul & Spiti) were covered under the baseline survey and these interviews were conducted with 211 people above 35 years. Given below is the graphic representation of the findings.

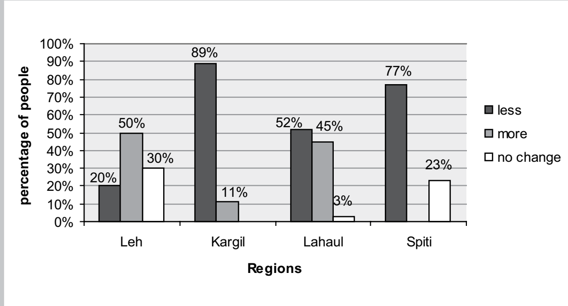
Changes in Summer temperature



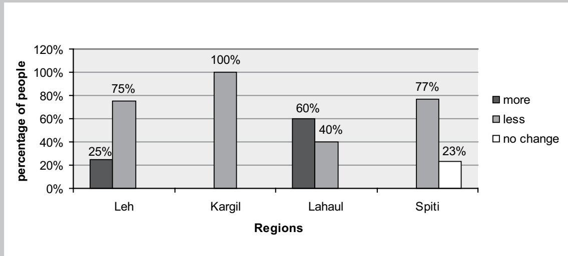
Changes in Winter temperature



Changes in rainfall



Changes in snowfall



Baseline findings:

- There is consistency between the climatic data and the findings of the baseline survey (for Leh).
- In all regions, more than 80% respondents felt summers were getting warmer.
- In Leh and Kargil more than 90% felt that winters were getting warmer and in Lahaul & Spiti the perceptions varied.
- The response for snowfall patterns was similar for all regions i.e. 60-100% agreed that snowfall was decreasing.
- However regarding rainfall, the perceptions varied. Except for Leh, all other regions felt rainfall was decreasing.

Limitations of the Study:
So far there is no scientific work /research done on glacier retreat/extension in this region which needs to be done urgently or the role of changing climate on various aspects of agriculture or horticulture.

Impact of climate change on mountain women's livelihood & challenges regarding energy access

Yankila SHERPA

Introduction

Climate change is not neutral. Although it affects everyone, the intensity of its effect differs according to the vulnerability and coping abilities of the people affected. Climate change impacts both men and women, but differently, thus magnifying inequality. Due to climatic and geographic conditions, men and women in Nepal's Himalayan mountain belt work long hours, but women work longer hours than their male counterparts. In many mountain areas like Mustang of west Nepal and the mountain villages of Olangchung area in the Kanchenjunga region of east Nepal, men mostly work on livestock grazing and trading, whereas women work on energy and natural resource management besides local crafts as an additional source of income. The impact of climate change is especially significant on the lives of mountain women. Thus, a correct assessment of the impact or recommendation would first require an analysis of the livelihood activities of mountain women and its relation to the external environment. This paper will attempt to provide a closer analysis of climate change's impact on women's livelihood.
This paper will attempt not just to highlight a correlation between hardship of mountain women and climate change, but more importantly a direct causal link between the degradation of women's livelihood and climate change.

Rangeland, ecological degradation and increasing work hours

Mountain people are perennially in contact with external nature, and nature affects living patterns and livelihood. Activities such as animal husbandry and local crafts like weaving of carpets, blankets and textiles used for their own clothing and traded via the trans Himalayan border with the Tibet Autonomous Region, are still prevalent today in these mountain regions of Nepal. A great deal of their livelihood activities are thus dependant on the rearing and raising of livestock animals, mainly yaks, zoms (cross breed of yak and cows), sheep and goats; and the raising of these animals is directly affected by climate change. The yaks and zoms are most useful as means of transportation for trading and for wool from their fur they produce besides the obvious milk for yak butter, cheese and yak meat, which is also a staple food of the people of these areas. For example, in the Olangchung area young yaks are raised for export to Tibet, which is a major source of income for the mountain people. These yaks and zoms depend on rangeland for fodder.

Due to climatic and geographic conditions, men and women in Upper Mustang, of which 40% is rangeland, have to work long hours. Furthermore, around 60% of the land area in the Greater Himalayan region is rangelands which are threatened by degradation and desertification (Sherpa 2007). Rangelands are defined as those areas of the earth which, due to physical limitations, such as low and erratic precipitation, rough topography or cold temperatures, are unsuited for cultivated agriculture and are a source of forage for wild and domestic animals of the mountain region (Miller 1998). Due to climate change and global warming the snowline in these mountain regions are moving increasingly northward, resulting in the depletion of rangelands and thus creating scarcity of fodder. As the animals have to be moved higher and higher for grazing, this is directly affecting the lives of mountain women: they face shortage of cow dung, the main source of energy, which is also becoming scarce. Ultimately, because of the scarcity of their main source of fuel, people have to resort to chopping firewood from the forests, which lead to further ecological degradation and unsustainable management of rangeland resources, thus adversely affecting the environment of the rangeland areas. Moreover, the shortage of food supply for livestock also leads to malnutrition and ultimate degradation of livestock resulting in decline in commercial activities and thus shortage of food supply for the people themselves, such as yak butter, cheese, meat and wool.

Further impacts of climate change on women workload

Another important resource affected by climate change is water. Access to safe drinking water is a big issue in Nepal's Himalayas, especially in regions like the Everest region, Mustang, Dolpa, Langtang and the Kanchenjunga region. Women in most villages still carry water in jerry cans of 35 litres from nearby rivers every day. This is a physically laborious and time consuming task. Even though most villages have community drinking water taps, they dry up during winter season.
And, with the changing environment, unpredictable weather changes have caused mountain people, especially the women, to become the worst victims of

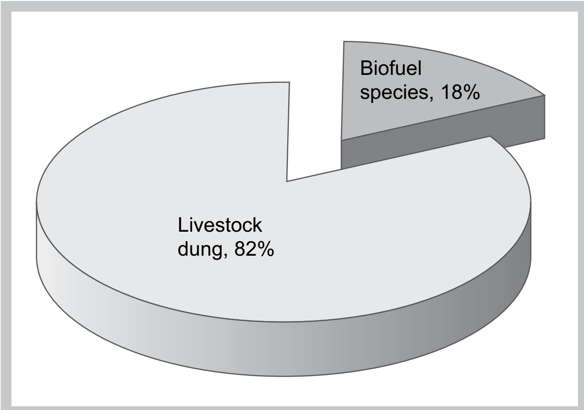
global warming, due to lack of preparedness and vulnerability: since global warming is drying up rivers, women have to travel even further to fetch their everyday necessity, water.
Besides river systems, climate change has also caused a depletion of forest resources, introduction of cash crops and increased male labour migration, which have affected women adversely by increasing their workload in rural Nepal. It is evident that women's workload will increase, since it is the women who carry the water, plant and water the seeds, tend the vegetable gardens, take care of the livestock, feed and milk the cows, and look after the households. This culture of division of work also affects girls' education since they will be more likely to be pulled out first from school to assist the mothers with household chores.

Institutional gender discrimination

Besides the above mentioned infrastructural constraints that adversely impact lives of mountain women, these women face even further hardship resulting from discriminatory social and political practices: women in the mountains are double marginalized firstly as women and then as mountain women; they experience unequal treatment based on traditional gender relationships that deprives them from equal access to health, education, property and wellbeing. In Nepal, women consistently face hardships, due to lack of access to market, education, exposure, information and communication, contributing to

Energy demand/supply and women's workload

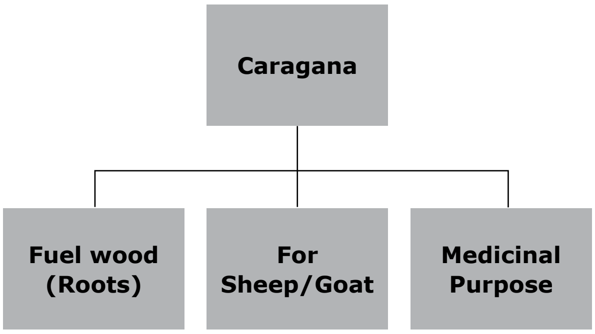
Climate change has an adverse affect on one of the central issues that determine the quality of life among mountain people: the accessibility to fuel resources, for accessibility to fuel determines both the people's quality of living and their livelihood. With changes in climate, fuel energy is becoming scarce, resulting in a direct increase in women's workload. For instance, women of Upper Mustang and Olangchung area work for nearly 17 hours on average compared to men's 10.5 hours a day. Similarly, women walk for long hours (5-6 hours a day in summers and 10-12 hours a day in winters) to high rangeland areas to collect fuel energy like bio fuels and livestock dung for cooking and heating purpose. Although the most time consuming activity is fuel energy collection and traditional methods of craft making, they do not fetch the income commensurate with the amount of work the women put into them. Fuel energy collection amounts to 30.33% of women's work time. Due to lack of alternative fuel, women have to depend on livestock dung and fuel wood. Most of the women's work is difficult and physically laborious, which they have to undertake without sophisticated tools and technologies.
The above paragraph is further validated by a case study undertaken by Dechen Sherpa in Upper Mustang. She states that the Upper Mustang has an energy demand of 3.1 kg per person per day, totaling up to 6,123.6 metric ton per year. There is high demand for energy mainly for cooking and heating purpose, mainly because of its cold weather and tourism activities, which is met by very scarce natural resource, now affected by the fast changing weather patterns. Only 18% of this energy demand is met by bio fuels like caragana, remaining being met by livestock dung. However, livestock dung is needed for many purposes, viz. fuel, agriculture productivity and pasture cultivation. If the livestock dung is used for fuel energy, there is less manure left for agriculture, and even lesser for pasture regeneration (Sherpa, 2009). Moreover, as mentioned in the preceding paragraph, rangeland degradation itself has caused a shortage of livestock dung and depletion of livestock resulting in greater pressure on energy needs, decline in commercial activities and decline in the food supply. Energy issue has deeper impacts on women's everyday life.



Adaptation strategy to climate change is to explore new alternative energy that can reduce pressure on natural resources, and at the same time increase efficiency. However, this has to be done considering the different energy needs of men and women, relating to distribution of, and power over, energy services.

Energy confict

Dechen Sherpa's study also highlights the conflict between livestock production and energy demand that threatens women's livelihood. Caragana is women's most preferred bio fuel as its roots serve as firewood since it ignites easily and burns well. But the practice of continuous uprooting of Caragana from underground ultimately puts pressure on its sustainability and its regeneration ability. With the increasing demand for energy, caragana is being uprooted at a high rate, leaving little for grazing purpose for sheep and goats. This has posed threat to livestock rearing. Moreover, Caragana, due to its medicinal characteristics, is highly demanded by the traditional doctors as well. Thus there is a vicious cycle of conflict between livestock production and energy demand (Sherpa, 2009).



Tools and technologies

Here the issue is not about whether men and women work or not. It is about "Who works how much with what kind of tools and technologies?" The difference in men's and women's work is widened by women's lack of access to tools and technologies. Where men demand for walls, women demand for threshing machines, where men demand for irrigation, women demand for private water pipes for drinking, where men demand for electricity, women demand for electrical appliance. There are differences in the demands of men and women that are generally neglected. In case of trainings, men demand for exposure visits, whereas women demand for in-village trainings, where men demand for training in farming, women demand for training in weaving and knitting.

Conclusion

Adaptation strategy to climate change is to explore new alternative energies that can reduce pressure on natural resources, and at the same time increase efficiency. However, this has to be done considering the different energy needs of men and women, relating to distribution of, and power over, energy services. Alternative energy like micro hydro electricity, solar energy, wind energy, LPG gas or improved cooking stoves which require lesser fuel wood, have to be explored and promoted, to meet the increasing energy demand with limited supply in the unpredictable weather conditions and changing climate. Adaptation strategies have to be explored taking into account local knowledge and tradition.

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Building community resilience towards climate change adaptation through awareness & education

Rashmi GANGWAR

"Himalayan glaciers could shrink from the present 500,000 square kilometres (193,051 sq miles) to 100,000 square kilometres (38,610 sq miles) by the 2030s" says report released by Intergovernmental Panel on Climate Change (IPCC) on February 2007. The report also confirmed with a 90 per cent certainty that the global warming caused by human behaviour is responsible for the climate change affecting the ice reserves around the planet. Glaciers in the Himalayas are the headwaters for Asia's nine largest rivers providing water for one-sixth of humanity which now are exposed to climate change threat.

As known, rampant burning of fossil fuels and some other anthropogenic activities have been identified for the production of greenhouse gases (GHGs) creating a green house effect that is believed to be responsible for unpredicted weather conditions or the climate change. GHGs emission patterns have been analyzed and known globally drawing attention of not only the scientific community but have warned action at governance and policy level as well. Thanks to the exhaustive research that has given humanity an opportunity to buy some time to prepare and strategize adaptation and mitigation measures to cope up with the climate change threat. Adaptation refers to the measure taken to minimize the adverse impacts of climate change for example, crop improvement to ensure food security; water management to avoid droughts; improved health support system; better forest cover to contain GHGs; clean energy and energy efficiency to minimise the fossil fuel use.

Per capita energy consumption in India is less than one third of the global average. People living in harmony with nature since thousands of years in the Himalaya have actually negligible contribution to the GHGs that are considered to be the main culprit for climate change but the resultant glacial retreat is expected to affect these people first. The depletion of glaciers will not only result in water shortage but glacial lakes outburst floods (GLOFs) is another potential threat that may affect the well being as well as the livelihoods of the mountain people. There is an emerging concern about the climate change refugees in the developed world which may change the demographic profile of the world. Mountain and coastal communities are at highest risk to fall in the category of these refugees.

Mitigating climate change requires a multifaceted approach, involving all areas of policy and decision making. Comprehensive national development strategies are a key tool for mitigating climate change and the integration of climate change impacts into development programmes through each sector is crucial to combat climate change. There exists a clear recognition that development and adaptation as well as mitigation efforts must be complementary.

Most of the countries in Asia being more vulnerable to climate change threats are taking concrete measures to combat the climate change impact. Government of India has come up with a National Action Plan on Climate Change (NAPCC) in 2008 comprising of 8 national missions. It reflects on the priorities of GOI that 'Sustaining the Himalayan Ecosystems' has been identified as one of the eight missions. NAPCC gives adequate importance to knowledge dissemination through education and awareness. Building public awareness through curriculum reforms, civil society involvement and media engagement has been considered vital in supporting and implementating the NAPCC.

Local wisdom is not adequate to help communities cope with the unpredictability of agriculture due to the effects of climate change. No education prepares our community on how to cope with future change, yet. It's important to inform the farmers who used frog noises and the flight patterns of birds and the songs of frogs for the timing of rice planting to understand early warning systems and plan their crops accordingly. Environmental education and awareness is significantly important locally and globally in helping the communities particularly from most fragile ecosystems like the mountain and coastal areas. Effective dissemination of information and raising public awareness about the cause and effects of climate change will lead to informed action by individuals which are the key approach to tackle this challenge.

United Nations identifying education as pivotal driver for addressing climate change challenge maintains that educated population aware of the challenges of sustainable development and climate change can successfully respond to these challenges. UN Decade of Education for Sustainable Development (DESD) 2005 – 2014 includes climate change and potential local threats as thematic priority. UNESCO responsible for implementing DESD has focus on mobilizing all sectors of society and available expertise both formal and non-formal education to bring in values and behavioural/attitudinal changes that minimize negative climate impacts through climate change education.

India recognizes education for sustainable development (ESD) as a major driver of change and its commitment to sustainable development is reflected in its policy and programmes. Ministry of Human Resource Development (MHRD) is the National Focal Point for ESD in India and Centre for Environment Education (CEE) has been appointed by the MHRD as the National Implementing Agency for ESD in India. CEE is responsible for preparing the National Action Plan for DESD. The key thrust areas identified for DESD in India include:

- Developing public understanding and awareness
- Improving access to basic quality education
- Reorienting existing education programmes
- Providing training

Climate change education is cross cutting through out the ESD initiatives addressing issues like sustainable energy production; use of renewable energy sources; management of water and other natural resources, agriculture, health, forests and biodiversity to build community resilience towards climate change impact.

As energy demand continues to grow, the ability to address energy issues, including energy access, efficiency, renewable, low carbon technologies and security, is crucial. Advances in energy efficiency offer the quickest, most affordable and most sustainable means of reducing emissions. Renewable sources of energy offer a win-win solution by increasing access to energy whilst reducing air pollution and mitigating climate change. Solar energy has great potential in the Himalayan region where sunshine is available in plenty for long hours in high intensity. Another potential renewable option is micro-hydle power generation to meet the local requirements. India has over 7,000 MW of wind energy capacity – the fourth largest in the world. Informed choices can help people adapt better to climate change impact whether it may be the energy & water requirements or the food security through appropriate agricultural options.

CEE is working with an integrated multi-sectoral approach for climate change education at different levels. Climate change education is cross cutting through the thrust areas of CEE and its programmes. CEE is addressing a range of target groups through different programmes. To name a few as follows:

Climate change focus in higher education

CEE partnered with Gujrat University, Ahmedabad to set up the Management Education Centre on Climate Change which is to offer short and long term courses on climate change. A 3-day programme on "Understanding Climate Change" was organised by CEE from 31st January 2009 to 2nd February 2009 which included a public lecture by Dr Tim Flannery (Vikram Sarabhai Memorial Lecture Series) and film screening of Al Gore's "An Inconvenient Truth" at Gujarat University.

Through a joint programme of Jawaharlal Nehru Port Trust (JNPT), Bombay University & CEE integrated climate change mitigation and adaptation plan is being developed and implemented at Jawaharlal Nehru Port.

School education and climate change

CEE develops, coordinates and conducts a number of educational programmes for school children, in both formal and non-formal streams of education. To this end, on the one hand, it trains teachers, develops materials for EE, and assists other groups in developing such materials. On the other hand, it endeavors to bring a hands-on, field-based dimension to school education through opportunities offered by governmental and non-governmental initiatives such as the National Green Corps, eco-clubs, camping, education in and around Protected Areas, etc. The Centre is implementing disaster preparedness and awareness campaign in five districts of Kashmir valley through above 2000 schools. Teachers training and orientation on climate change education is an integral component of this programme.

2000 rural students get climate change education

An interactive presentation on Climate Change was one of the highlights of the five-day event for rural students on the theme "Science in Everyday Life" in Bhavnagar district, Gujarat. Mr. Kartikeya Sarabhai, Director CEE interacted with over 2000 students from 20 Post Basic Schools, weaving in the science of Climate Change with real life examples, as well as linking it with their textbooks. Post Basic Schools are rural residential schools based on Gandhian Principles and managed by NGOs. The presentation emphasised how climate change was closely connected with developmental & lifestyle choices.

Campaign

With support from Ministry of Environment and Forests, CEE initiated a countrywide campaign 'Pick the Right' aimed at creating awareness about climate change and adaptation through the right choices of resource utilization. Honorable President of India launched this campaign on 5th June, the World Environment Day 2008. Picking right, making the right choices, can make positive contribution to the future of planet Earth. Individuals, communities, companies and all policy makers need to choose alternatives and good practices that promote energy efficiency, conservation and sustainable consumption.

This campaign has two components:

1. CO2: Pick Right Campaign aimed at 2 lakh schools with the objective of generating awareness on Climate Change. Pick Right package developed in 15 Languages including Hindi and English is comprised of a booklet containing information about right choices one can make to reduce the impact of climate change; 2 posters; 2 stickers; one pick right stencil and a postcard for voting.

2. Second component is "Kaun Banega Bharat ka Paryavaran Ambassador" for electing an Environment Ambassador of India. The person thus elected can be an actor, sportsperson, political or local leader or any one who is perceived to be an able representative. S/he will be a concerned citizen and a role model who would help focus public attention for achieving the mission of sustainability and promote the cause of environment.

The campaigns aim at involving as many students as possible in electing their Paryavaran Ambassador (PA), initiate educational conservation activities as the schools level, having at least one active school cluster in every district of India which will demonstrate the scope of environmental education through formal, non-formal and extracurricular programmes.

With the slogan "Choices can make a Difference" the campaign advocates for small actions that contribute directly or indirectly towards climate change mitigation. These include:

• Save Trees, Plan Trees: each one of us can be an Ashoka! – A tree not only provides beauty, shade and food, but also acts as lifetime sink of carbon dioxide.

• Use Resources Wisely: generations have been doing! – Do not waste, Save energy, Save fuel, Save water, Save Paper

• Bus, Bicycle, Walk: make it a habit! – Fewer Cars on the roads lesser carbon dioxide in the air

• Be Energy Efficient: save some for tomorrow! - Say yes to CFLs, Pressure cook, save cooking fuel, use solar devices, service your vehicle regularly, check pressure, enjoy natural light and ventilation.

• Recycle Reuse Reduce: it's not new to us! – Refill, Renew, Recover rather than throw, discard of dispose off

• Buy in Season and Local Foods: that's the Indian way! – Tinned preserved and imported foods need more fuel inputs, which means a bigger carbon foot print

• Switch Off when not around! – Do not leave electrical gadgets on. Do not keep TVs, computers, music systems in standby mode. Save electricity, save money, care for the environment

• Conserve Water: every drop counts! – Never waste water, reuse where possible, do not dump hazardous substances in to water bodies, harvest rain water

• No to Plastic Bags Yes to cloth Bag: carry one always! – Plastic do not degrade easily, they clog drains, are threat to animals, release toxic substances on burning

Being implemented through schools the campaign is to address 2 lakh schools in India and is also expected to indirectly involve the community through students and teachers.

NGO projects through SGP programme of UNDP

CEE is the Nodal Host Institution for UNDP's Small Grant Programme (SGP) under Global Environment Facility (GEF) initiative. NGOs are supported for small scale projects under five thematic areas of which climate change is one. Projects that focus on removing cultural, institutional, technical and economic barriers to energy conservation and energy efficiency and promotion/adoption of renewable energy are being supported through out the country. Projects on eco-sustainable agriculture, livelihoods and renewable energy are being supported in the Himalayan region for example:

"Promotion of Community led Approaches towards Non-Conventional Energy and Management of Land Resources to Reduce GHG Emissions and Desertification/ Deforestation in the Kumaon Himalayas"

“Design and Implementation of Renewable Energy Villages in Papumpare District, Arunachal Pradesh”

Further details at www.sgpindia.org

All these education and awareness programmes are being implemented in partnership with government departments; educational institutions, NGOs and community. The overall objective is awareness and education with a locale specific perspective catering to the local environmental needs. The education programmes are innovative in the sense that these ensure participatory and activity based learning to have a real impact.

Environmental education (EE) is mandatory in India by the directive of Honorable Supreme Court. EE always has been seen in the development context in country and therefore is better addressed as ESD which brings about a shift from teaching to learning and has economical, social, environmental and cultural dimensions. CEE’s efforts are in the direction of strengthening ESD in the country though building synergies between Government, NGOs and CEE for a comprehensive impact. CEE is supported by the Ministry of Environment and Forests, GOI as a Centre of Excellence in the field of environment education. In addition, there are number of projects supported by national and international agencies being implemented by the Centre.

Over the years CEE and its programmes have created a niche in the field of EE and ESD. CEE is recognized nationally and internationally for its interventions. CEE is the first institution in country to work on environmental education and has played an important role in getting ESD recognized as integral component of conservation initiatives. No conservation effort can succeed without adequate awareness and education. To meet the challenge of climate change, educational strategies would be necessary to address all the stake holders including the community, schools and Institutions of higher learning, decision makers, industry and private sectors and so on. ESD can be implemented in local specific and relevant manner by creating awareness and providing relevant information, capacity building in terms of skills, orientation towards sustainability thinking and practice, developing a variety of ideas to promote sustainability. Through education, understanding and capacities can be built to help the citizens take informed decisions. Climate change education is already infused into most of the programmes of CEE.

Artificial glaciers: a high altitude cold desert water conservation technique

Chewang NORPHEL

Context

Since times immemorial, the melting water from the glaciers has been the only source of irrigation for 80 percent of villagers in Ladakh. About three or four decades back this Himalayan region used to receive snowfall twice as much as it receives now with much lower winter temperatures which created the right conditions for glacial formation and increase. However, in recent times Ladakhis have observed decreased and untimely snowfall, retreating glaciers in almost every part of the region. This is due to changing climatic conditions (decreasing precipitation and increasing winter temperature). The retreating glaciers are having an impact on almost every aspect be it for irrigation purpose, domestic, ecological purpose, etc and poses one of the main challenges as the very existence of the Ladakhis is dependent on glaciers.

Besides, due to the short summer season they cultivate only one crop per year which needs to be sown in the crucial month of April or May. If it is not sown at this time the crop cannot fully mature, resulting in low yielding crops. However, at that time of the year there is not sufficient water in the streams as the natural glaciers are located at a higher altitude and further from the village and this start to melt only in the month of June which is too late for sowing.

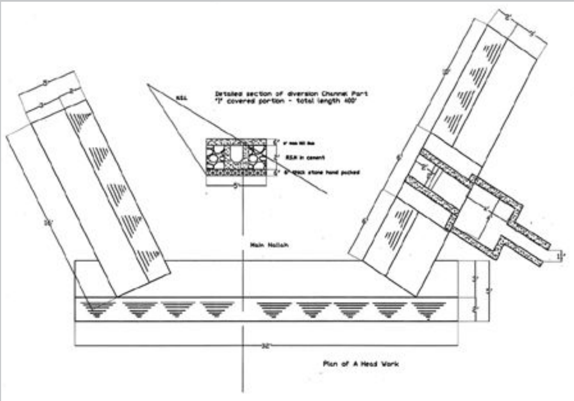
Keeping the above facts and requirements in mind, locals had devised a unique system of water harvesting/conservation technique to augment water supply for irrigation. The system of "Artificial Glaciers" which is an intricate network of water channels and dams along the upper slope of a valley was revived and innovated. The artificial glaciers have been innovated and located as close as possible to the village and at lower altitude than natural ones so that it starts to melt much earlier as compared to a natural glacier i.e. in the month of April –May so as to supplement with additional irrigation water and for a host of other purposes which is mentioned more specifically under the section of impacts.

Activity – technology

Some of the salient features pertaining to this technology are:

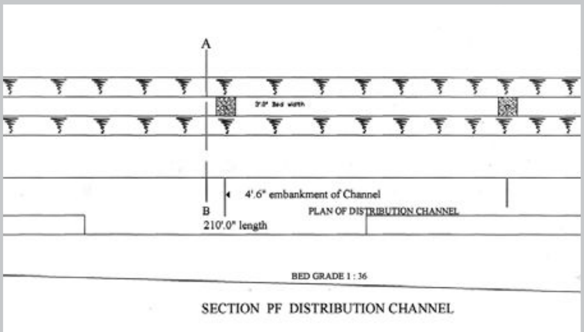
1. The design for head work of diversion channel needs to be done in such a way that in the lean period i.e. in the month of November (when the discharge of the nalla reduces to the minimum level) it can enter the diversion channel simply by opening the head regulator gate, without blocking the main stream as shown in the Figure 2. Like wise, in summer season when the velocity of the water in the stream is at its highest the head regulator gate should be kept closed so that the diversion channel as well as other structures may not get damaged.

Diagram 1: Plan of head work



2. The bed grade of the diversion channel should be steep enough as compared to normal canal's bed grade. Through this arrangement the water does not block by freezing. First the water enters into the silting tank and after the silt settles down, the clean water will flow into the distribution chambers. In the distributing chamber 1.5 diameter G pipes have been installed at an interval of 5 ft so that a smooth distribution of water can be obtained. As soon as the water comes out from the pipe it starts to freeze. The number of pipes is dependent on the total volume of water available for the particular stream.

Diagram 2: Distribution channel



3. Since the terrain in Ladakh is undulated and uneven, it is not possible to calculate the amount of water using the usual formula. The ice retaining bunds, stone masonry dry in the crate wire in the depression area are needed to be constructed. The melting water from the ice easily passes through the pores of the dry walls without destroying/damaging the structure.

4. As far as possible, it is essential to ensure that the water flows in small quantity with less velocity by spreading it over the entire area of the artificial glaciers, so that it freezes instantly. If the water flows in one place, the volume and velocity of the water can be increased by forming bunds. On the other hand the terrain being very steep, the velocity of the water tends to be very high with the result that instead of forming ice, it destroys the already formed ice. As such, regular monitoring of the water velocity/formation of the ice is required.

Picture 1: Artificial glacier in Sakti village

Target group

Since the artificial glaciers are constructed close to the village, its benefits are equally distributed amongst all the villagers. Hence, the entire population of a village located close to an artificial glacier is the target group of this intervention. The community on the other hand contributes towards the maintenance of the artificial glaciers and monitoring.

Implementation methodology

Prior to the construction of the artificial glaciers, a lot of preliminary work in a step wise, systematic manner is done pertaining to:

(I) Community mobilization and participation
Since the village communities are the main stakeholders and know the area and its dynamics thoroughly, the first step is to mobilize them and to hold intensive discussions with them regarding:
1. Water availability in the stream during peak winter time.
2. Presence of shady area along the course of stream
3. Timing of sunrise and sunset
4. Village history regarding water availability

Apart from the discussions, the villagers are oriented about the innovated technique of artificial glaciers and a comprehensive irrigation management system is developed.

(II)Technical aspects
Under the technical requirement, priority is given to various aspects such as direction of the village, water availability in the stream during peak winters, location, etc.
1. Orientation of the village
All villages where artificial glaciers will be constructed should be south facing villages (on the south of the Indus River) so as to ensure proper formation during winters and its timely melting during the spring season. E.g. Saboo, Igoo, Sakti, etc.

2. Location/proximity to the village
The location of the artificial glacier must be as close as possible to the village so that the artificial glacier melts quicker as compared to the natural glacier and reaches the adjoining village at the crucial time i.e. sowing period in April/May.

Financing

Till date the Government Watershed Department and the Sadbhavana, the philanthropic wing of the Indian army have been financing the artificial glacier projects in Ladakh.

Impacts of artificial glaciers

The project on artificial glaciers has been operating in the region since the last four years and farmers in particular have given some positive feedback regarding its impacts. These can be classified into three:

Economical benefits

1. By providing timely and adequate irrigation water to the barley and wheat fields and some other cash crops, there is overall rise in agricultural productivity which contributes to increased cash income for farmers. (P.S. the estimates on barley can be shown here). See annex.

2. Besides, because of the availability of water at early spring time, farmers are able to harvest two crops in a year as compared to traditional single harvest per year. This double harvest again enables farmers to generate additional income, e.g. Alfalfa.

3. Due to the additional water made available by the artificial glaciers, villagers are able to increase the number of tree plantations. Trees are a major source of income as the twigs/branches and the main trunk is mainly used in constructing houses (roof and wood floor) as building material.

4. Increased availability of water also leads to pasture development in the village, creating conducive conditions for cattle rearing, hence an additional source of income from dairy products like milk, curd, etc.

Environmental benefits

The artificial glaciers have a range of benefits which directly impact the environment in a positive manner. These include:

1. Channels that are diverted in the shady area to slow down the water, helps to reduce the surface runoff thereby recharging underground aquifers and increasing the underground water table. Water discharge from natural springs (locally known as 'chumiks') has increased as a result of the increased water table.

2. Because of the artificial glaciers, the total agricultural land holdings have significantly increased thereby extending the green belt cover.

3. The simple technique of artificial glaciers also contributes in soil moisture conservation and humidity which is responsible for creating conducive conditions for plantations and promoting vegetative growth.

4. An increase in cattle population leads to increased use of animal dung as manure in agricultural fields rather than chemical fertilizers.

5. Restoring ecological balance by harnessing, conserving and developing natural resources i.e. land, water and vegetative growth.

Social impacts

1. Ladakh is essentially a peaceful region where different communities co-exist in spite of different religions, caste, etc. However, traditionally and even today, one main source of dispute arises from use and distribution of water resource which is the most scarce and valuable natural resource. One evident impact of the artificial glaciers on the social life can be perceived in the form of reduced water disputes amongst neighbors and families because of the additional water generated by the artificial glaciers.

2. Increased confidence and interest in farming activities thereby resulting in decreased migration of villagers to urban areas for seeking new employment opportunities.

Lessons learned

In the past four-five years some of the lessons learnt were:

1. During the crucial period of construction/formation of artificial glaciers i.e. November-February, it is extremely difficult to find and retain labourers either for construction or maintenance as the temperature goes below zero degrees.

2. To increase the efficiency and to enable the smooth formation of glaciers in these harsh conditions, it is required and suggested to mechanize the operation of the head work and the distribution chambers. This will reduce the use of manual labour and the regular monitoring work which is required to ensure the proper formation of the glacier.

Replicability

The technique of artificial glaciers is a winter/spring technique which is easy and simple and can be replicated in similar geo-climatic regions as Ladakh such as Spiti (in Himachal Pradesh) and some central Asian countries like Kazakhstan, Kyrgyzstan, etc. These can be replicated in areas which have the following features:

1. 14,000 to 16,000 feet altitude;
2. Temperature as low as minus -15 to -20 degrees Celsius during peak winters;
3. Longer winter period of 4-5 months minimum to ensure longer expansion and formation of glaciers;
4. Villages that are primarily dependent on glaciers or snow melt water for irrigation purposes.

Integrated approach for adaptation to climate change

Gehendra GURUNG

Abstract

Nepal's temperature is rising faster than global average with elevated rates in the high altitude regions. The precipitation is becoming unpredictable resulting in extremes. Poor people, whose livelihoods are nature based, have experienced adverse impacts of climate change and are struggling to cope to their best. Adaptation to climate change has become urgent for the poor communities. Practical Action Nepal is working to understand the adverse impacts of climate change on the livelihoods of poor communities and helping them to adapt better, by building their resilience. The community perception to climate change, their response and needs were appraised. The experiences indicate that climate change adaptation requires an integrated approach including socio-economic development, environmental conservation and disaster risk reduction. The integrated programs become effective when focused within a watershed where the biophysical and socioeconomic systems are interlinked.

Climate change in Nepal

The annual mean temperature of Nepal is increasing steadily at a rate of 0.4°C per decade from 1975 to 2005 (Baidya et al. 2007). This rate is much higher compared to the global temperature rise of 0.74°C in the last 100 years (1906 to 2005) (IPCC, 2007). Warming trends of the maximum temperature ranges from 0.068 to 0.128°C per year in most of the middle mountains and Himalayan regions of the country, while the southern plain regions show warming trends of less than 0.038°C per annum (Shrestha et al. 1999). However, the trend varies from - 0.06 to + 0.080°C per annum showing variations and localized characteristics of climate change (Practical Action, 2008). Extreme temperatures have also been observed in recent years in addition to increase in annual averages. Days and nights are becoming warmer while cool days and nights are becoming less frequent (Baidya et. al. 2008).

There is no distinct trend in precipitation in Nepal. Observations show that high rainfall regions and seasons are becoming wetter, whereas low rainfall regions and seasons are becoming drier (HMG/N, 2004). The number of monsoon days, with early onset and late withdrawal, and the intensity of the monsoon rain have shown an increasing trend (Sharma, 2006). The precipitation extremes show an increasing trend in intense precipitation events at most of the stations studied (Baidya et. al. 2008). Nepalganj in mid-western Nepal recorded ever-highest rainfall of 336.9 mm within 24 hours on the 27th August 2006 (SOHAM 2006). The 2006 monsoon record showed the wettest for Nepalganj for the last 123 years (Sharma, 2006).

Impacts of climate change in Nepal

Glacier is the much highlighted sector under impacts of climate change in Nepal. Studies show that Nepal's glaciers are retreating faster than the world average (Dyurgerov and Meier 2005) and the number and size of glacier lakes are increasing along with increase in temperature. Glacier AX010 in Shorong Himal retreated by 30 m from 1978 to 1989 (Fujita et. al. 2001), and majority of glaciers in Khumbu region retreated by 30 to 60 m from 1970s to 1989 (Yamada et. al. 1992). The increase in number and size of glacier lakes in Nepal imposes threats to Glacier Lake Outburst Flood (GLOF) with potential to damage considerable magnitude of live and property along the GLOF occurring river bank.

Studies have shown glacier reduction in Sagarmatha National Park by 4.9% between the end of the 1950s and the early 1990s (Salerno et al. 2008). In Langtang area of Nepal Himalayas, it has been observed that 27.4% of glacier coverage was lost during the period from 1988 to 2000 with more severity from 4,400 to 5,400 m asl elevation area (Sharma et al. 2008).

The melting of glacier will increase the discharge of glacier fed rivers initially and subsequently decrease after the snow and glacier become smaller (Shrestha 2004). Koshi river in eastern Nepal showed a decreasing trend of discharge during low flow season from 1947–1994 (Sharma et. al. 2000). An annual decreasing trend has also been observed in the discharge of Karnali River in mid-western Nepal from 1963-2006 (DHM Data). Whereas Kali Gandaki River in western Nepal increased by about 1% annually from 1964-2000 (Shrestha 2004). This will have serious impacts on hydropower plants, ground water recharge, agriculture and drinking water together with disturbances on local hydrological cycle and aquatic life.

The water springs in mid-hills of Nepal are recently drying up. The Government of Nepal (GoN) publicly announced a decrease of 45% in spring flows which are the source of drinking water for Kathmandu valley (Nepal Drinking Water Supply Corporation, Public Notice in Annapurna Post, 15 April 2007). The intensive monsoon does not adequately recharge the groundwater reservoirs as most of the precipitation drains out through surface runoff despite increase in total precipitation. On the other hand, the decrease in precipitation during the dry season has an adverse impact on groundwater recharging.

The frequent floods and landslides due to intensive rainfall affect the water quality. The heavy floods of 26 - 27 August 2006 in mid-western Nepal were followed by outbreaks of diseases including gastroenteritis, eye infection, and pneumonia (SOHAM 2006). Human health will be affected adversely in dry season because of lack of water for sanitation as the dry season becomes drier where there is already lack of sufficient water for sanitation (Erickson 2006).

Agriculture, the mainstay of over 80% of the Nepalese population (CBS 2001), has been affected by both warming and uncertainty of precipitation. The increase in temperature has both negative and positive impacts on agriculture. As the climate warms, farmers in higher altitudes (e. g. Jumla district, 2700m asl) can harvest two crops a year (rice – barley) comfortably. There are also potentials in higher elevations to bring new lands under cultivation. The warming in higher elevations has also created conducive climates for increasing crop intensity. However, thinning in snow deposition and retreat of snow line has created problem of water scarcity in the region. The prospects of bringing new land under cultivation by clearing vegetations have also threatened the biodiversity conservation in high altitude areas through habitat destruction, degradation, and land fragmentation. Important habitats will be displaced by crop lands. The relationship between crop yield and climate change has yet to be investigated.

Out of 2.64 million hectare of cultivated land in Nepal, only 43% have access to irrigation facilities, of which only 70%, 20% and 10% get irrigation water in monsoon, winter and spring seasons respectively (ADB 2004). The remaining agriculture completely depends on natural precipitation. The crop yields have strong relationship with the amount of precipitation at right time. Yield of wheat and rice in Kaski district declined in 3 consecutive years (2003 – 2005) because of decrease in precipitation (Regmi and Adhikari, 2007). But flooding due to excessive rainfall also affects the crop yields adversely (Gharti Chhetri, 2005). It is more likely that the extreme climate events with associated pests and diseases will adversely affect the agriculture frequently.

Studies have shown early onset and late withdrawal of monsoon (HMG/N 2004). But the actual monsoon month and the main rice-planting month, July, is becoming erratic. Farmers from Kabilash VDC in Chitwan Nepal could not transplant rice in two consecutive monsoons (2004 and 2005) because of dry months (personal experience). Some farmers changed crops from paddy to banana. As a perennial crop, banana is more resilient to erratic precipitation (Gurung 2007).

Extreme precipitation events account for increase in hazards. The intensity and amount of monsoon rains positively correlates with increase in water-induced hazards like floods and landslides (Min of Homes quoted in DWIDP 2006). Intensive rainfall was the main cause of landslides in Laprak (Gorkha district) in 1999 and Nepane (Kaski district) in 2006. A heavy downpour of rain on 26 – 27 August 2006 exceeding 300 mm within 24 hours was responsible for extensive flooding in Nepalganj area destroying lives and properties and costing millions of rupees for relief and rescue activities (SOHAM 2006).

No sufficient study has been conducted in Nepal on impacts of climate change on biodiversity. However, local people have observed some anomalies in plants growth patterns such as sprouting and onset of flowers. Gyalpo Gurung, a local resident from Humde, Manang has observed earlier greening of pastures in high altitudes (3,000 – 4,000 m asl) than the normal season (personal interaction). He has observed emerging of new pine forests on deglaciated and glacial retreated areas. The impacts of such phenomena on livelihoods have yet to be understood. However, it is likely that the biodiversity in high altitude areas will be much affected by climate change as the soil productivity is poor to support plant growth and there is a limit for space for further upward shifting. Such vertical shifting of ecological zones will affect both flora and fauna of high altitude through habitat destruction.

The First Communication Report of Nepal to IPCC showed increasing evidence of Malaria, Kalajar and Japanese Encephalitis (HMG/N 2004). However, their correlation with global warming is yet to be understood. In several locations of high altitudes, local people have experienced an increasing trend of insects which were not there in the past, and many of them are disease vectors like flies and mosquitoes.

Community perception

Local people loving in high altitude areas have experienced increase in temperature. A number of indicators have been used by them to justify temperature rise. These indicators include glacier melting and retreating, disappearing of snow from the mountains, shifting of cultivation line upwards, elongated growing season, early sprouting of grasses in the pasture, decreasing snow fall compared to the past, incidences of flies and mosquitoes for extended periods of time, appearance of new and disappearance of local bird species, etc.

Similarly in lower altitudes, the indicators of temperature increase include early sprouting of plants, shifting of fog-line in the valleys towards higher elevations, presence of mosquitoes for extended months instead of summer months only.

The local people have also experienced changes in the precipitation. In higher altitudes, there are more rainfall events with larger drop size and less snowfall. But the local people have different perception on the total annual precipitation. Compared to the past, the rain and the snow cannot be predicted and can occur at unusual times. Evidences of hail have also increased. This is also the same case in lower elevation areas. The intensity of monsoon rainfall has increased. People have experienced that the rain is not on time when required. There are extended dry periods during winter, the dry season.

A number of impacts have also been experienced by local people due to climate change. There is less water flow in local rivers especially during dry season. The agriculture is adversely affected due to lack of irrigation water as local water sources are drying up as a result of less snow deposition in the mountains. In higher altitudes, crops have also been affected by new diseases. The drying up of rivers has affected adversely the local watermills and micro hydro plants especially during dry season. The water stress has resulted into dropping off of immature apples. On the other hand the increase in events of rainfall instead of snowfall has affected the earthen roofs of traditional houses in high altitudes. There is more and more seepage from the roofs and local people are replacing the earthen roofs with corrugated galvanised iron (CGI) sheets, threatening the local architecture. The increase in rainfall has increased flashfloods and landslides with increasing trend and damaging infrastructure such as trails, bridges, irrigation canals, cultivated lands, etc. Traditionally local people are not prepared for some of these events which expose them to potential disasters. Local people repair through community approach when such damages occur. But now there has been increasing trend in such damages and the traditional practices are not able to repair. This has challenged the traditional knowledge and practice systems.

In hills, people have noticed increasing trend of landslides, flashfloods and erosion, whereas flood is the main hazard in the plains. A number of non-climate change factors such as development activities, might also be responsible for some of these events. However, local people perceive that changing rainfall patterns is equally responsible.

Some households who depend on herb collection for livelihoods have experienced disappearance of herbs plants in the pasture. However, this has to be further studied to identify whether it is due to change in temperature and precipitation or due to excessive collection by the people.

In high altitudes, local people have also realized some positive impacts of climate change which include increase in the length of growing season that provides opportunity for increasing crop production. As the cultivation line is shifting upward there is also opportunity to bring new lands under cultivation for increasing production. However the other side or the impacts of bringing new lands under cultivation in higher altitudes are to be assessed from environmental and socio-economic point of view.

Need for building the resilience

A brief need assessment among the local people identified that water resource and related livelihoods are becoming their main concern. The traditional agriculture is affected by erratic rainfall, rise in temperature, emergence of new diseases and destruction of irrigation facilities, and agriculture being their main way of livelihoods, the next concern for the local people is to seek technologies that help strengthen the agriculture in the area. However, as the agriculture fails and the households become difficult to meet their needs, they are also looking for alternative livelihoods and income generation activities. They have also identified disaster risk reduction activities including forest conservation and reforestation, as one of their main need under the circumstances of growing events of flashfloods and landslides. The need for forest conservation is realized basically for minimizing soil erosion and landslides that have been occurring due to increase in rainfall events.

Climate change is a new phenomenon that is enhancing some of the prevalent hazards like drought, floods, etc. Although local people are aware of climate disturbances and their impacts in their area, they are not fully aware of global and local climate change, its potential impacts and needs for adaptation. Need for awareness raising has been realized. The issue of climate change has to be integrated into local development activities for which the local institutions need re-organisation to accommodate climate change issues.

Integrated approach for climate change adaptation

Experience of Practical Action in Nepal shows that integrated approach is required for adaptation to climate change as the impacts of climate change is multifaceted. Such adaptation practices should be designed and implemented at community level or local level as the climate change and its impacts are localized. The needs for adaptation are also local specific although they can be broadly categorized. The major technical sectors for adaptation to climate change might include diversifying agricultural crops, alternative livelihoods, disaster risk reduction and natural resources conservation. At the community level, awareness and strengthening the institutional capacity of the communities are essential as prerequisite for climate change adaptation. Whereas climate change adaptation needs to be mainstreamed through all sectoral programs at policy level. The following paragraphs highlight the major activities that Practical Action adopted for community based integrated climate change adaptation.

The experience described here is based on project activities implemented in a hill district. However during the course of studies, the impacts of climate change in higher altitudes have also been found to be of similar nature. The exact technologies will be definitely different depending upon the location for actions; however, the approach might be applicable for adaptation to climate change at community level.

Awareness Raising:
The first intervention into the communities for adaptation to climate change was through awareness raising on climate change. The primary focus was the target communities and the students of the communities. The activities included sharing of information on global climate change, its causes and impacts. The imperatives and approaches for mitigation and adaptation were also shared with the communities. During the awareness process the community perception of local climate change, its impacts and their responses were appraised. Such exercise helped the communities relate their observations with global information and understand the local climate change and need for adaptation. The awareness activities also helped enhance the planning process for adaptation by identifying the community problems related to climate change, identify the gaps and interventions and resources including local knowledge and practices.

The next target for awareness raising on climate change was local government and non-government stakeholders who are directly or indirectly the service providers to the communities. Understanding of the stakeholders towards climate change was appraised. In most of the cases they did not see any significant difference between environment and climate change. So they were viewing climate change as a part of environmental degradation, which was not exactly the same. Then information on global climate change and on the need for mitigation and adaptation were shared with them. Focus was also given on how they can support the communities in the process of adaptation to climate change.

Varied materials and approaches such as slides, films, field observations, leaflets, pamphlets, etc were used to make the target population aware on climate change.

Institutional Setting up:
Climate change was an unrealized issue to the communities that needed to be looked from a different angle. To mainstream the climate change adaptation into local development process, the existing institutions were not prepared. The community also realized the need to reorganize the existing institutions. The community where Practical Action worked had a number of institutions most of them being saving and credit groups. These groups were on settlement basis. A watershed level committee was formed, represented by all the settlement within the watershed (catchment). This committee became the main focal institution for planning and implementing climate change adaptation activities within the watershed. The committee was registered at the district government office to be recognized as a legal entity. A number of activities were undertaken to strengthen their capacity in climate change adaptation. These activities included institutional development, financial management and technical management. This committee got involved in all the stages of activities -identifying the issues related to climate change, identifying activities, planning and implementation.

Agriculture Diversification:
Rural agriculture is nature based. Agriculture is also the mainstay of the people. It is the one which is foremost hit by impacts of climate change. The first priority of the communities was to get support in agriculture. The interventions included basically to diversify crop species and varieties that can best perform under erratic rainfall and water condition. Grain crops are the priority of the communities. If specie cannot grow their preference go to the next grain crop. In the project area, the communities' first preference was to grow rice. But in several plots and for consecutive years they were unable to grow rice because of lack of rainfall on time. They tried to grow maize and millet. When the annual crops failed, the farmers opted for perennial crops like fruit crops. In their experience perennial plants or crops can withstand erratic rainfall situation better than the annual crops. So the farmers were supported to diversify their crop species and varieties to adapt to different local conditions associated with climate change and its impacts.

Income generation and alternative livelihoods:
Within the agriculture, supports were also given to the communities to diversify their crops for income generations. Vegetable crops in off-season which

fetch good market price were promoted. Such activities helped diversify the farm activities and increase the income which helped in food security and spread the risk of failure of main crops under uncertain climatic condition. Also the farmers are looking for short season crops to avoid the risk of being damaged by uncertain weather conditions. Since the longer the crops stay in the field, the more it is exposed to being damaged by uncertain weather conditions.

The other activities that were promoted for income generation and livelihood diversification were goat raising, fruit cultivation, post harvest technologies of the agricultural products, community dairy development and off-farm income generation activities.

Rehabilitation of irrigation canals
The direct impacts of climate change on agriculture have been observed through disturbances on water resources management, either from irrigation canals damaged by floods or from not having rain on time. Traditionally local communities repair their irrigation canals when the floods wash away. But since last years the impact of flood is frequent and severe and the communities are unable to rehabilitate their traditional system and resources. Moreover, the water in the sources was drying up and couldn't be diverted to the canals with the existing practices. As a result, despite the need and importance of the irrigation canals, local people could not rehabilitate them. Their agriculture was adversely affected. The rehabilitation of irrigation canal was on the priority list of the communities as well. Once the canals were rehabilitated, the communities were able to continue their agriculture activities and diversify the crops for both home consumptions and income generation.

Soil and Forest Conservation:
Local people practice cultivation on slope lands without any terracing. Under such practice, the soil gets extremely dry when there is no rain for long time; on the other hand it gets eroded when there is intensive rainfall. The soil erosion on the hill slopes upstream is one of the main causes of destructive flashfloods downstream, while the lands under cultivation deteriorate severely from its productivity point of view. Such problem increased because of increase in extreme weather conditions. In order to help conserve the soil, Slope Land Agriculture Technique (SALT) was promoted. The technique included multipurpose plant species which helped increase fodder production for livestock and income for the households in addition with helping to stop the soil erosion.

Similarly, there was a lack of proper forest management. The forest management system was strengthened by establishing Community Forest Users' Group, registering them at the District Forestry Office to get legal entity and authority. The forest management helped the communities' access to forest products such as fodder and fuel which reduced illegal practices and ultimately helped improve the forest condition and reduce the soil erosion.

Disaster Risk Reduction:
In Nepal, climate change has posed a high degree of disaster to the local people through diverse range of hazards including floods and droughts. The local people have perceived that they are exposed to flood as the intensity of rain is increasing. So they proposed activities that help minimize their exposure to flood. Such activities included basically putting dykes and check dams at strategic sites along the river, and planting trees on the slopes to minimize the landslides and protect lands along the river banks.

Conclusion

Climate change has undermined the livelihoods of the people. The poor are the most vulnerable to adverse impacts of climate change as they have limited resilience due to lack of access to resources.

Increase in temperature and erratic precipitation are found to be the two main variables of climate change that are active in the study areas. Both variables are affecting the livelihoods of the people directly or indirectly. The effects are either solely related or a product of the two factors. It has been observed that climate change and its effects are localized, indicating the need to understand local climate change and applying the actions at local level through community based adaptation approach.

Water resource was found to be most affected both by increase in temperature and erratic precipitation. In high mountainous regions the water resource is becoming crucial as the water discharge in the rivers and springs are declining especially during dry season due to decreasing trend in snowfall and rapid melting of snow and glaciers deposits.

Both changes in temperature and precipitation have affected agriculture, the mainstay of most rural population. The erratic precipitation has also increased the water, induced disasters including landslides and flashfloods that are ultimately affecting the infrastructure at local levels.

The communities have been observing the climate anomalies, experiencing its impacts and are responding to their best. However they are not aware of global climate change, its potential impacts and the need for adaptation. The government and non-government stakeholders at local level are also not adequately aware of climate change. There is an urgent need to raise the awareness on climate change especially the local climate change, its impacts at local level and the specific adaptation measure.

Climate change is affecting all development sectors. Experience shows that adaptation measures require an integrated approach including agriculture, water resources management, soil and forest conservation and management, disaster risk reduction and diversification of livelihoods strategies of the communities. It is also essential to mainstream climate change into all development sectors with a view that climate change and its impacts affect development and vice versa.

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Land legislation and pastoral adaptation to climate change - The example of Mongolia

Anna SCHULZE

Introduction

Mongolian herding is a proven livelihood system that has been reliable and successful for a long time, adapted to the local conditions; around 30% of Mongolian households make a living directly from livestock breeding. However, it has always involved risks related to weather and climate variability. During the zud – the harsh winter and spring – of 1999/2000 and 2000/2001 Mongolia's herd was reduced by over two million livestock. Thrown into the new system of a market-oriented economy, which due to the omission of many state jobs brought many people to try their fortune as –unexperienced and poor–herders, leading to an important heterogeneity of the pastoralist society, and deprived of the former intensive Soviet assistance through hay reserves and transportation facilitation for long movements of herds pastoralists were not able to cope with the occurrence of these extreme climatic events. These events have drawn the attention to the devastating role that risk plays in the pastoral economy.

Climate change is likely to increase the frequency and intensity of climate hazards in such an already extreme climatic region as Mongolia. Located in the northern latitudes, Mongolia is part of the regions where the highest global warming is occurring. The 1.9°C temperature increase since 1940 has led to short, rapid warming and melting of snow cover occurring in winter. As the ground is then still frozen, the melted water creates ice sheets on the ground surface, impeding animals from both grazing and using snow as a substitute to water.

Adaptation and disaster risk management options for pastoralists will become more and more crucial. Due to the socio-technical system of pastoral livelihoods, these options are mainly determined by the possibility of accessing natural resources, mainly pasture, water and salt licks.

Besides numerous customary patterns, the access to pasture land is regulated by the land tenure legislation. The real capacity of a legislation to solve problems does of course depend on its implementation and on the quality of governance in a country. However, the existence of an adequate legal framework regulating the access to pasture land is of particular importance in the attempts to allow pastoralists to adapt to increasing risk as a consequence of climate change.

This paper will describe the development of pastoralism, property rights and land tenure legislation in Mongolia. Potential solutions to the issues of land degradation - with the consequence of shortages of usable land - and vulnerability to extreme events will be brought into relation to possibilities offered by the land related legislation. Good starting points as well as weak points of this legislation will be analyzed and other factors impeding the use of existing possibilities will be emphasized, leading to the presentation of ways ahead.

The importance of access to vast areas of pasture land

As pastoralism is a system of animal husbandry often exerted in extreme environments and on marginal soils, there is a need for mobility and flexibility of access to land and other natural resources in order to create options for disaster risk management and adaptation to climate change. At the same time, the ongoing degradation of Mongolian pasture land makes it important to create incentives to prevent pasture from degradation in order to not further increase scarcity of resources. To combat this scarcity, it is important to reactivate remote pastures as well. Thus, the regulation of the access to pasture land is of overriding importance.

Options for access regulation to pasture resources

The traditional access regulation system in Mongolia has largely disappeared as a consequence of the socialist time of complete state regulation and the following transition to a market economy with the almost abandonment of any kind of regulation and a situation of de facto open access. In the international debate different options are discussed to regulate the access to pasture resources: The reestablishment of a strong state regulation, privatization and land titling, or a community based management based on herder groups. Privatization of pasture land is unsuitable for a country where around one third of the population relies economically on the flexible access to this resource for their pastoral livelihoods. In addition, it is in contradiction with the current Mongolian constitution and not accepted in the public opinion. A mere state regulation will be impossible to handle for the state due to a lack of financial and personal resources, and the complexity of the issue because of extreme local variation and the geographic extension of the country. The past 18 years have shown that the state alone cannot cope with this issue. Therefore, the option of an access regulation through user groups is preferable.

Building user groups

User groups can be formed either on kinship or following a territorial approach (Fernandez-Gimenez et al. 2008). The kinship approach allows for an easier communication between the members of the smaller and socially related group, which maintains transaction costs for agreements low. However, they pose the problem that social and spacial boundaries may not be well in accordance with each other because usually, not all herder households on one same territory will be part of the same group. This problem can be avoided with the territorial approach meaning that all inhabitants and resource users of a certain territory should form part of one group. However, it has to be acted with caution in order not to create parallel structures to the existing political structures, especially the structure of the *bag*[1]. This danger could be alleviated by giving groups an economic function, e.g. as producers´ cooperative, which distinguishes them from the mere political and not rent-seeking function of the *bag*. State support can be useful in the phase of establishment of these groups, and for inter-*sum* and inter-*aimag* agreements, especially if access to additional pastures will be needed in case of disasters.

Key principles for a legal framework for land management based on user groups

Law is certainly not per se a representation of a common will and not neutral to the political and economic interests of parts or groups of the population, nor is it always enforced neutrally through independent state institutions (see e.g. Benda-Beckmann 2005, Benda-Beckmann 2009). Besides the official law of the state and international law, there are often traditional and religious legal orders and a wide variety of principles and procedures generated by non-state actors. However, state law is a crucial aspect of governance.

Experiences and lessons learned from other examples of pasture management frameworks as well as from the forestry sector in Mongolia show that an adequate official legal framework is extremely helpful in order to allow for the formation and operation of user groups. It must meet with some key principles.

A concrete procedure for granting tenure rights should be in place, those tenure rights should be exclusive rights for the respective user groups and adequately secured. Furthermore, groups should be provided not only with tenure but also with management rights to enable them to carry on the responsibility of sustainable maintenance of the resources allocated to them.

With regard to the organization of the groups themselves, clear criteria for membership status and corresponding rights and duties should be in place as well as working mechanisms for intra-group dispute resolution.

Concerning the external relations of groups, there should be clear provisions for the legal recognition of groups and the formation of land possession contracts, and procedures for resolution of conflicts with other groups or with the land owner – the State – should be provided. In addition, the responsibility of the State for a subordinate coordination through a broad land management plan at *aimag* and national level and the coordination of land allocation to the various groups must be clearly determined. Ultimately, adequate capacity building must take place in order to make all regulations available to the knowledge of the stakeholders and enable them to participate in their implementation.

Historical context of land tenure legislation in Mongolia

It is important to understand the historical context of land tenure legislation in Mongolia as well as the general current legal frame in order to analyze if the Mongolian land regulations meet the listed principles and are an adequate tool facilitating the needed access of pastoral user groups.

In Mongolia, individual private ownership of pasture land has never existed. Before the communist revolution in 1921, pasture allocation and use were governed in many areas by a combination of formal regulation imposed by ruling nobles – secular princes or important lamas in the Tibetan Buddhist church - and informal norms and customs.

After the revolution in 1921 the concept of pastoralist lifestyle was included in the socialist concept by the Mongolian People's Revolutionary Party. Although pasture use was regulated by the state through the mechanism of the so called *negdels* - the collectives each of which managed pastoralism

[1] Smallest administrative unit at rural level, including less than thousand individuals, sometimes only 30 to 50 families.

in an entire *sum*[2] -, the decisions of the *negdels* were often influenced by customary patterns of use and tenure. Important investments were made in water supply, winter shelters, hay and fodder production and transportation for the pastoral technique of *otor* by which herds are repeatedly moved over distant and lesser-used pastures as a method of intensive feeding. Summarizing the property rights situation of that time, land was owned by the state, use was managed by the collective's leaders, and within the areas allocated to each collective, pastoral households made use of recognized areas of pastures.

With the end of socialism in 1990, pasture use was initially not formally controlled. In 1992, the *negdels* were dismantled, and collective and state-owned livestock and other assets were privatized by issuing share coupons which employees could use to claim a share of the collectives assets. Land, however, remained a public resource in state property. Its use by local pastoralists should have been regulated by local government, but during the first years of this transition period it can be said that-despite the fact that all land was in state ownership - there was rather a situation of de facto open access to the resource.

Property law and land legislation in the current legal system

One of the most remarkable results of the transition in Mongolia is the establishment of a new system of law in which the property law is incorporated. The current system of Mongolian law borrows from the Romano-Germanic legal tradition and is therefore divided into private and public law. There are manifold customary norms. They are not considered to be a principal source of official law. However, some evidence of the importance of customary rules can also be found in Mongolian written legislation (Narangerel 2004). There is a prohibition on judicial interpretation in Mongolia (Lindsay et al. 2006). This means that judges are not allowed to fill in indefinite legal concepts. This is common in socialist legal systems, where law is only meant as another means of implementing governments' decisions. It will be difficult to preserve this concept outside the context of a planned economy, because many abstract legal terms are needed in order to be able to cover reality in its complexity and unforeseeable developments. A prohibition of judicial interpretation leads to a need of extreme concretion if a legal provision is to be applied efficiently.

[2] Local government district, including something around thousand households.

Property law is found primarily in Articles 83 to 152 of the Civil Code. It designates property - synonymously termed as 'objects' - to legal subjects[3] who may be the owners or the possessors of this property. As in many countries` legal systems a distinction is made between movable and immovable property. Land is classified as immovable property as are assets such as buildings that cannot be used for their original purpose when they are separated from the land. The right to ownership of immovable property has to be registered with the State.

The core elements of Mongolia's land legislation are Article 6 of the Constitution, which deals with the possibility of private ownership of land, Charter 12 of the Civil Code, the 2003 Law of Mongolia on Land (LML) and the Law on Allocation of Land to Mongolian Citizens for Ownership (LALMCO).

Land tenure is regulated mainly by the Law of Mongolia on Land (LML) enacted in 1994, which was followed by a revised version in 2003[4]. As the LML contains provisions for leasing of campsites and pasture, it introduced some provisions for the regulation and management of pasture land. Leasing of winter and spring campsites began in 1998, but the local administrations were slow to divide and allocate grazing land. This was partly due to an impreciseness of the law concerning the issuance of certificates of possession over winter and spring campsites. Traditionally the right of a campsite entailed an implied use right for the respective winter and spring pastures in the surroundings within a radius of several kilometers (Sneath 2004). However, with the wording of the law it remains unclear if the certificates of ownership apply to these pastures as well. Most sum issued certificates only for winter campsites (Fernandez-Gimenez and Batbuyan 2004), thus for small point locations.

Summer and fall pastures must remain openly accessible, and so must water and mineral licks. The law empowers *sum* and *bag*[5] governors to enforce these provisions and to regulate seasonal movements and stocking rates, but few of them are aware that they have this authority, nor do they have the resources to carry it out (Fernandez-Gimenez 2006; Fernandez-Gimenez and Batbuyan 2004).

[3] Legal subjects can be individual citizens, but also legal entities such as business entities or organisations.
[4] The primary motivation for revising the law was to make possible a - limited - land market for urban and peri-urban land, household plots (including herders' winter camps), vegetable gardens, hayfields and arable land, amounting to a total of around 2 % of Mongolia's land area. The basic provision concerning pasture land - that it shall be property of the state and protected from private ownership -remained unchanged. (Mearns 2004, p.144).
[5] The smallest administrative unit, covering only up to 1000 people.

With regard to the use and possession of land by groups, the LML regulates the issuance of possession contracts. Land possession is provided for a duration of fifteen to sixty years through a license that may be extended for no longer than forty years at a time, Art. 30.1 LML. These land possession contracts are made with the sum land authority. They are thus only possible between a legal subject and the State. The possibility of leasing contracts between two legal subjects, transferring the right to use the land to a third party, or the possibility of sub-tenancy are not mentioned in the LML but are possible according to the Civil Code. The advantage of a land possession agreement compared to a mere use contract consists in the fact that the LML requires the government to compensate land possessors if their land has been given away or repossessed by the government. However, this applies only if the conditions for compensation are spelled out in the respective contract. Due to such ambiguities of the LML, it cannot be seen as sufficient to re-install a system of sustainable pasture use.

If land is allocated to individuals or groups the question if their tenure right is only a use right or a more secured possession right is of overriding importance. With regard to a potential future legislation specifically regulating the access to pasture land it should therefore be carefully taken into account that only awarding possession rights might provide land holders with the necessary security that makes them willing to invest in the long-term maintenance of the land.

The Law on Allocation of Land to Mongolian Citizens for Ownership (LALMCO) adopted in June 2002 has the purpose to allocate land to citizens for ownership, Art. 1 LALMCO. According to Art. 4 and 7 LALMCO, the allocation is limited with respect to the purposes the land will be used for and with respect to certain categories of land. The purposes provided by the law are restricted to family needs as well as agricultural and commercial purposes. With regard to the categories of land, grazing land and forests are exemplary mentioned by Art. 6.1.1 LALMCO. Furthermore Art. 6.1.2 LALMCO restricts the scope of the provisions on privatization to - tilled and untilled - agricultural land. Although this formulation seems to be contradictory, it has to be read in synopsis with Art.6 of the Constitution that bans the privatization of pasture land. In addition, Art. 7.1 sets the size of land that should be transferred for free to the particular citizen. These provisions reveal that the land privatization does not cover large areas of pasture land as the main resource of the pastoralist population. Thus, as a result of the controversial privatization debate privatization under the LALMCO is limited to non-pastoral land.

The recent draft of a Law on Pasture land can be a good starting point for a legislation helping to re-install a system of sustainable pasture use. It addresses for example delays in the issuance of possession contracts with a provision that demands the issuance of a possession contract within 5 workdays. However, it does not meet either with all of the key principles mentioned above.

Required improvements

Therefore, further legislative actions are necessary that connect the principles for group forming with those of land allocation in order to create better incentives for pastoralists to form user groups and to take over responsibilities for the management of land. They have to take into account especially the need of clear provisions for all procedural steps and a reasonable order of the requested procedure of the land possession contracting. In addition, the provision of model contracts is missing, which poses an obstacle for potential land managing user groups to become active. Making available such model possession contracts, as well as exemplary pasture land management plans would stimulate more effective group formation and operation of existing groups. Furthermore, in order to meet the key principles of tenure security and exclusivity, unintended overlapping land allocation must be avoided. In addition, detailed criteria for the possibility of land condemnation as well as concrete compensation regulations in the case of such condemnation should be determined. To facilitate both, further efforts to develop a working land registry will be necessary, which will also allow for an adequate land valuation as a prerequisite for the calculation of equitable compensation payments.

Concerning the principles with regard to intra-group relations – clear membership criteria and provision of dispute resolution mechanisms – further research is necessary to evaluate whether the consideration of criteria based on the social structure and kinship, or rather of territorial criteria is preferable to determine membership in groups. Either way, overriding importance should be given to clearly determine and stipulate the respective criteria. Model user group charters would be very beneficial at this point. With regard to the dispute resolution mechanisms, third party reviewing of the results has proven beneficial. It would be useful to develop a set of rules that can guide third parties in such reviewing processes.

Similarly, efficient dispute resolution mechanisms for external conflicts must be established; above all ensuring not to create conflicts of interest due to a double role of one same governor being responsible for both, the land allocation and the following conflict resolution – possibly even with the State as the land owner involved as one of the conflicting parties - concerning the allocated land.

To meet the key principle of subordinate coordination, the role of the State in this pasture management system based on user groups has to be regulated. The functions of the State are to draft broad land management plans at national and regional level, to take care of the inclusion of less capable or less wealthy herders, and to take into account the need of reserve pasture for incidences of disaster. These responsibilities of the State have to be clearly determined, while on the other hand its restriction to this role has to be made clear as well.

Ultimately, not only the legal but also a broader institutional framework for adequate information services and capacity building of stakeholders has to be implemented. A broad reform of the land management system cannot be achieved without the active participation of the persons concerned, the pastoralists.

Concluding remark

Without question, the formation of herder groups and the development of a user group based pasture land management system does not only enhance the adaptation potential of pastoralists, but also generally avoids further land degradation and consequential scarcity of pasture resources. This shows that adaptation to climate change is often accompanied by general development.

Although most of the proposed improvements of the legal framework, especially the creation of an adequate institutional framework for capacity building and participation, are rather long-term activities, there is no time to lose because climate is changing and degradation is increasing. Adaptation and land management are very pressing issues for a positive development and accumulation of wealth of pastoralists in Mongolia.

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Discussions and outcomes

In the first session some of the main discussions and outcomes were:

- 35-year data is relevant to ascertain climate change trends as long as we don't extrapolate further than 10 years. 35-years scientific data on temperatures & precipitation of Leh are consistent with the perceptions of the communities. Main findings: increase of almost 1 degree Celsius in winter temp; clear decline of snowfall by 50 percent, hence the importance of emphasis on the perceptions of local people.

- Mountain women are among the most vulnerable (housework & livelihood activities) to climate change impacts, especially in terms of the increase of time spent in collecting fuel wood & water. Male migration for socio-economic reasons also increases the impact of climate change on women.

- Sensitization of the release carbon footprint is essential in each country (according to the local context), but sharing the responsibilities & efforts between developed & developing countries (in which respective proportion?) remains a debate...

In the end, participants agreed unanimously that lots of discussions that come up during the seminar might be forgotten after some weeks, but follow-up is essential in order to disseminate best practices in the development sector.

The second session discussions and main outcomes were:

- Artificial glacier is simple local technique to adapt to decreasing water availability due to decrease in the amount of snowfall. Though artificial glacier is a simple local adaptation technique, it is surprising to know that only 10 artificial glaciers have been constructed in the past 4 years. Lack of funds? Lack of promotion? Are artificial glaciers a permanent adaptation solution? These were some of the questions that were raised about artificial glacier.

- Erratic patterns of precipitation; it is causing more frequent disasters (flash floods, draughts, etc). Since most of the people are farmers it is important to provide alternative choices for new crop species and varieties. Water management for agriculture is crucial for agriculture as glaciers are retreating, springs are drying up and rainfall patterns are changing. Introduction of new crops varieties in Nepal is an opportunity for livelihood development and income generating options.

- In Changthang a very comprehensive study has been conducted, the outcome/data provided by this study will serve as a guiding document for the implementation of the strategy for development projects in Changthang. The problems and subsequent recommendations made through this project have been submitted to the Hill Council which is to be included in the district plan.

- In Mongolia after the socialism retreat and the loss of jobs, traditional pastoralism has increased. The loss of livestock between 1999 and 2000 due to harsh winters and lack of coping mechanisms raised the issue of a need to adapt to climate change. Degrading land and less availability of suitable pastureland raised the problem of a better land management.

Energy and household

The International Energy Agency (IEA) states that it is necessary "to break the vicious cycle of energy poverty and human underdevelopment in the world's poorest countries." This statement holds special significance for cold regions where natural resources like biomass are scarce, whilst household energy requirements are enormous. Winters are long and harsh; temperature can drop as low as -30°C. People belonging to these cold mountainous regions heavily rely on traditional biomass such as wood, wild-bushes and cow dung for cooking and heating. Space heating claims substantial amount of domestic energy needs. Thus, the per capita energy consumption in the cold regions is higher than rural areas of lowlands. This has strong consequences on the livelihood, environment and economy of the inhabitants.

People living in high altitude and cold regions are highly vulnerable to energy because of the scarce biomass and widespread poverty. Energy demand for heating purpose is huge; a household consumes about two tonnes of biomass (wood, wild-bushes, twigs and cow dung) in a year. On an average, a family spends two months a year on fuel collection, which is primarily done by women and children. Therefore, introduction of energy efficient houses will lead to the reduction in biomass usage; thereby reducing human drudgery, indoor air pollution and cold related complaints.

Natural forest and mountain vegetations are decreasing due to overexploitation and uprooting. In case of Afghanistan, 70% of the natural forest has disappeared over the past 40 years. The uncontrolled use of wood and bushes has led to soil erosion, which reduces the productivity and fertility of pasturelands. The use of dung as a fuel instead of agricultural manure leads to soil degradation and lesser yield of crops.

In urban areas, up to 30% of the annual household income is spent on heating purposes. Moreover the houses are inadequately insulated and fuels such as coal, wood and dung are used ineffectively. Energy saving and efficient use of energy are the key elements of any sustainable development.

Modern houses are built with concrete and they are less energy efficient as compared to the traditional houses, which are built with mud, clay and local resources, and includes bioclimatic concept. The problem of space heating in the cold and arid regions is addressed through the use of solar energy, insulation techniques and improved cooking stove. Many interventions have been introduced to enhance the energy efficiency of the households, one of them being Passive Solar Housing (PSH). Passive solar house is built on the principle of maximizing heat gain and reducing heat loss. According to research by experts, a Passive Solar House can keep the interior space at approximately 20 degrees Celsius above the ambient temperature. At the same time, it reduces the reliance on fuels up to 70%, besides reducing air pollution and health hazards. Similarly, improved metallic stoves are designed to increase the efficiency for space heating and cooking and also to protect people's health from indoor air pollution. Utilization of 'heat exchanger' can raise the efficiency of metallic stoves by 50-70%.

Energy demand is increasing due to the rising standards of living, modernization; urbanization and population growth. Hence, energy efficiency in appliances is essential. New directives and legislations are introduced in different countries in order to promote energy efficiency at the end-use electric consumptions in the households. One such directive is the energy labelling of the domestic appliances. Under this policy, manufacturers are required to attach an energy performance label on appliances when displayed on sale. Thus, labelling significantly reduces the electricity consumption. At the same time, consumers pay lower energy bills.

Speakers

Two working sessions were devoted to 'Energy and Household'. Both sessions were chaired by Mr. Alain Guinebault, General Manager, Groupe Energies Renouvelables, Environnement et Solidarities (GERES), France.

The first presentation was given by Mr. Eric Buysman GERES Cambodia with introduction on the technical concept of biogas production. He presented the benefits of biogas plants on income, health, environment and ecology. He later addressed the challenges posed by cold climate on biogas production in high altitude regions of Hindu-Kush Himalaya. With some technical modifications biogas plant is possible in cold regions and he shared some of the success stories and experiences of Biogas Support Program (BSP) in Nepal, PROAGRO/GTZ in Bolivia, and Integrated solutions of SNISD & BSP in Nepal.

It was followed by presentation by Mr. Hari Gopal Gorkhali, Director of Centre for Rural Technology, Nepal, on "Introduction of improved metallic stove for people living in high altitude regions of Nepal". Energy consumption pattern in Nepal for cooking, heating and lighting was introduced. He focused his presentation on the salient features of improved metallic stove of CRT, including its design, performance and cost. The stove is officially approved by government of Nepal as a standard design for high altitude regions.

Mr. Frank Löwen, Welthungerhilfe, Tajikistan gave the third presentation on "Low cost options to increase resource use efficiency in degraded rain fed areas of Southern Tajikistan". He described the climatic, hydrologic and soil conditions of Khatlon Province in Tajikistan. His presentation was focused on the key aspects for rehabilitation and integrated management of degraded rain fed areas. He shared Welthungerhilfe's skillful interventions to enhance house energy efficiency of house like; improving the art of winter heating systems by introducing insulation and 'heat exchanger'. Utilization of heat exchanger can raise the efficiency of metallic stoves by 50-70%. Moreover, it significantly reduces the fuel consumption for space heating. Cow dung thus saved is used in agricultural fields as manure. By doing so, the soil organic matter and fertility is restored.

The next presenter was Ms. Indira Aseyin, Habitat for Humanity, Kyrgyzstan. She started her presentation with national statistics on geography and demography of Kyrgyzstan, with special emphasise on Bishkek, the capital city and Barskoon village. She focused on the award winning project "Cane Reed Houses: 19th century idea, 21st century solution". Advantages of Cane Reed houses are earthquake resistance, simple construction and low consumption of electric energy which being highly replicable and environmentally friendly. She also shared the steps of building methodology, and financial arrangements of housing projects (Habitat Revolving Fund).

The final presentation of the first Working Session on 'Energy and Household' was jointly presented by Ms. Aurelie Agniel, GERES India, Mr. Rigzin Dorjey, Ladakh Ecological Development Group (LEDeG), Leh and Mr. Rigzin Namgail, Students' Educational and Cultural Movement of Ladakh (SECMOL), Leh. It was focused on "improving livelihood of rural population in the cold desert areas of Indian Himalayas by disseminating energy efficient housing". They shared the technical and social components of "passive solar housing" – a project jointly implemented by GERES and five local NGOs in Ladakh, Lahaul and Spiti. The impacts of PSH on environment, health, education and economy were discussed.

The second Working Session of “Energy and Household” began with the presentation of Mr. Ilia Domashov, BIOM, Kyrgyzstan. It was focused on “Energy risks in Kyrgyzstan and their mitigation through use of renewable sources of energy”. BIOM cover projects on water, food and energy security, besides ecological sanitation and sustainable agriculture; and promote various renewable energy technologies such as sun batch heater, sun collector, solar-cookers and efficient stove and biogas plants.

The second presentation was “Renewable energy for households in Kyrgyzstan” by Mr. Ruslan Isaev, CAMPalatoo, Kyrgyzstan. Potentiality of renewable energy sources such as solar, wind, hydro and biomass were discussed. He gave a general scenario on the shortage of energy resources and low energy efficiency. Village Energy Committees are formed in Kyrgyzstan, Tajikistan and Kazakhstan to develop a long term energy strategy and promote energy saving activities. He proposed efficient stoves to save money and improve living comfort; training and development of insulation technologies to reduce energy consumption.

Mr. Ralph Pförtner, INTEGRATION environment & energy, Germany gave the next presentation on “Impact monitoring energy and household”. His presentation was focused on the structure and procedure of impact monitoring. He shared some example modules on household baseline survey, and the results of such surveys from Afghanistan, Pakistan, Tibet and Mongolia. He stated that photo documentation is useful in distinguishing different household types during baseline surveys.

It was followed by a joint presentation by Mr. Robert Angioletti, Agence de l’Environnement et de la Maîtrise de l’Energie (ADEME), France and Mr. Sandeep Garg, Bureau of Energy Efficiency (BEE), India. Mr. Robert presented on “Appliance Energy Labelling: what did we learn in European Union?” It was largely focused on energy labelling policies and directives in EU on cold appliances, washing machines, dishwashers, tumble dryers, lamps, domestic air conditioners, and ovens etc. Energy labelling is beneficial for all stakeholders (manufacturers, retailers and consumers), and shared the results of such policies on energy savings. The last part of the presentation covered the electricity consumption of office equipments, consumer electronics and the standby consumption of electronic devices. Mr. Sandeep Garg, BEE India continued the discussion with his presentation on “the situation of energy labelling schemes in India”. Per capita consumption of electricity is increasing in India; therefore, energy efficiency is important. He shared BEE’s role and experiences in planning, managing and implementing the “Energy Conservation Act 2001”. BEE recommends to the Central Government on energy consumption standards and labelling on equipments. There are currently 11 products covered under National Energy Labelling Programme in 2006. Energy savings as a result of Standard and Labelling (S&L) programme were discussed.

Mr. Robert Celaire, Concept Energy and Mr. Alain Enard, Architect, France jointly presented the final presentation. They shared their experiences from a pilot project implemented by ADEME in Heilongjiang province of China on energy efficient housing in rural areas. The traditional houses in China are energy inefficient, and the Chinese energy efficiency standards do not apply to rural housing. The project aimed to demonstrate up to 50% reduction in coal consumption through improved energy efficient housing designs. The presentation was largely focused on their improved designs of the floor, roof and walls and air ventilation for stove combustion.

Biogas for developing countries with cold climates

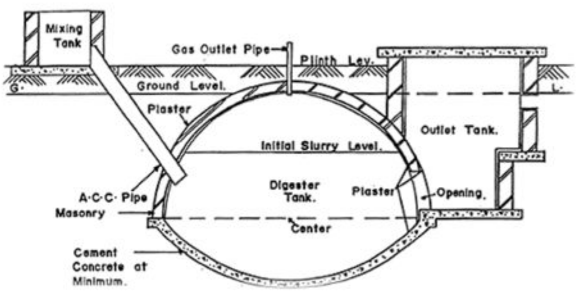
Eric BUYSMAN

1. Introduction

Domestic biogas production is one of the most promising uses of biomass wastes because it provides a source of energy while simultaneously resolving ecological and agrochemical issues. The provision of bio-energy tackles both energy poverty and the reliance on polluting and non -renewable fuels. The implementation of domestic biogas plants is however limited in regions with cold climates since low prevailing temperatures have a detrimental impact on the biogas production rate. This paper addresses the challenge to overcome this detrimental impact by reviewing a number of affordable and implemented solutions. A case study of biogas in Georgia provides an interesting example of biogas in a country with cold winters (a separate print-out).

2. Biogas production

Biogas is produced under anaerobic conditions; the process is denominated as anaerobic digestion. The major constituent of biogas is methane (55-70%), CO_2 (30-45%) and some traces of gases such as H_2S and ammonia. Common digester feedstock (feeding material) is cow, buffalo and pig manure. A typical family needs at least 1 m^3 biogas per day to satisfy fuel demand for cooking. To produce this amount of biogas the manure of at least 3 cows' or 2 buffaloes' or 8 pigs' is required. The picture on the right shows a typical underground built domestic biogas plant.



A typical domestic biogas plant (model: deenbandhu)

3. Benefits

The benefits of anaerobic digestion are not confined only to private benefits; there are significant spillovers to the local, national and global environment.

1. Private benefits
A biogas installation tackles a great number of problems, such as access to sanitation (3,4 billion people lack access to sanitation), a shift from the reliance on traditional fuels to a modern fuel, biogas, thereby making a leap on the energy ladder. In addition, since women in particular benefit most from the biogas plant, the procurement of a biogas installation empowers women and reduces gender inequality. Furthermore, biogas can be utilized to meet several services next to cooking such as lighting and fuel for an internal combustion engine for mechanical shaft power or electricity generation.

"The new stove is cleaner, faster and more reliable. Before, smoke used to irritate my eyes, nose and lungs, and I had less energy. Now I don't have any of these problems. Before, I used to spend three hours preparing a meal. With the new stove I spend half that time. Now I can use that extra time to do other things at home."

Punyadumari Sanjel, age 70

Mr. Babubhai was barely able to make a living with farming for his family in a village in India. He attended a masonry training program for biogas plant construction and started working as a biogas mason. As a result his annual income almost doubled. During the lean season he used his newly acquired skills to work on other projects, such as house construction. Over the years he acquired a house and commodities such as a television and a bicycle. Now he is living comfortably with his family.

The most common direct private benefits

On site house energy production
Time expenditure and the drudgery of wood gathering are avoided or revenues are saved if fuels were otherwise bought for cooking or other energy services.
Latrines
Usually a latrine is attached to a digester. The addition of human waste to the process will increase gas production, improves local sanitation and hygiene and reduces the incidence of disease.
Reduction in pollution
Kitchen smoke is the main factor in indoor air pollution. Using biogas as cooking fuel dramatically reduces indoor air pollution.
Lower incidence of disease
Installing latrines and biogas fuelled stoves will lower the incidence of common diseases such as eye infections, respiratory diseases, smoking-induced coughs, diarrhoea, dysentery, and parasites among both adults and children.
Improved agricultural yields
Applying bio-slurry, the by product of biogas production will improve soil fertility and increase agricultural output. The side benefits are reduced use of chemical fertilizers, avoided expenditures and clean environment.
Time saving for women
Biogas plants reduce women's need to collect firewood and thus their workload. An evaluation of the biogas program in Nepal showed that women save 3 hours daily per household using biogas for cooking versus cooking with collected firewood.
Reduction in firewood consumption
The biogas fuel for cooking results in reduced pressure on native forests for fuel wood and leaves the forests' services intact.

2. local benefits
The main local benefits are spillovers from private benefits; the positive externalities which occur at local scale. The dissemination of biogas technology creates job opportunities in the rural areas, for instance the construction of digesters require masonry workers (both skilled and unskilled), technicians and employment in the financial sector. Widespread use of biogas reduces the pressure on the forests. Forests delivers a multiple of goods and services, such as spiritual and religious services; fodder, timber, medicines; non-timber forest products (fish, game, rattan, bird's nest); recreational sites and (eco) tourism opportunities and are therefore, an important asset to people.

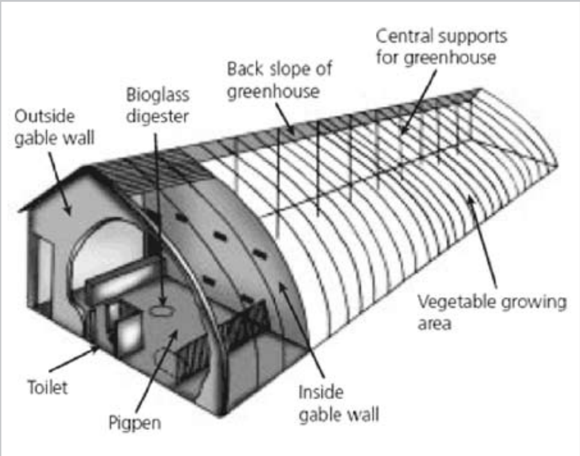
3. National/global benefits
National benefits arise from the sheer number of private and local benefits, such as reduced health costs, healthier and more productive population and reduced fuel imports. Another important benefit, which affects us all, is the mitigation of greenhouse gas emissions via three pathways:
1. Change in manure management modality: The release of methane from feedstock is captured and destroyed (utilized for energy services) and release to the atmosphere is therefore prevented
2. Fuel switch: The displacement of non renewable biomass and fossil fuels by biogas
3. Chemical fertilizer substitution: The production and application of chemical fertilizers results in considerable GHG emission.

4. Biogas in cold climates

Large areas in the developing countries are highlands or have a continental climate with warm summers but with cold winters. The low ambient temperature in these regions decreases microbial activity and hence the rate of biogas production. To overcome this, either the digester volume or the temperature of digestion has to be increased. In India for instance, the retention time of the feedstock in the tropical south is 30 days and in the north 50-55 days, hence the digester volume is around (55/30) 1,8 times larger. With this solution a digester functions well at an average temperature of 15°C. At lower temperatures heating is required. Next a number of promising low cost solutions for digester heating are discussed.

Bolivia – ProAgro/GTZ – Biogas at the Altiplano
In Bolivia inexpensive plastic tubular biogas plants are being popularized in the Altiplano, a barren plateau at an altitude of 4,000 meter. By capturing solar irradiation with a solar canopy (greenhouse covering), by hot charging, an increased retention time and finally by inertia (the sand walls have a high thermal mass which avoids rapid cooling of the system during the night), the digester remains at 10°C compared to 0°C ambient (from Jaime Marti Herrero)

Integrated solutions – The use of a multifunctional greenhouse
By the utilization of heat from a greenhouse system to enhance agricultural produce, digester and stable/house warming creates both income generation opportunities and a niche for biogas. A complete integrated solution would also connect a toilet for access to sanitation. BSP Nepal has constructed some of these systems with success at a height of 2,600-3,000 meter and SNISD in Yunnan China at an altitude of 2,800 meter.



The integrated solution of SNISD and BSP Nepal.

Heap composting (BSP Nepal)
A completely different approach is the utilization of aerobic heat resulting from composting of organic matter. It proved possible to increase the temperature of digestion to 8-11°C at an ambient temperature of -3°C. At the moment when the growth season starts, the compost is available as fertilizer (from Prakash Lanichhane).

Other approaches
A solar assisted biogas plants consist of a solar collector to capture solar heat for digester heating. This solution was on a limited scale practice in Georgia and received a fair amount of discussion among Indian scientists in the late 1980s. A solar assisted biogas plant is a relatively robust but expensive technology, cost deductions are possible by utilizing local skills and expertise, WECF and the partners have considerable experience with this.

5. Financing the technology

A domestic biogas plant is an expensive technology, \$400-\$800, a significant investment barrier. The running and fuel costs are however negligible and since a well built plant has a lifespan of over 20 years, the technology in general has a high internal rate of return. Tackling the investment barrier requires the combination of several solutions:
1. Investment subsidies
In Cambodia \$150 are refunded from the total investment by the families, the necessary funds are provided by donors. Carbon finance could also be utilized for this.

2. Micro financing – special biodigester credit
Provision of affordable credit which reflects a realistic payback period

3. Income generating activities – Extension programs to enhance and commercialize agricultural produce

Farmers are able to repay the credits as the investment pays off, i.e. the avoidance of purchasing fuels, time savings and improved agricultural production. NBP Cambodia estimates that around \$12 per month is saved in Cambodia. As before mentioned, a biogas plant mitigates the emission of GHGs. These carbon offsets have a value under the clean development mechanism and the voluntary carbon market. A review of the registered biogas programs showed that on average around 4,4 tCO_2 is claimed per household digester and this amounts to an estimated carbon rebate €22-66 per digester per year for a credit period of either 10 or 7 years. To fully exploit the financial opportunities arising from a biogas plant, it is imperative that activities are undertaken to generate additional income, such as a bio-slurry extension program and commercialization of agricultural produce along with capacity building.

6. Replication & discussion

Biogas technology is marginally implemented in cold regions. Most projects are of pilot scale in specific niches, all learning by doing, and it is therefore impossible to extract a best practice. We should however, not look at experiments for biogas alone since there is significant learning from the experiences with greenhouse construction and passive solar housing at high altitude regions. The results from these experiences could be combined to design an integrated system, which tackles a wide range of problems among poor households about the lack of sanitation, energy poverty, dependence on non-renewable polluting biomass, low income and the short growth season of crops. An integrated approach is the best solution to tackle poverty from the grass roots level, as it both reduces fuel costs and increases income. Financing biogas a program requires an approach aimed at both decreasing the investment barrier (microfinance, subsidies) and on providing the means to increase household income (capacity building and extension programs).

Introduction of improved metallic stove for people living in high altitude regions of Nepal

Hari Gopal GORKHALI

Introduction

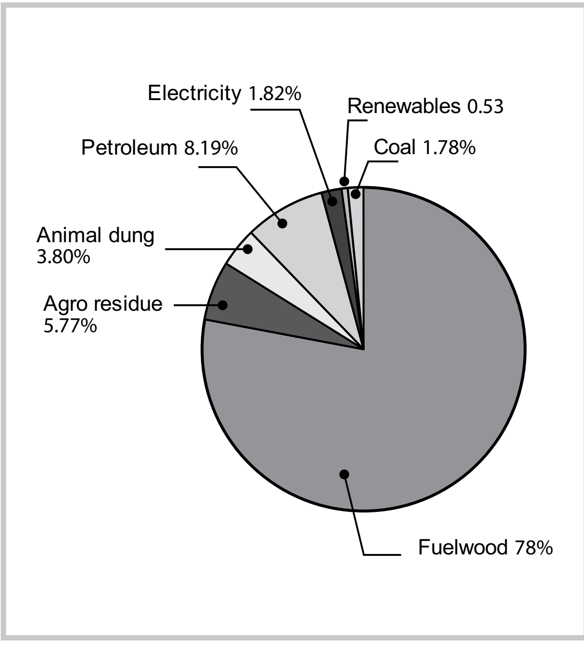
Majority of households in Nepal use open fire places inside their homes for cooking, heating and even for light generation. This badly affects their health especially among women and children (who spend more hours in a day around the open fire places than men), as the "pine" and "utish" woods used in the high altitude regions of Nepal have a lot of resin and burn producing lots of black smoke.

Interim Improved Metallic Stove is specially designed for space heating and cooking for people living in high altitude regions of Nepal, and also specially designed to protect people's health from smoke as it takes all the smoke out of the room through a chimney. Thus the indoor air is clean and the firewood consumption is also reduced up to 40%. It has 3 pot-holes of different sizes to allow cooking rice, lentile and vegetables, at the same time providing hot water continuously from small attached-tank for washing purposes. There is also a provision of bread roasting slit on which one can insert roti/bread directly exposed on to the flame/fire inside the combustion chamber.
This stove has a double bottom, which is insulated with mud underneath, and a firebox, from where the fire flames directly hit the pots. Draught can be regulated through an adjustable vent in the main door and a damper in the chimney.

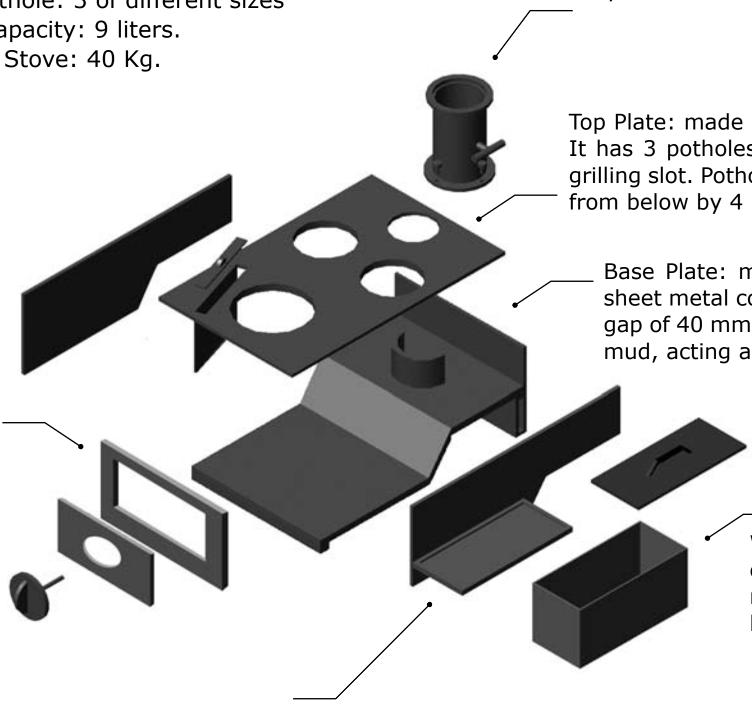
Picture of a complete improved metallic stove.

Energy consumption pattern of Nepal

Over the years, biomass has served as a main source of energy in the world especially in developing countries like Nepal. These account for about 88% of total energy consumption in Nepal (WECS, 2006). Among biomass fuel wood, agricultural residues and animal dung are being utilized as a main source of energy since centuries.



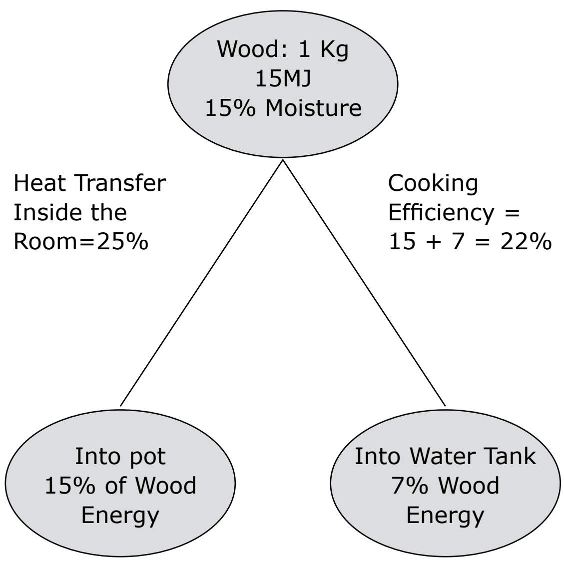
Specifications:
- Length : 675 mm
- Breadth: 430 mm
- Height: 260 mm
- Number of Pothole: 3 of different sizes
- Water Tank Capacity: 9 liters.
- Weight of the Stove: 40 Kg.



Performance

- Consumes around 40% less firewood compared to the traditional open fire stoves.
- Average firewood consumption per person per day for all day for food and space heating is 1.8kg to 2.6kg.
- Maintaining average room temperature of 31-32°C
- Maximum pothole temperature: 300-350°C during cold and up to 450°C during hot
- Time of firewood burning: 30-35 minutes for 1 kg fuel wood.
- Water temperature inside the tank: 30-40°C
- Cost: NRs. 6000.00-7000.00 (US$.75-87)

Energy flow chart



Subsidy policy

According to Nepal Government Policy on "Renewable Energy Subsidy Arrangement 2008", following subsidies have been arranged for Metallic Stoves:

• Flat subsidy of NRr. 4000.00 (US$ 50.00) will be provided to Improved Cook Stoves used for cooking and space heating, as they are costly and unaffordable in high mountain regions.

• Subsidy will be provided to the people who live above the altitude of 2000m or above1500m in the case of north facing areas.

Program

Under ESAP Phase II, Biomass Energy Support Programme has set aside a target to install about 50,000 Metallic Stoves with partial subsidy in high mountain areas of Nepal for 2007-2011. The program is funded by Energy Sector Assistance Program (ESAP) of DANIDA and executed by Alternative Energy Promotion Center (AEPC) of Nepal Government. The Center for Rural Technology, Nepal (CRT/N) has been working as a key service providing partner to AEPC/ESAP and facilitator to National Biomass Activities in 16 of 75 districts. The overall objective of the program is to support the development and application of the new biomass technologies like mud made Improved Cook Stoves for mid hills; biomass gasification and metallic stoves in high mountainous areas where space heating needs are to be addressed. The program will also facilitate for improved capacity of local organizations to offer affordable biomass energy (BE) solutions to the rural communities with quality assurance.

Achievements

• With high priority, Government of Nepal has launched the Metallic Stove dissemination program in cold regions of the country for 2007-2011

• 15 manufactures are pre-qualified by AEPC /ESAP and trained to manufacture quality metallic stoves

• Few hundreds of metallic stoves are already being distributed in high altitude areas under the ESAP Phase II program.

• Increase in demand for more stoves from northern part of Nepal.

• Since 1999 about 4500 Metallic stoves are being distributed by Rural Integrated Development Services (RIDS-Nepal) in Jumla district situated in northern part of Nepal with 50% financial subsidies.

Cooking and warming family members from Improved Smokeless Metallic Stove

Positive aspects

Experience has shown that smokeless metal stove saves fuel consumption and cooking time. The installation of an Improved Smokeless Metal Stove in households has drastically reduced the amount of IAP produced. Breathing has become easier and families enjoy much more to sit around the warm stove and in the kitchen for long time in cold season. Children are much cleaner; their hands and faces can be regularly washed with the hot/warm water from the water tank.

Moreover, the local traditional meal can be cooked all at once. Homes are much cleaner, without smoke and black soot in the air of the kitchen. The important aspect of the stove is heat that is produced inside the kitchen, which is a great relief in those villages that are situated at a high altitude, around 3,000 meter and experience freezing temperatures and heavy snow for 5 months of the year.

Rehabilitation of degraded rain fed agricultural land in Tajikistan through household energy efficiency

Frank LÖWEN

Abstract

Tajikistan is a landlocked country in Central Asia with predominantly continental semiarid climate. Due to the rough topography of the high mountainous region only about 7% of the country's surface land is suitable for agriculture. During the period of Soviet Union (1924-1991), large amounts of heavily subsidized agricultural inputs and fossil fuel sources were available for the overwhelming rural population. Nowadays large parts of the country's rural population are not in the position to regularly purchase expensive external agricultural inputs. Instead they strongly rely on the locally available natural resources, which are nevertheless often used in a very inefficient and wasteful manner. As a result signs of severe natural resource degradation are widespread.

The consumption of large amounts of firewood and animal dung by rural households as major fuel source for cooking, bread baking and winter heating is one of the major driving forces for advancing natural resource deterioration. The amount of dried animal dung used as fuel source can be as high as 25 tonnes per year for one single family. Low cost options to improve household energy efficiency have shown the capacity to drop fuel requirements of rural families by 50% and allow even resource poor farmers to return large amounts of animal dung back to their plots and to improve agricultural production by their own means.

1. Introduction

Tajikistan is economically the poorest country of the former Soviet Union. Most of the country's territory consists of semi arid high mountainous land and only about 7% of the country's surface land is suitable for agricultural activities. More than 50% of the country's populations of approximately 6 million people live in rural areas.

Since February 2007, respectively January 2008 Welthungerhilfe is implementing two EC TACIS supported integrated rural development projects in the three districts Baljuvon, Temurmalik and Khovaling of Southern Tajikistan. Most of the land in the predominantly rain fed area is severely degraded. Water and wind borne erosion, deforestation, removal of agricultural crops as well as the regular collection of animal manure as fuel have contributed to sharply reduce the nutrient and humus content of soil.

Annual precipitation in the area varies with the altitude and additionally shows a high variation from year to year. As an average the area receives an annual precipitation of 400-1000 mm in the period between autumn and spring whereas the long summer periods tend to be hot and dry. Key water-related problem in the area is not the unavailability of sufficient precipitation for agricultural activities as such but its uneven distribution combined with reduced capacity of water infiltration and retention by the degraded soil. In particular during the second part of the summer period water scarcity negatively affects the crop development. Agricultural yields in the project area are often not even allowing farmers to recover their investment costs.

During the period of the Soviet Union (1924-1991) "resource use efficiency" was not considered important. Instead the population was used to have access to large amounts of highly subsidized agricultural inputs and fuel sources such as gas and coal. After the country's independence the situation changed dramatically. Due to financial constraints nowadays large parts of the population are not even theoretically in the position to purchase agricultural inputs or expensive fuel sources on a regular basis. Instead most rural families strongly rely on the locally available natural resources, which are however till the present often used in a very wasteful and destructive manner.

To address dwindling agricultural productivity on degraded rain fed land in semi arid regions of Tajikistan numerous projects have concentrated their efforts in past years on the distribution of "improved seeds" and chemical fertilizers to the local population. Large amounts of money have been invested on purchasing and distribution of expensive external agricultural inputs. The approach has clearly failed to improve local agricultural production in a lasting manner. By the end of project implementation period most local families were unable to buy expensive agricultural inputs by their own means. Apart from that, the application of chemical fertilizer and improved seeds are not able to address one of the most severe limitations of rain fed agriculture in the region: the low water infiltration and storage capacity of the soil, which is affecting water availability for the crops during the long dry period.

Table 1: Comparing characteristics of mineral and organic fertilizer in the Tajik context

	Mineral fertilizer	Organic fertilizer
Type of nutrients	only N, P, K	many different macro and micro nutrients (N, P, K, Mg, Ca, Fe, Cu, Zn, Mn)
Price	expensive, constantly rising prices	free of charge or at low price
Availability	not always (some types only produced in Uzbekistan)	locally available
Other properties	only successful when other conditions (water, temperature) are optimal	improves general conditions of the soil, longer-lasting effect

2. Need of an integrated approach

To achieve lasting positive impacts on agricultural production, the major constraints of current low productivity of crops need to be thoroughly analyzed and understood. In the case degraded rain fed areas in Southern Tajikistan the implementation measures to improve the water storage and retention capacity of the soil plays a particular important role for improved crop development. Whereas the application of chemical fertilizer is not able to make a significant contribution for enhancing water availability of degraded soils, the use of organic fertilizer can help to substantially increase the water infiltration and retention properties of the soil. One ton of dry animal dung has the capacity to store about the same amount of water!

Most of the local population in the project area is at the same time engaged in subsistence agriculture and extensive animal husbandry. Large amounts of animal dung from donkeys, cows, sheep and goats are locally available- but so far hardly used as organic fertilizer. Instead, influenced by the lack of affordable alternatives, large parts of the local population use most of the available animal dung together with increasingly scarce fire-wood as major fuel source for cooking, bread baking and winter heating. Efficiency of locally used facilities is very poor and annual consumption of dried animal dung as energy source at household level can be higher than 20 tonnes per family.

In the case of extremely poor households the percentage of available animal dung used for cooking and heating can reach up to 100%.

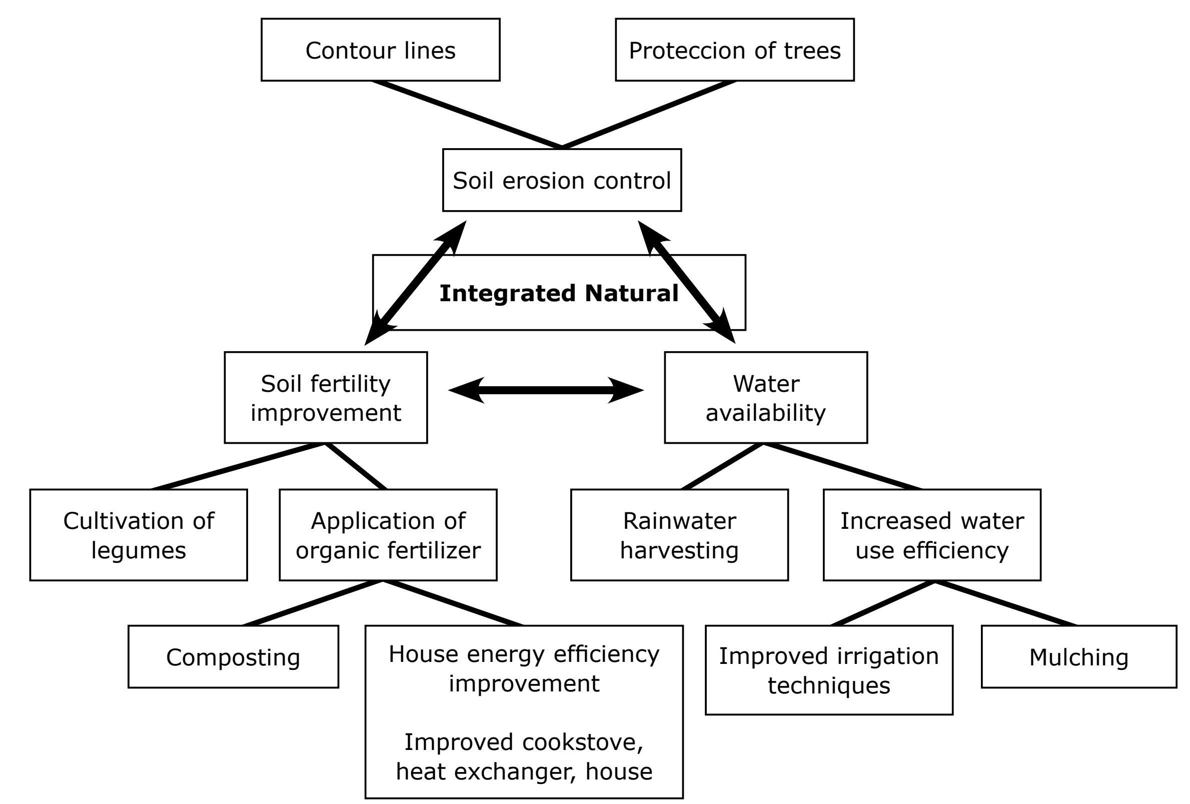
To break the vicious cycle between decreasing soil fertility and deteriorating agricultural yields, Welthungerhilfe is following an integrated approach, which is linking the activities to raise resource use efficiency at household and farm level. To improve agricultural production, special emphasis is given on the reduction of soil erosion and increasing humus content of the soil. The humus content is of particular importance as organic material has the capacity to substantially increase both: soil fertility as well as the infiltration and water storage capacity of the soil.

To address the inefficient use of important natural resources at house level, a number of innovations and complementary measures have been developed. Rather than seeking to promote sophisticated measures, which might be very efficient but expensive and difficult to multiply under the local conditions, emphasis is given to options that are simple, cost efficient and easy to replicate.

Table 2: Annual house energy consumption of a rural family in Temurmalik District, which use exclusively dry animal dung as locally available fuel source at household level

	kg per summer period (7 months, 214 days)	kg per winter period (5 months, 151 days)	total kg per year
Cook stove	21,5 kg per day 4,60 to. per summer	0	4,60 to.
Iron stove	0	40 kg per day 6,04 to. per winter	6,04 to.
Bread oven	80 kg per week 2,40 to. per summer (30*weekly consumption)	100 kg per week 2,10 to. per winter (21* weekly consumption)	4,50 to.

Figure 1: Major elements to be considered for the rehabilitation of degraded rain fed land



To enhance the general sense of responsibility and ownership, Welthungerhilfe expects, in general, significant personal contributions from the target population for different project activities. Nothing is given to the local population for free. Instead apart from labour, on an average personal financial contribution between 50-100% is expected to cover expenses for required materials.

Energy efficiency improvements developed for household energy efficiency increase

Improved cook stoves
Locally used cook stoves are commonly made out of clay. To raise their efficiency, simple adjustments have been developed to improve airflow and to optimize the position of the pot towards the fire. A simple metal sheet is used to avoid heat loss through the open front part. Due to a cleaner burning process, smoke concentration level in the kitchen can be significantly dropped. The modification of local cook stoves can be realized in about one hour and can help to reduce fire requirements by around 50%. Dedicated and enthusiastic local women are integrated into the project work as promoters.

Promotion of more efficient bread baking
Bread is one staple food of the Tajik population and around 30% of fuel material consumption in the project covered rural areas is used for bread baking alone. In the project area bread is prepared two-three times per week. Currently many local women are baking alone, using in each occasion an average 9kg of wheat flour. Per kg of wheat flour consumes an average of 0,9 kg of firewood or 1,8 kg of dried animal dung in the process of bread baking. Most of the energy is used for bringing the temperature of the room to around 30oC from outside condition. If several women bake their bread one after another, huge amount of fire–wood can be saved. In this case, rather than promoting mainly technical adjustments to the bread ovens, Welthungerhilfe promotes "joint bread baking" activities among rural women to decrease fuel consumption.

Raising the efficiency of winter heating systems
During the cold winter period traditionally simple iron stoves are used at the same time for cooking and to warm one room of the family's house. Conducted energy efficiency assessments revealed that most of the produced heat is lost through the

exhaust pipe. In order to address low energy efficiency of traditional winter heating systems, a complementary element called "heat exchanger" has been designed and further adjusted. The "heat exchanger" is integrated into the exhaust pipe of traditional winter heating system and its main purpose is to reduce the flow of hot air in the pipe and to increase the surface for heat transmission into the room. A box integrated into the heat exchanger can additionally be used as an oven. By using "heat exchangers" fuel requirements can be dropped by 50-70%.

Enhancing house insulation
Due to poor insulation, in many rural houses, generated heat in the room vanishes quickly. As a first step to address the situation, actions have been initiated to promote low cost insulation of house ceiling, doors and windows with utilization of locally available materials (mainly wheat straw, clay and sheep wool).

Promotion of low cost rainwater harvesting
As a complementary measure to contribute to more efficient resource use at household level; low cost plastic rainwater retention ponds have been developed. The benefits of these structures are manifold and include increasing (woody) biomass production during the dry summer period as an additional and sustainable source of fuel materials.

3. Achieved impact and perspectives

So far about 1,200 local families have shifted to the use of improved cook stoves, 100 families have acquired heat exchangers to improve winter heating systems and more than 250 families have improved insulation installed in one room within their house, which is occupied in winter by the entire family.

Families, who have adopted some of the developed low cost innovations, have been able to experience substantial positive changes. Women and children, who in rural Tajikistan carry most of the responsibility for procurement and preparation of fuel material, have been relieved from this part of their high daily workload. The use of improved cook stoves has created a healthier working environment at kitchen level. The conducted activities in the field of household energy efficiency improvement have allowed the projects to substantially improve its cooperation with rural women, who tend to be largely underrepresented in many other project activities.

With fuel requirements dropped to as much as 50% (which in some cases is equivalent to annual savings per family of 10 tonnes of animal dung as fuel material), the introduction of innovations at house level have open even resource-poor households a viable path to return large amounts of animal dung as organic fertilizer back to the agricultural plots. Local farmers who have started to apply more organic fertilizer and erosion control measures on their land have, already from the first year, been able to observe tangible positive changes in terms of plant development, drought resistance and yields. If the application of activities to raise energy efficiency at household level as well as the application of appropriate soil management continues to increase, the resilience of rural families and entire communities to drought should further raise.

Initiated activities by Welthungerhilfe in Southern Tajikistan represent the largest successful initiation of energy efficiency improvement campaign for rural areas in recent decades, not only in Tajikistan but in Central Asia as a whole. However, so far the positive impact has been mainly achieved at family/household level. In order to reach a lasting positive effect on natural resource development at community level as a whole, the amount of participating families is still too small. So, there is a need to think for viable options to further spread and scale up the initiated activities in the field of household energy efficiency improvement.

Apart from ongoing promotional activities within the project area, since an early stage complementary activities for information sharing with governmental institutions, donor organizations and other project implementing agencies have been launched. Governmental institutions so far remain largely inactive apart from verbal support; at donor and implementing agency level positive developments can be observed. In several cases other organizations or projects have already started to promote some of the developed innovations in their own working area.

Last but not least it is worth to mention, that the initiated activities in the field of household energy efficiency improvement have not only triggered positive impacts among rural families but have at the same time helped the project itself to use its own resources in more efficient and sustainable way. Rather than spending large amounts of money for the distribution of agricultural inputs, which once the project intervention ends, will again become unaffordable for large parts of the rural population, the project's interventions in the field of raising resource use efficiency at household level are expected to produce lasting positive effects even long time after the project has come to an end.

Cane reed house: 19^{th} century idea, 21^{st} century solution

Indira ASEYIN

Introduction

Searching for solutions to provide needy families with an affordable housing, HFH Kyrgyzstan started an absolutely innovative in Habitat world project - Cane Reed Houses, in September 2004. These houses are built using local materials - cane reed mats that are environmentally friendly, energy-efficient, seismically stable, affordable and fast in construction. Habitat Kyrgyzstan's innovative Cane Reed project won US$116,389 World Bank Award at the prestigious World Bank Development Marketplace competition that took place in Washington DC in May 7-10, 2006. The winning project "Cane Reed: 19th Century Idea, 21st Century Solution" is among 30 winners chosen from 2,500 applicants from 55 countries. In May 10, 2007 construction started and the families built 2 row houses (each of 5 apartments) with the help of local and GV volunteers. To date 48 cane reed houses have been built.

We will present this type of technology, which was recently improved by the implementation of a solar collector system for warm water and heating – in collaboration with Women of Europe for Common Future.

History of the project

Kyrgyzstan's population amounts to 5.4 million. 70% of them live under substandard housing conditions or are homeless, live in dormitories, with relatives and friends. Due to social and economic problems poor families move to the overcrowded capital, searching job and shelter. The population of the capital city Bishkek has grown from 800,000 to 1,500,000 people during the last five years. The capital is overcrowded and in extreme need of decent houses. It is not unusual for 3 generations of a family to be crowded in one single room with no heating or running water. About 700.000 people (45% of the population) live in new housing estates around Bishkek with no central infrastructure, many of them having electric or solid fuel house heating. Solid fuel heating often means dangerous makeshift furnaces. Besides the new builds, there are 13 housing estates in Bishkek, including 40,000 unfinished, to 30-70% completed houses. Our innovative heating system can also be applied while renovating/finishing these houses.

House building is extremely expensive, as is heating a home. Families must spend up to 50% of their earnings on heating. Electric heating is clean but dangerous because often makeshift furnaces are used, and almost unaffordable. The traditional solid fuel heating, used by 80% of the population is cheaper but pollutes, does not properly heat all the rooms, even kills through CO poisoning and causes excessive misuse of forests and coal resources. As solid fuel heating is the cheaper, people are forced to be unconscious of pollution and new technologies. Their main concern is to heat the house and still having enough to eat.

One of the greatest problems on national level is the disparity between energy production and consumption. Kyrgyzstan consumes more coal, oil and natural gas than it produces which causes dependency on import. At the same time, local electric energy production is almost 50% higher than the current consumption. Further, the loss of energy by consumption is exorbitant. The country's energy development program aims at reducing energy loss, introducing energy saving technologies and taking measures against pollution and climate changing caused by the use of gas, coal, biomass etc.

In the long run, our innovative method can tackle poverty housing, misuse of energy resources, dependency on imported energy and last but not least by saving a considerable percentage of their income, help the poor to live a decent life.

The government of the overdebted new republic is currently unable to tackle the problem of social housing. Habitat for Humanity has already proven to be able to mobilize the communities by building simple, decent and affordable houses at no profit or interest, involving volunteers. The energy-saving programs of the country are relatively new.

The purpose of the project to provide an affordable and environmentally clean house heating to poor and low income families, by building houses using a traditional cane reed and clay construction technology, combined with a coiled circuit under floor heating system.

As a solution to the building costs and to the energy problem our innovation of combining the traditional reed and clay construction technology with the relatively new coiled circuit floor heating system, has allowed us to achieve both low construction and heating costs. We have achieved a capital construction cost saving of circa 40% and the innovative, clean and cheap floor heating system saves 75% of the energy costs. The reed and clay technology is in used in the floor, walls and ceiling of seismically stable timber carcass home. The heating system is 'sandwiched' between the slabs of reed and clay, and the concrete floor slab. The water in the system is 30ltrs with a 10ltrs boiler tank and the circulating pump 3.4 kW.

Idea and innovation

The 'rule of thumb' in construction technology is: 'a low construction cost delivers a high running and maintenance cost' or 'a high construction cost delivers a low maintenance and running cost.' By combining the traditional cane, reed and clay construction technology, and the relatively new coiled circuit under floor heating system, we have achieved both low capital construction costs and low maintenance and heating costs – without compromising the structural integrity of the home.

Our project addresses the problems identified in the previous points by building simple, decent, warm and affordable houses for the poor:

- Using cane reeds for heat isolation in the walls, ceiling and floor construction (cane reed is a seismically stable and meets local building codes, is an ecologically pure and cheap natural building material produced locally),
- Using an innovative floor heating system, through a local company, which is cheap and easy to install, involves low electric energy consumption, is safe, environmentally friendly, and warm,
- And disseminating this project (old technology with a new technology) to people, raising awareness, to expand the project;

The innovation in this project is the combination of an old technology - use of cane reed for building houses that we developed further – with a new technology: the innovative coiled circuit under floor heating system. Opposing to the traditional 19th century cane reed houses, we build the house with a timber frame that is filled with cane, reeds and clay. This construction has improved insulating properties, is seismically stable and meets local building codes, is low cost and minimizes the impact on the environment. The floor heating system is unique in terms of using extra thin pipes, thus minimizing the volume of water circulated in the system. A further innovation is the laying of the floor and the heating system in one step.

The building of the first 3 individual pilot houses in 2004 took us 6 months. The greatest barriers were the rainy weather during construction, the search for a reliable cane reed supplier and the search for appropriate construction materials, such as plastic pipes, heaters, boilers etc. During this process we found our partner organization Chelebi which provides us the materials cheaper and is willing to take part in the further development of the innovation to duplexes and multi-home houses.

Project awards and international recognitions

"Cheap and Clean Electric House Heating for the Poor in Bishkek" project was selected as a finalist for the 2008 World Habitat Award.

"Providing Affordable Housing to the Poor by combination of traditional building method with an innovative heating system" project was selected as a Best Practice by an International Independent Jury for Best Practices in the year 2006 for its outstanding contribution toward improving the living environment.

"Cane reed: 19th century Idea, 21st century Solution" project was selected as a finalist in Development Marketplace Global Competition 2006 and won award 116, 000 USD for building 10 new houses.

Project beneficiaries and results

Kyrgyzstan is one of the poorest countries of the former Soviet Union. The country provides poor protection from harsh winters, yet families continue living under these inhumane conditions because they cannot afford something decent. Habitat for Humanity Kyrgyzstan is the only organization in the country, providing simple decent and affordable houses to the poor. Our houses built with the new technology are highly appreciated by the Construction and Architecture Commission under the President of the

Republic. The city's architecture and construction commission will support us in designing the house and getting authorizations and construction permits for project implementation. The municipality will provide access to water and electricity.

Project success is measured by following:

- Energy services are improved, safe electrical heating is provided to at least 60 poor people then to whole communities.
- One family will save up to USD 60 per month. For this money you can buy 490 loafs of bread, or 20 kg of meat, or 160 ltr of milk. It means practically, that a family can feed all its members on the money that it saves through energy savings.
- Through building the houses together with the homeowners, we not only build houses but also communities. The savings can also be used to improve the living conditions of the families and secure the mortgage payments of USD 15-25 per month.
- The use of solid fuel is reduced, resulting in less pollution and improving health.
- The community saves up to 3000 kilowatt/family and per month that is the equivalent of USD 60.
- Reed houses are seismically stable: what is important particularly in the mountain regions.

Financial viability

One of our financial resources is our revolving fund funded by donors and by the monthly mortgage repayments of homeowner families that will be used for the up-front investment. The loan bears low interest and has a life time of 15 years. Due to the savings of 60$/month through this project, the families will be able to pay the monthly installments, and the revolving fund will help us to help more poor families. Average cost per cane reed house is 12000 USD for 45 m^2.

As Habitat Kyrgyzstan working on eliminating poverty housing in Kyrgyzstan by developing communities through building and renovating simple, decent and affordable houses in partnership with families in need the role will be to house poor people in Bishkek and demonstrate the efficiency and the better way to improve their life. Habitat Kyrgyzstan is the affiliate of Habitat for Humanity International and was established as non-profit, non-governmental organization in 1999. Has 2 affiliates in Kyrgyzstan: HFH Bishkek and HFH Barskoon. The organization is funded by donations from individuals, organizations, churches and companies.

One of the organization strength is a revolving fund principle of donations from organizations and individuals are combined with mortgage payments from homeowner families to build more houses. This makes more people have houses, take responsibility to repay and support value.

Organization has well worked out and sustainable planning, implementation, monitoring and reporting system. It has a monthly activity tracking on construction, partnership developing, volunteer recruiting, training, fundraising and program managing. Have served 130 families, have sustainable partnership with the government, signed a MOU between Habitat and the Government, have partner organizations both local and international, recruited over then 200 volunteers, have contacts with every provinces of the country working on incorporating Habitat programs such like new building, renovation, partnership work, half build completion and so on.

On November, 2008 by financial support of WECF was installed new pilot solar heating system in one of existing cane reed house. To date is conducting monitoring process in different season and to be planned to issue report on this innovative idea in the next year. We will be happy to share with all of you.

Improving winter livelihood of rural population in the cold desert of Western Indian Himalayas

Aurelie AGNIEL, Rigzin DORJEY and Rigzin NAMGAIL

1. Introduction

The project "improving the winter livelihoods of rural population in the cold desert of Western Indian Himalayas through dissemination of energy efficient housing" covers three districts of Leh, Kargil and Lahaul & Spiti of Jammu & Kashmir and Himachal Pradesh states in India.

The environment of these high altitude cold desert areas is very harsh: severe temperatures in winter, a short frost-free period, very low rainfall and scarcity of vegetation. Villages lie between 2800 and 4600m above sea level. The region is isolated not only geographically, with roads remaining closed for six months a year, but also economically with limited access to the markets of mainland India. The 300,000 inhabitants of the target area are also culturally isolated due to its Tibetan heritage. The population is largely rural, living in isolated villages, depending on agriculture as a subsistence activity. Their lives are mainly aimed at surviving the long and harsh winters.

Energy vulnerability is widely recognized as a factor reinforcing poverty. Local population do not have access to energy facilities and depend on biomass based energy inputs. Shortage of firewood and the high price of imported conventional fuels result in a situation of high energy vulnerability. Women and children have to devote about two months per summer to gather firewood. Traditional houses are thermally poorly efficient and room temperatures fall below -10°C in winter, resulting in unhealthy living conditions. By reducing the energy vulnerability, improving the heating conditions, reducing the unhealthy indoor air conditions, the project supports the progress of the communities towards development.

The project is effective in Leh district (Nubra, Sham, Changthang, Leh area) and Kargil district (Zangskar, Drass, Suru valley, Kargil), in Jammu & Kashmir state; and in Lahaul and Spiti district in Himachal Pradesh state.

2. Objectives

The project aims at disseminating energy efficient housing in these regions, and therefore improving winter livelihoods of rural population in the cold desert areas of Indian Himalayas.

The specific objectives are:
- Integrating energy efficiency techniques in 1,000 private and community buildings
- Organizing sustainable networks for dissemination of energy efficiency measures
- Enabling income generation activities in the newly warm houses
- Reduce the pressure on local and global environment.

3. Integrating energy efficiency in domestic and community buildings

3.1 What is a passive solar house?

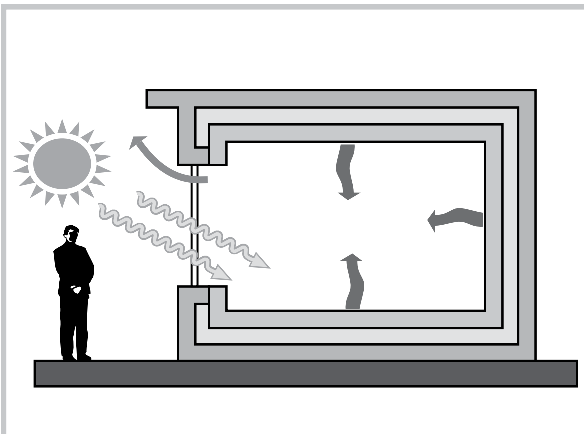
Passive solar house aims at taking advantage of solar radiation during the cold season to heat the inner space of a building. Through south facing walls and large south facing windows the house collects solar radiation during the day and enables the rooms to remain warm both during day and night.

Four factors work together to make a passive solar house efficient:

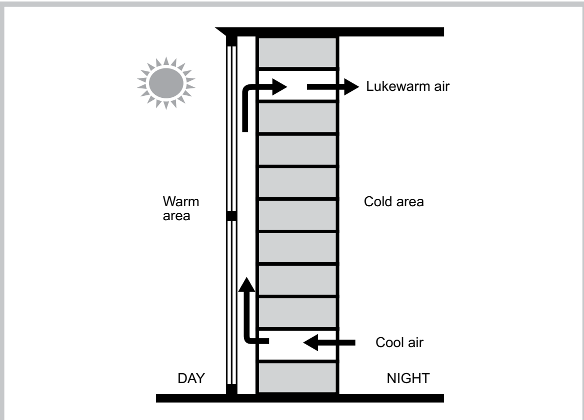
a) Collection of solar radiation during the day
b) Storage of the heat collected during the day
c) Release the heat inside the building at night
d) Insulation of the whole building to retain the heat inside the building as much as possible

3.2 Passive Solar Gain

The orientation of the house must be south-facing, and it should receive at least six hours of sun in a day, to be effective. Three different technologies of solar gain are promoted by the project: Trombe wall, Attached Greenhouse and Direct Gain.



3.2.1 Trombe wall
The southern wall is painted black and is covered with double glass to absorb maximum heat during the day. This heat is transferred slowly into the room and is released during the night. The air in the space between the glass and wall is very hot; this hot air circulates inside the room through the holes that are located at bottom and top of the wall.



3.2.2 Attached Greenhouse or veranda
A greenhouse is attached to the house on the southern side. Heat is transferred to the adjacent room by convection and radiation through the window, and by conduction through the wall. People can carryout handicraft activities in the greenhouse when it is nicely warm during the daytime.

3.2.3 Direct Gain
A large double glass window is integrated on the southern side of the house to heat the room by radiation. During the night, thick curtains are used to reduce heat loss.

3.3 Thermal mass and insulation
During the day heat is stored in the properly insulated roof, walls and floor, which is released during the nighttime. The walls, roof and floor are properly insulated. The insulation material could be straw, sawdust or any other local material.

4. Implementation methodology

4.1 A dynamic NGO network
A network of five Ladakhi NGOs and one Euro¬pean NGO, work together in implementing this project. The local NGOs are organized into as resource NGOs and proximity NGOs. A resource NGO, experienced and skilled for an activity, elaborates a methodology and advises other NGOs. Proximity NGO, technically less experienced but with a trustful relationship with the communi¬ties in its working area, takes advantage of resource NGO's expertise to implement the project. A resource NGO can also implement the proj¬ect as proximity NGO in its own area. GERES, a European NGO, coordinates the net¬work and elaborates the implementation methodology with the resource NGOs.

4.2 Two phases: demonstration and diffusion
The project is divided in demonstration phase and diffusion phase. Two different selection methodologies have been set up for the two phases.

The demonstration phase targeted key persons of the community who were able to demonstrate the interest of the innovation: one demonstration house has been installed in each village, making 100 demonstration sites.

In the diffusion phase, the household selection was based on technical, social (0,5 €/day/capita) and motivational criteria such as: future or existing house had to be south facing, with enough sunny hours and no shade, the owner's agreement to invest by participating to the construction cost, one adult family member has basic handicraft skills, the motivation to incorporate energy efficiency measures in building and to assure maintenance.

4.3 Organising sustainable networks for energy efficiency measures
A main objective of the project is to set up all required conditions to insure a large and sustain¬able dissemination of energy efficient housing tech¬niques after the project period. In this view, the project aims at organizing and strengthening two types of sustainable networks at different levels to allow a large diffusion of energy efficient housing measures.

4.3.1 Training and organising artisans as service provider
100 masons, carpenters and 15 rural engineers are trained and certified as service providers for renovation and construction, based on energy efficien¬cy techniques.

4.3.2 Setting up 15 grassroots level networks
These networks, set up at the level of village clusters, play a very important role in ensuring grassroots' participation in the project as well as acting as a pressure group to advocate policy with the district authorities.

5. Impacts

5.1 Environmental and energy impacts
The fuel consumption of households for space heating has decreased in winter by 70% or 2 tonnes of biomass is saved. 95% of the PSH owners stopped collecting bushes which are otherwise uprooted, hence no regeneration. The indoor atmosphere of the building is improved; people live in comfortable temperature without much heating. The temperature inside the room is 20°C more than the outside temperature and is always above 5°C.

5.2 Social impacts: Increased household and community centre activities
The warmer atmosphere in winter invariably increases the duration of activity, which up to now is limited to the sunniest hours (2 hours per day). As a consequence, the inner atmosphere becomes much more comfortable from morning to evening (6 pm). The supplementary time is used to practice winter activity i.e. handicraft production. At the household level, social relations have increased as families have more comfortable space to receive family relatives, neighbours and friends. In addition, it was observed that children spend more time to read or to study when the house is warmer. The time for the religious prayers has increased as well. The community centres are more open to receive members who can conduct meetings or other social affairs.

5.3 Financial impact
As the fuel consumption is reduced, the amount devoted to fuel wood collection has also decreased. In the areas where fuel is bought (due to scarcity of natural resources, no subsidy) the money saved is 50 euros per winter.

5.4 Health and hygiene impact
The less frequent use of heating stoves reduces the toxic gas emissions and improves the indoor air, reducing the chances for cases of respiratory infection and associated diseases. Children and expecting/feeding mothers are the most significant beneficiaries of this improvement. Adults suffering from arthritis are relieved with the warmth in the room. As the room temperature is controlled, women no longer have to use heating/cooking stoves and have shifted to more efficient means of cooking, like gas stoves. Thus the indoor air is improved even more.

5.5 Gender impact
The improvement of indoor atmosphere has a clear direct impact on women's living conditions. Since women are the one's performing much of the household activities, the usual rigidity of domestic tasks (clothes washing, cleaning, cooking and looking after children) is relieved to a great extent. In addition, the arduous task of collecting fuel wood for women and children are immensely relieving: in some areas the time of collection of fuel wood required for cooking purposes are reduced from two months to few weeks.

6. Project funding

The project, lasting from 2008 to 2012, is funded by the European Commission with co-funding from the French Fondation Ensemble, Gaz and Electricity of Grenoble (GEG), the Lord Michelham of Hellingly foundation and other private donors. It involves a staff of more than 60 persons and benefits directly to 1.500 families or 10.000 persons.

7. Project partners and contacts

1. Groupe Énergies Renouvelables, Environnement et Solidarités (info@geres.eu)
2. Ladakh Ecological Development Group (info@ledeg.org)
3. Ladakh Environment and Health Organisation (sultana@leholadakh.org)
4. Leh Nutrition Project (lnpleh@yahoo.co.in)
5. Students' Educational and Cultural Movement of Ladakh (publication.info@secmol.org)
6. ECOSPHERE (ishita@spitiecosphere.com)

Energy risks in Kyrgyzstan and their mitigation through use of renewable sources of energy

Ilia DOMASHOV and Anna KIRILENKO

Modern energy crisis in Kyrgyzstan has put the greatest impact on small mountain communities, and natural ecosystems in the country. As a response to this challenge "BIOM" developed the concept of individual ecological safety measures, aimed to help such communities through several priority programs, such as:

1) RE for local communities program - we conduct information-practical seminars, where local population gets knowledge about simple methods to save energy and use of renewed energy sources in household conditions, skills to make simple installations, and discuss positive effects of using RE for mitigation of climate change and conservation of local mountain ecosystems.

At present BIOM works with 30 villages, mostly located in the mountain regions or near nature protection areas. They are joined into "Solar villages of Kyrgyzstan" network and are involved in development of local strategies on increasing energy-efficiency and ecological safety measures. In 2007-2008 BIOM also conducted several researches on adaptation of local communities to the consequences of climate change.

Besides BIOM has established a solar laboratory which investigates new designs of solar barrels, collectors, etc and the most effective ones are now presented at 7 RE exhibitions, where people of diverse civil group can choose the most suitable installation for use.

2) Energy-saving for youth (SPARE) – has been working in KR since 2002 on improvement energy-efficiency in schools. More than 70 schools of the country are now involved in the program.

3) Assistance to use RE at the country level. BIOM took part in development of the Law about RE, and now actively cooperates with parliament and political parties for development of a national policy in this sphere.

Also separately we realize some initiatives in the sphere of rural development in mountains villages of Kyrgyzstan. Bellow we represent more detail information about some of our initiatives:

1. Our fields of work in Asia

1.1. Development of methods for effective energy management in the local community

As in the Novopakrovka village (Chuoblast of Kyrgyzstan), people have uncovered some priority problems in the sphere of energy:

a) The electricity can not cover all needs in cooking, but the transition to other energy resource (furnace heating) increases the burden on women and atmosphere;
b) Shortage of hot water have negative effect on the hygiene of people, the direct impact is the increase of diseases, especially among children;
c) For the winters each family need up to 3- 7 tons of coal. The coal costs about 2800-3000 SOM (around 40 – 70$) –generally family need 15000 SOM. The average wages of local people in villages are 2500 SOM per month, thus, not everyone can buy coal;
d) The use of coal and generators worsens the condition of an environment.

As a result of this research we came down to work with the local actors to plan the energy management development. Also this plan of energy management has been realized now. Thus, in October14 villages were officially open for the action of first energy effective furnaces.

Construction of energy effective furnaces went about 10 days, and had been combined with training rates for stove-makers of village. The master, who supervised over process, had been invited on the part of international organization CAMP. At the opening of the furnace there were journalists of broadcasting companies and newspapers of Kyrgyzstan. The information on opening of the furnace has been broadcasted in mass media, and by its results in EM "BIOM" some local people and government organization have offered to cooperate in distributing energy effective technologies for the people of Kyrghyzstan.

1.2. International School Project A Resources and Energy (SPARE)

The project was started in East Europe, Caucasia and Central Asia (EECCA region) in the year 2002. What is the progress of SPARE project?

First of all it is:
- Direct attention towards a sustainable life style;
- Innovative methods in school education processes;
- Real contribution to lower CO_2 emission and energy saving;

The main focus of the activity is:
- Development of educational programs on sustainable energy in schools
- Realization of low cost and small-scale energy pilot projects in reneweble energy and energy saving spheres

Some results / outcomes of the project:
- Long term impact from education/ awareness building on sustainable energy
- Contribution to energy saving methods at schools and home
- Reduced growth in CO_2 emissions (for example solar heating installation and window restorations)
- Improved comfort, better indoor atmosphere
- Save vulnerable natural resources (nature ecosystem)
- Entrepreneurship in local societies- because school students become initiators of changes in the life style of the communities
- Well developed multi stakeholder cooperation

Lessons learned:
- A school is a very good instrument for dissemination of information – the major parts of activities in LC are connected to schools. Teachers in rural communities have great prestige in the society.
- Teachers' competence on environmental problems linked to energy and climate is poor.
- There is a gap between educational programs and real challenges in protection of the environment.
- Local societies in districts are very interested and receptive to small-scale, local solutions
- Authorities are focusing on big-scale solutions (which poor people in the regions often do not see the results of)
- For achievement of SD it is necessary to demonstrate concrete positive and practical results.
- Multi-stakeholder cooperation give results

And finally some steps for the future:
- Use school for dissemination of information to the local community.
- Improve competence and training of teachers. It is very important because it is contribution to the future.
- Improve knowledge and competence on environment, energy and climate on all levels! Especially it is very important on local community level, because use of ecologically clean technology allows community to protect local nature.
- National focus on small-scale solutions, not only big energy projects, saves energy for example in schools, window restorations and solar installation constructions.
- Authorities on education, environment and energy issues should have better cooperation and interaction regarding education on energy and environment.

1.3. Country network activity "Sun energy for Kyrgyz Republic"

The project is realized by Ecological Movement "BIOM", Norway Society of nature Conservation under support of Small grants program of Global Ecological Foundation and Ministry of foreign affairs of Norway. The project started its work in 2005 and some network activities are still going on to this day.

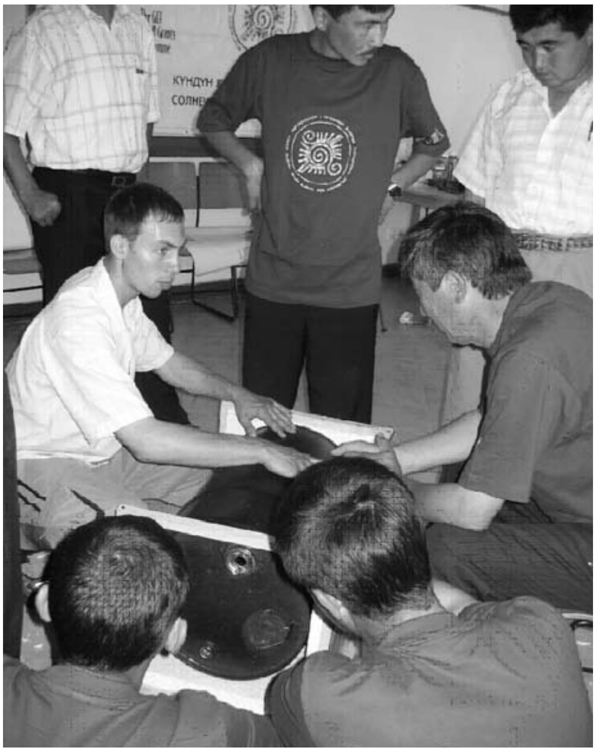
The main goal of the project is to promote reduction of greenhouse gas emissions through enhancement of Kyrgyzstan's population potential in the sphere of solar energy utilization. The special focus was given to local communities, which were located in the high mountains where the weather is cold most of the time.

The following tasks are also important for us:
- Reduction of cutting down of forests and using wood for heating and cooking
- Improvement of the quality of life and social conditions
- Reduction of level of catarrhal diseases and brucellosis among women and children

There are four main activities in the project:

1) To construct sun installations on training courses. In framework of the project we are working with 20 pilot villages. When choosing pilot villages the priority was given to those, which are closer to natural ecosystem of nature protection areas. In each training participants from 10 families from local community were to construct 10 solar installation (batch heater, solar collector). Women, teachers and children get involved in this process very actively.

Each of the training consists of two parts – construction of the solar installation and testing. Testing part was very popular for all population in local community. Especially women, as they suffer most from the lack of warm water in the house.



Now there is no need to spend money or time on electricity or to chop firewood for heating of water, as solar energy is accessible to everyone. According to participants' response for the past autumn and winter women and children were less sick with catarrhal diseases in households after the installations of solar stations.

Within the framework of the training, project exhibition was established in every region of Kyrgyzstan, where visitors can see a wide range of solar stations. Solar station models, which are present at the exhibition of villages and settlements, can be assembled at home by people using makeshift materials. Also at the exhibition there are solar stations, which can be purchased from the market of Kyrgyzstan.

Exhibitions are established at places of social significance like kindergarten schools, tourist centers, mosques, children's home, etc. Staff and visitors of these territories are able to use solar stations for cooking, water heating and room lighting. Those who desire to know more about solar energy can visit solar exhibitions and choose those things for themselves which are more suitable with conditions and needs of the household.

Villages participating in the Project exchange experiences of solar stations' maintenance and information about new availabilities of solar energy. Such cooperation results in establishment of Kyrgyzstan's Solar Network, which include 20 villages and 7 solar exhibitions.

2) Low cost technology and accessible materials

Sun plastic collector is used for water heating, works for the major part of the year. It is possible to construct it from simple materials and in home conditions. The volume is about 60 liters, heats water to 70-80 degrees in 2-3 hours.

Solar batch heater is simple sun installation for heating water, keeps water warm for more than 48 hours; it is possible to construct it from improvised materials in home conditions. The volume is about 60 litres, heats water to 50-60 degrees in 4 hours.

Sun pasteurizer allows pasteurizing milk, butter, sour cream and other milk products in 1 hour, and reducing the risk of brucellosis diseases.

3) Information campaigns

Till today we have issued publications for the broad sections of the public and decision making sectors:
- Brochure on using of sun energy in Kyrgyzstan
- Manual on the creation of sun installations
- Brochure on passive heating of buildings
- Issuing posters, T-shirts, bags, etc.
- We issued more than 10 news video-plots, more than 20 printed articles and electronic mass-media

Our project results:
- During the project realization we provided more than 600 consultations to diverse interested persons and organizations, who applied to us
- We spread knowledge about possibilities and practical examples of using sun energy among the population of all regions of Kyrgyzstan.
- We educated more then 300 people to use methods of self-construction of sun installations
- We created demonstrational – functioning installation
- We developed and distributed information materials

As a result of our project we have a reduction of more than 27000 kg of CO_2. (It aggregates 26087 kg of wood and 12564 kg of coal).

4) Rural development programme

This program of EM "BIOM" is directed to increase the level of literacy of farmers in the sphere of sustainable agriculture, agro-ecology and other related fields. Also this program focuses on practical skills of farmers, in particular on the high mountain villages. This program has some sub-programs:

Educational program for local community farmers "the sustainable agriculture - new opportunities"
In the framework of this subprogram following lists are included:

- Organization of some seminars and practical meetings for pilot local territory;
- Creating a database on environmentally friendly agro-technologies;
- The edition and distribution of thematic brochures and the booklets devoted to various aspects of a sustainable agriculture.

Educational program for students "environmentally friendly rural development: problems and prospects"
The given educational program is directed on distribution of ideas of environmentally friendly rural development among students of different specialties. For this purpose seminars are organized for students with the agriculture, water and ecological faculties of the universities of Kyrgyzstan.

The organization of round table and thematic discussion clubs on environmentally-friendly rural development topics, with the participation of students and farmer associations.

Public programs:
Within the framework of EM "BIOM" activity we have published different materials, some devoted to the principles of sustainable agriculture. So, for example, we have developed books of - Korotenko V.A., Domashov I.A., Postnova E.A., Kirilenko A.V. Ecology and in the lifestyles - Bishkek, 2004 and also some brochures on this theme. In these publications we represent some common topics of sustainable agriculture and environmentally friendly technology in rural development projects.

Community involvement in constructing energy efficent houses in rural Kyrgyzstan

Ruslan ISAEV

Living conditions and energy situation in Central Asia

Living conditions have worsened in Central Asian mountain areas since independence. A major reason of this decline is that households have insufficient heating to cope with temperatures, which can drop to as low as minus 40°C. This also affects people's health, in particular women, children and the elderly who stay at home in winter. At the same time people still expect to consume energy without paying for it since in Soviet times energy was provided free of charge. Now however, households must pay for their energy needs, but an insufficient supply and the lack of purchasing power make this an ongoing struggle.

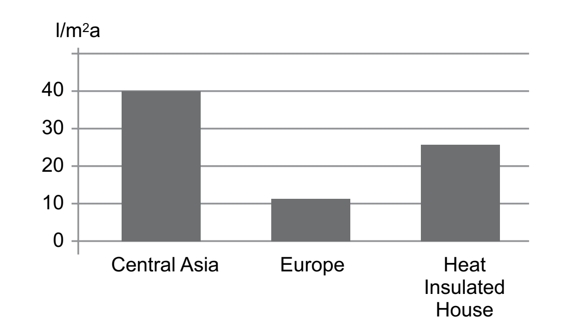
In Tajikistan, Kyrgyzstan and Kazakhstan the process of privatising the energy sector is ongoing but is taking place under different conditions and following different strategies. In many mountain villages the supply of electricity, coal, gas or fuel is often no longer provided. Therefore villagers mostly turn to cheap and accessible energy sources such as dung and wood. On an average a household uses up to three tons of biomass per year creating further problems:
- The use of dung as a fuel instead of as fertilizer leads to soil degradation and smaller yields.
- The uncontrolled use of wood and bushes is leading to erosion, which reduces the productivity of the pastures.
- Privatisation of the energy sector will most probably not benefit the local people as the energy is produced for urban centers and for export. Moreover electricity prices are likely to further increase.

Shortage of energy resources

Energy saving and the efficient use of energy are key elements of any sustainable development. In Central Asia, the disintegration of the former centralized and large scale energy systems as well as the constant gradual increase of costs for energy carriers has led to serious social and economic problems affecting particularly the inhabitants of remote mountain villages. As a consequence, in rural areas about 50% of the annual household budget is spent on heating purposes. This is mainly because houses are usually insufficiently insulated and fuels such as coal, wood and dung are used inefficiently. Due to the current difficult economic situation many households are forced to use their own energy sources i.e. dried manure (on average up to three tons per household per heating period). This leads to a decrease in soil fertility since less manure is available as fertilizer. Moreover the cutting of trees and forests contributes to soil erosion.

Ultimately all these processes contribute to the increase of carbonic acid in the atmosphere, the destruction of natural resource cycles, and global warming. This explains why improving energy efficiency at different levels is crucial for Central Asia which can benefit both local population (e.g. by improving health, saving household expenditures and decreasing women's and children's work load related to fuel wood collection) as well as the environment (e.g. by reducing CO_2 and slowing down the degradation of resources). This is why one of the major goals of the CAMP Program is to raise awareness about energy saving and to propose ways and means to the local population on how to improve their living conditions.

Fuel consumption in 2001 in liters of oil per square meter and year



Low energy efficiency

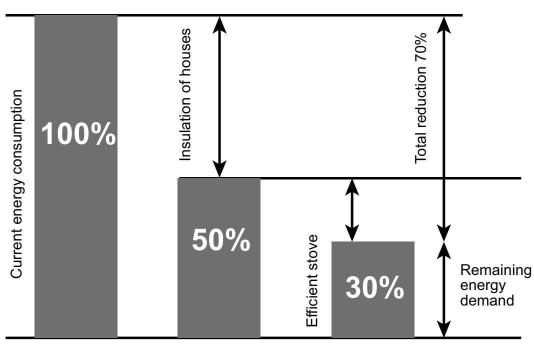
Almost all private and public buildings are poorly insulated. In colder areas, private households spend between 30 and 50 percent of their income on energy - a figure that continues to rise. 80 percent of household energy use is spent on heating and cooking. Better insulation could potentially cut energy consumption by about 30 to 60 percent.

Rationale and objectives

Since it was established, the CAMP Program has initiated natural resource management (NRM) activities in Kyrgyzstan, Tajikistan and Kazakhstan directed towards developing appropriate technologies for a more effective and sustainable use of renewable energy resources. The insulation of houses reduces heating costs and improves comfort. Heat insulation technology, based on the use of locally accessible materials is simple, easily implemented by villagers and doesn't require special skills, tools or assistance. The objectives are:

- To develop and promote the use of insulation materials produced from locally available and accessible raw material such as clay, hay, reed, sawdust, and wool.
- To train local people how to install simple yet effective insulation into their homes, cheaply, and with their own hands.

Current energy consumption and energy savings



Adapted from Jegge 2001

Identifying needs and setting priorities

The results of research into the current energy situation in three mountain villages in Kyrgyzstan were discussed during exhibitions and roundtables within the 'Dom Gor' project. Three main fields of priority intervention to improve the energy situation were identified:

- The insulation of rural houses using local materials.
- The technical improvement of stove systems.
- The rehabilitation of forests at a village level as a future fuel source

'The CAMP Program' then started projects regarding the first two fields of potential intervention.

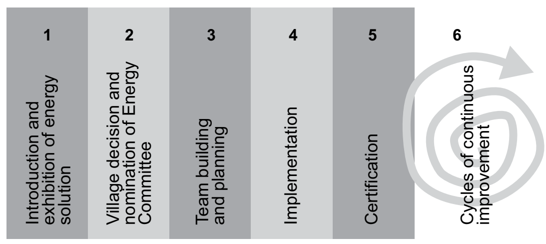
Goal

Our main efforts are to promote more efficient use of energy resources through house insulation, thereby improving people's living conditions and preserving the natural resources of mountain communities.

Energy Efficiency Program

The EEP is aimed at reinforcing the idea of energy efficiency and the use of renewable energy sources at a village level. To achieve this, a six-stage process has been devised. The stages fall into two catagories: stages one, three and five are externally driven; stages two, four and six are internally driven by the energy committees and the village representatives.

CAMP's process understanding for the implementation of the Energy Efficiency Program (EEP) at village



Creation of Village Energy Committees (VECs)

So far, 25 VECs have been established in Kyrgyzstan (20), Tajikistan (3), and Kazakhstan (2). The main tasks of these energy committees are:

- to develop a long term energy strategy for the village and a corresponding concrete action plan for one year
- to promote energy saving activities and the use of renewable energy resources
- to promote awareness raising of villagers regarding energy saving measures
- to initiate and support the organization of practical trainings on house insulation and the construction of efficient stoves
- to support the creation of micro credit agencies at village level, and
- to disseminate relevant information among the villagers.

CAMP agencies are continuously helping in designing project proposals to promote the support for creating more VECs.

Reducing energy consumption by constructing efficient stoves

As in the rest of the world, the energy consumption of private and industrial buildings in Central Asia is steadily growing and the Earth's natural resources are rapidly diminishing. Moreover, the efforts required to extract new energy carrier is becoming more and more expensive in Central Asia. Heating rural housing is mainly done with individual stoves. In the majority of cases they are ineffective and don't meet conventional environmental protection standards. The construction of more efficient stoves can thus cut energy consumption by 20%.

Typical heating schemes and traditional stoves
Typically a house is heated solely by one oven without a specific distribution system. Usually, heating for different needs such as heating water, drying clothes and cooking are not provided by a single heating device. Ideally however, these various functions could be fulfilled by a single stove. Thus the continuous development of heating technologies tries to meet the following requirements:

- become economically more efficient
- be better adapted to locally available fuel types
- be easy to learn with 'do it yourself' application
- be multifunctional.

Average annual household energy consumption without and with more effective stove (Jergetal village,Kyrgyzstan)

Energy source	Without efficient stove	With efficient stove
Electricity	1000 kWh	200 kWh
Coal	4-5 t	2-2,5 t
Wood	2t	0.5 t
Dung	3-5 t	1,5-2 t
Oil	50 l	20 l

'Miracle stoves' save money and improve living comfort
The development of multi-purpose ('miracle') stoves has many advantages for the household which invests in such new technology. Such stoves heat more than one room and can be used for baking. Moreover they are attractive pieces of furniture. However, rural inhabitants usually only pay attention to their stoves during the heating period while in spring and summer – when necessary maintenance work could be carried out – the financial means for reconstruction frequently lack. The construction of more effective stoves thus means:

- Less investment due to the use of local construction materials (100 – 150 USD/stove)
- Job opportunities in rural areas for local craftsmen specialised in stove construction
- In harmony with nature by preserving and protecting natural resources through their more efficient use.

To date more than 50 stove craftsmen have been trained in local areas of Kazakhstan, Kyrgyzstan and Tajikistan to be able to construct such efficient stoves on their own. They were provided with practical workshops that included theoretical know-how about heating principles. Up to now more than 70 stoves have been constructed providing experience to these craftsmen and showing that there is a considerable demand for such stoves by villagers. This demand might increase even more in future, as the price of electricity is progressing too.

Shortcomings
The experience gained so far has shown that different obstacles have to be overcome to make 'miracle stoves' a success story:

- Provide continuous backstopping support to local craftsmen
- Ensure correct and sufficient instruction for owners regarding the use and maintenance (e.g. cleaning) of new stoves
- Develop fact sheets allowing calculating costs, duration of heat preservation of the stoves and saving potentials through different measures
- Create an understanding regarding the time needed for constructing high quality products among both customers and clients

Development of insulation technologies and training

In spring 2002, insulation technologies for floors, walls and roofs using local materials such as straw, sawdust, loam, and cement were developed with the support of the 'Fachhochschule Beider Basel' (FHBB) and the 'Energy Fund of Basel' (Switzerland). Subsequently three seminars on the theory and practice of insulation were carried out in all three countries and co-organized by the FHBB, the CAMP Program and a local partner. This work also involved the Kyrgyz University of Statics, Transport and Architecture, the Tajik Technical University, and the Kazakh Energy Saving Department. The main purpose was to inform and train students and engineers. Later on, local specialists were trained during pilot insulation projects carried out in villages. For this, external backstopping was provided by Oekofacta, a Swiss company. From the beginning, activities in the field of energy efficiency were supported by several donors such as the Government of Liechtenstein, the GTZ-CCD/Batken, the SDC, and the Canton of Basel. The installation of insulation was usually followed by an awareness-raising seminar (L4S) on energy efficiency.

Demand for vocational training by local craftsmen

During Soviet times the traditional local energy production and its distribution network were replaced by centralized large scale electrical stations with a wide distribution network. Electricity was considered a strategically important resource that was subsidized by the state. The regular use of electricity for heating led to the disappearance of stove-making skills. Therefore local craftsmen requested practical training and specific knowledge from external specialists. As a response to this demand, regional vocational training workshops were organized. The training was conceived as one of the job trainings where new stoves were installed in people's houses. The main implementation steps were:

- To collect detailed information about typical stove facilities in rural areas and analyse their efficiency
- To develop simple construction technologies for effective stoves
- To evaluate different construction materials and their economic costs
- To organise a regional vocational training for craftsmen concerning the construction of effective stoves
- To elaborate and publish a construction manual for effective stoves in rural areas, using local materials
- To disseminate the gained experience in rural areas through partners

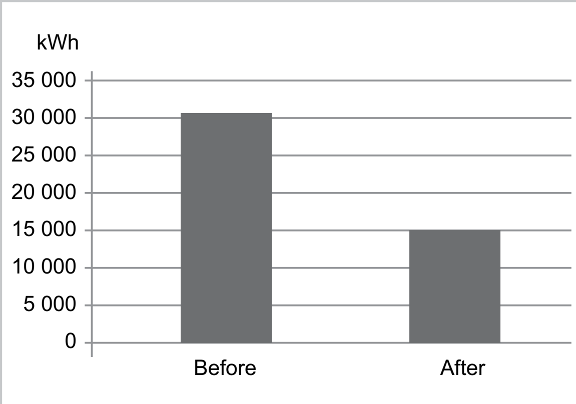
Ceilings are insulated with a layer of insulation (straw,sawdust, straw and reed, prefabricated straw and loam plates) on the garret floor which is then covered with loam.

Floors can be insulated from the top, from the bottom or both. The insulation layer (straw and loam, sawdust and cotton fiber, sawdust with a hermetic covering of tar paper, prefabricated straw and loam plates, pore concrete) is put over or under the existing floor and fixed with wood.

Satisfaction

The results of the insulation were satisfying: in the insulated houses less wood, electricity or dung is needed for heating and more rooms can be heated with the same amount of fuel. People feel warmer, especially when sitting on the floor. The results of electricity and fuel saving as well as improvement of heat comfort evaluated on the basis of monitoring and calculations made in insulated houses during the heating season before and after the heat insulation, show energy savings of 40 to 60 percent.

Annual heat consumption of private houses before and after heat insulation in Jardysuu village (Kyrgyzstan)



Obstacles

- The dissemination of heat insulation methods among villagers is poor due to the absence of concrete examples to convince the local people
- The lack of a clear pricing system and a transparent cost benefit analysis often put households off from installing insulation
- Villagers are often unaware of the advantages of heat insulation

Out of experiences made so far we can recommend to:

- Create construction teams consisting of energy craftsmen contributing to job creation and development at village level
- Establish micro credit agencies to provide financial support both for stove masters and clients
- Invest in improved stove construction only after insulating houses
- Conclude a contract between the master and the client to secure high quality services and further instructions and consultations
- Further study the multifunctionality of effective stoves for example as attractive furniture or useful element of the room.

Recommendations

- Carry out awareness raising activities in villages on the advantages and opportunities of heat insulation technologies
- Inform villagers and local management bodies about house insulation on a regular basis and in an accessible form
- Be guided by the experience, the ability of local masters and the results of local trials because the insulation technology varies from region to region depending on the quality, structure and composition of local materials, the climate, and other conditions of production
- Practical training on heat insulation should preferably target household with middle income and rich households first as they are more likely to be able to take action
- Create financial institutions at a village level for supporting heat insulation works based on small credits

Further development and dissemination

In order to promote the construction of efficient stoves in the pilot mountain villages, revolving funds were established in the form of public foundations ('Micro Credit Agency') in Jergetal and Balaaiylchy village providing financial support to both craftsmen and clients. For further dissemination of these energy saving measures, the help of other partner organizations and the financial support of the Small Grant Programs (SGP) will be crucial, as more and more villagers from different regions are asking for similar trainings. The dissemination of knowledge and experience regarding the technical improvement and construction of energy saving devices is becoming more and more relevant given the increasing efforts of villages to develop their own energy strategies. In this context the CAMP agencies understand the necessary process needed to promote the implementation of energy saving measures at village level by following the 6 steps. The first step consists of introducing and exhibiting energy solutions as a phase of broad information about energy efficiency and renewable energy options, conditions and benefits of taking part in CAMP's Energy Efficiency Program (EEP). The second step is devoted to village decisions and the nomination of a 'Village Energy Committee' (VEC) based on a formal application containing the list of energy members communicated to the CAMP agencies. The third step is devoted to team building and planning. A three day workshop conducted by the CAMP agencies for the members of the VEC and representatives of local authorities addresses the issue of a village energy strategy. The participants learn about team building, agree on individual roles and responsibilities, become familiar with decision-making processes and devise first ideas for a sustainable energy strategy for their village. Step four consists in implementing first concrete activities according to the developed action plan and in raising confidence among the members of the VEC and of the village population with regard to the committee. In step five first an evaluation is carried out assessing the EEP. It is usually conducted earliest in one year after the team building and planning workshop. Finally step six seeks to support continuous improvement by permanent planning, implementation, certification and labelling which commonly starts right after the first certification. In order to support this approach, the organization of practical demonstrations for inhabitants, partner organizations, mass media and representatives of village administration in houses with already functioning devices during winter time, is envisaged.

Further dissemination

Due to villagers' poor awareness on effective energy resources they continue to use cheap energy resources. For the application and dissemination of more sustainable technologies the CAMP Program has developed tools within the Energy Efficiency Program (EEP). They support the development of sustainable energy supply and energy saving strategies at a village level. They involve various partner organizations including representatives of local self governance bodies and state structures. The proposed approach is directed at developing potential and providing support. This will allow villagers to develop measures, taking into account local factors, and implement them as part of a more sustainable energy saving system in villages.

Impact monitoring in renewable energy projects

Ralph PFÖRTNER

1. Introduction

Each project/programme has the task of monitoring and verifying the impacts of its activities. Therefore *INTEGRATION environment & energy* has developed specialized packages for "Impact monitoring in RE projects" and offers its services to projects and programmes. With these impact monitoring services INTEGRATION responds to an increasing demand from donors as well as from project managers and team leaders.

The product provides the structure as well as the implementation features of impact monitoring (IM) accompanying the project. It includes flexible components: analysis of the village situation (survey of village representatives at the beginning and end of the project), analysis of household conditions (household survey at the beginning and end of the project[1]), annual household data survey, monitoring reports as well as a yearly photo documentation.

INTEGRATION offers three different work packages in total:

A) complete implementation by an INTEGRATION team (package 1)
B) joint implementation of INTEGRATION and local team members (package 2)
C) training and preparation of local teams for IA (package 3)

These can be independently implemented according to the demands or as prerequisites in the project/ programme impact monitoring strategy.

2. Benefits of impact monitoring

The goal of impact monitoring is to observe social and economic changes within the target group over the duration of the project/programme, to record trends and to make qualitative and quantitative judgements about these changes concerning the living conditions of the target group.

The impact monitoring results can be used as the basis for decisions, to improve the achievement of a project/programme's objectives, to provide a stimulus for project management, to alter project approaches and to identify additional necessary measures.

Furthermore impact monitoring offers RE projects support in the fulfilment of political goals.

2.1. Development of political framework conditions of RE project

Access to improved provision of energy through RE projects also offers the possibility to improve socio-economic living conditions apart from technology and knowledge transfer. This can be achieved in a variety of ways: through achievable income and time-savings, possibilities for productive use; labour savings and improvement of education.

Thereby RE projects achieve an important contribution to poverty minimisation, as stated in the UN Millennium Declaration and formulated in the Action Programme 2015 of the German Federal Government.

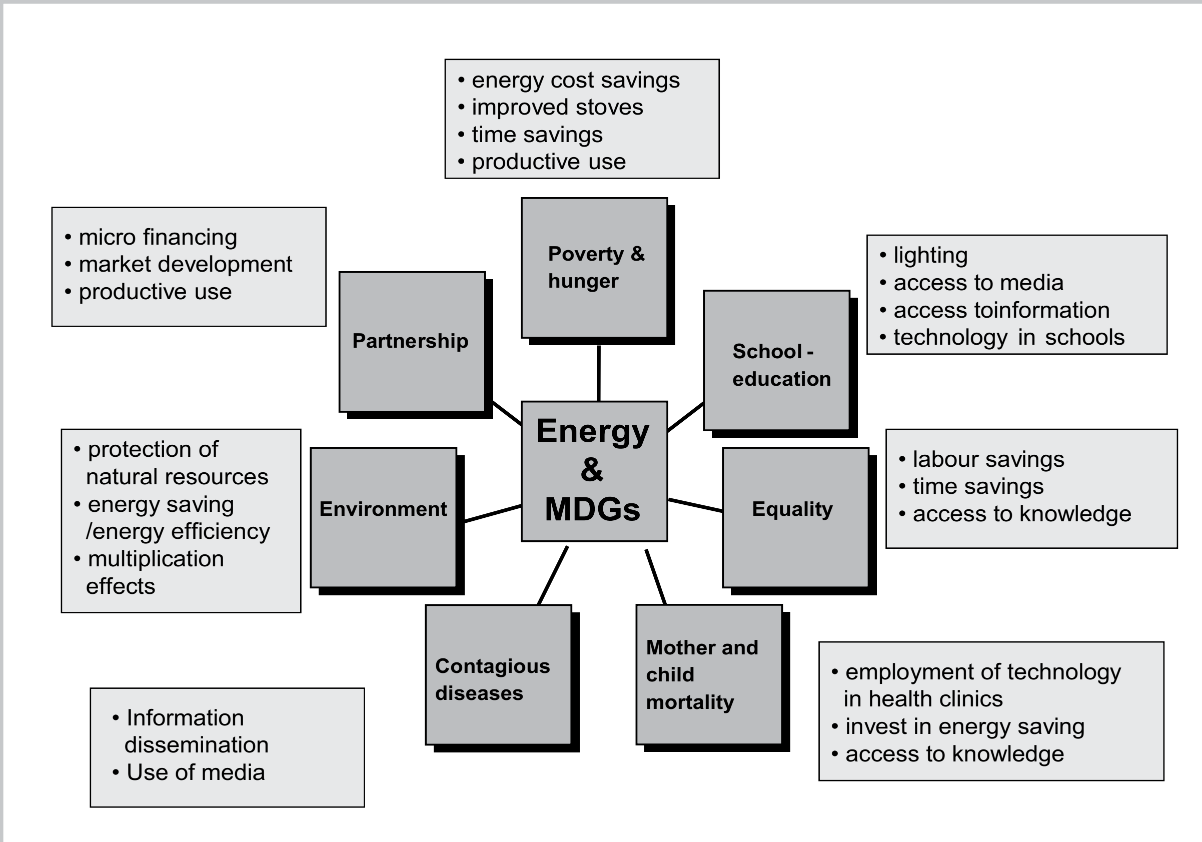
Moreover RE projects follow the principle of sustainable development, as expressed in different chapters of Agenda 21. This means for example "to support successful economic growth in the partner countries, to make more prosperity possible, to distribute chances evenly between rich and poor, north and south, men and women, to use natural resources for the good of the people today, so that they also remain for future generations." (GTZ home page, 16.01.2007)

With the help of impact monitoring, quantitative and qualitative contributions to the Millennium Development Goals (MDG) and to the framework conditions for RE projects can be demonstrated and verified.

2.2. Energy and the Millennium Development Goals

Improved access to energy can contribute to meet the MDGs in various ways, as the following figure shows:

[1] *The data are analysed with SPSS (Statistical Package for Social Science).*



A reliable and affordable energy supply is not yet considered to be a basic need[2] (in all countries) but energy proves to be of utmost importance and necessary for the satisfaction of basic needs, for example, nutrition, education or health. However, it still seems problematic to demonstrate a causal link between a reliable and affordable energy supply and improved living conditions and therefore to prove a contribution to the MDGs.

The product "Impact monitoring in RE projects" with its components offers to demonstrate possibilities with cause and effect relationships and therefore to determine the contribution of a RE project to the MDGs.

3. Structure & components of impact monitoring

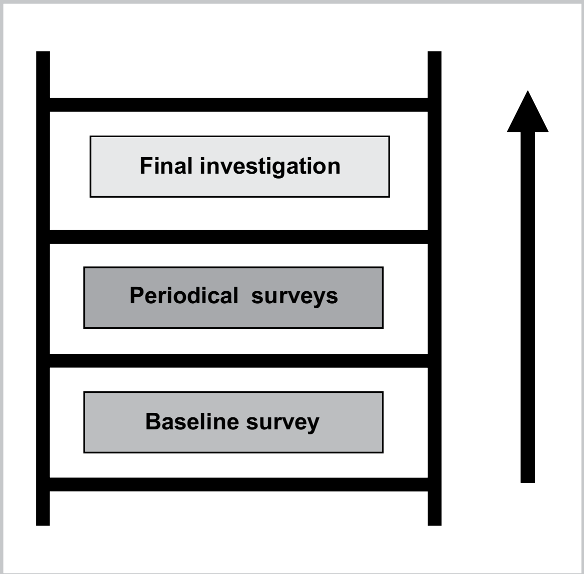
The implementation of impact monitoring with focus on the aspects described above, demands the development of more manageable procedures and methods. For continuous observations and to verify the impacts INTEGRATION has developed impact monitoring which combines quantitative procedures with qualitative features and which can be flexibly adapted to the respective project / programme requirements.

3.1. Baseline survey, periodical surveys and final investigation

To be able to demonstrate changes in the project plan, firstly the situation at the beginning and the end of the project must be documented. Further regular observations should be undertaken over the period of the project.

This happens with help of a baseline survey at the beginning and a final investigation at the end of the project as well as periodical surveys in between. The baseline survey (BLS) is an instrument, which can be exploited for the formation and measurement of impact monitoring indicators also. In this context not only is the data collection important, but above all continuous observation, analysis and discussion to recognise not only positive but also negative changes early enough and to be able to influence them through corresponding project measures, which may lead to necessary changes and/or adaptation of project activities and objectives.

[2] However, investigations show that some end users would definitely designate energy supply as so called basic needs (refer to the example of Indonesia: World Bank/Marge 2003: Impacts of Rural Electrification on Poverty and Gender in Indonesia. EnPoGen. Volume 1: Facts, Findings and Recommendations. Washington)



Carrying out a baseline survey delivers data for a comparison between the pre and post situations and therefore, aside from the use for impact monitoring, it is an additional basis for the legitimization of RE projects.

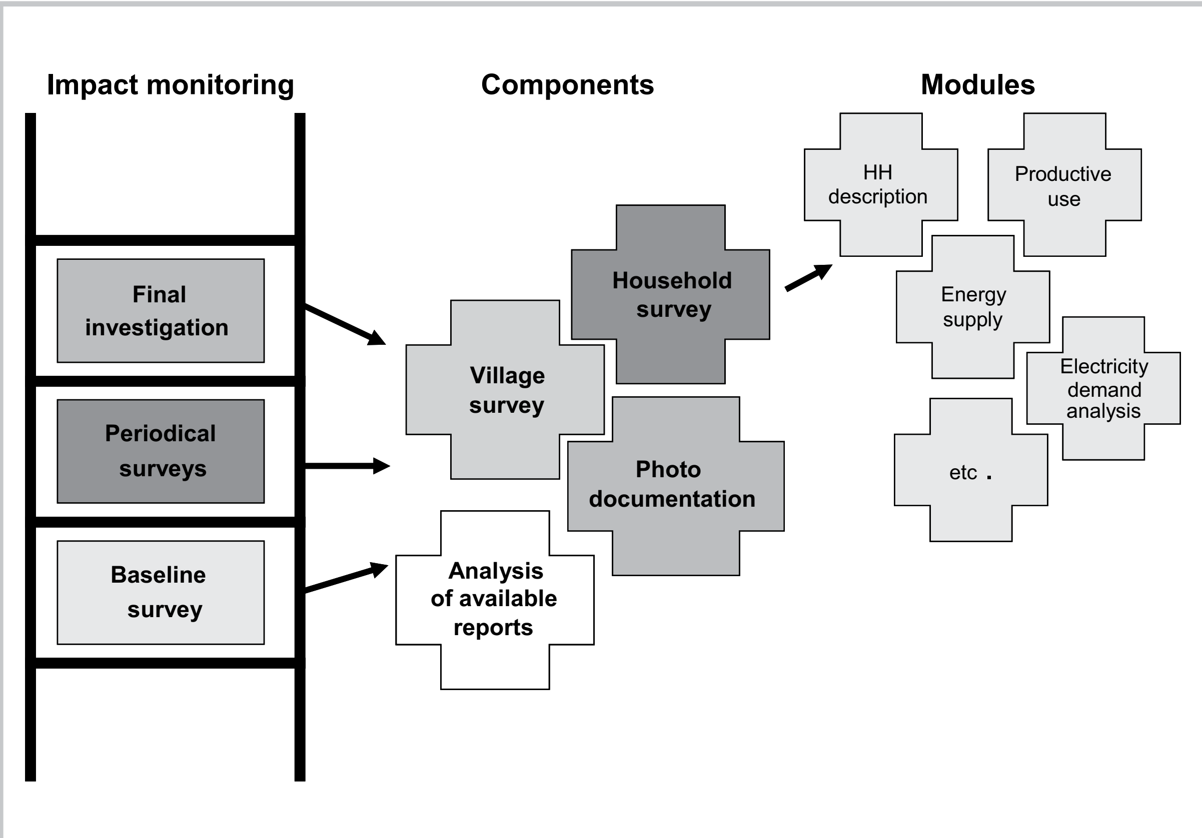
Moreover the up-to-date data collected allows the project management to individually adapt the project concept. BLS examines the "basis" on which a project is established. If the previous assumptions and information prove to be misleading (e.g. concerning income or outreach), the project management has a solid basis to adapt/change planned activities.

Periodical investigations show to what extent project measures actually "impact" the project environment; and also vice versa: whether the project environment demonstrates an impact on the project (for example changed social structures through migration, health problems etc.) and whether the project management should possibly react to the changed conditions.

The final investigation then shows ideally not only the activities implemented and the results achieved, but provides the proof, if the project has reached the required impacts.

3.2. Components of impact monitoring

The baseline survey, periodical surveys and the final investigation rely on a variety of methods that consist of different components. Quantitative and qualitative approaches are adopted. These approaches make the interpretation of statistical data with a quali-tative interpretation possible, which is above all required for the analyses of social impacts.



The combinations of village and household surveys have been proven adequate for the implementation of impact monitoring; the optional photo documentation complements the analysis.

3.2.1. Village surveys

The village survey[3] prepares for the household survey, since it makes the current quantitative and qualitative data of the village available. It also serves in information collection of the household and project environment in addition to the preparation of household surveys (e.g. issues concerning the social structure in the village, organisational preparation). Furthermore this information is necessary to be able to interpret the household data. The interview is undertaken by means of a discussion guide/checklist at the beginning of the survey with an official representative of the village. The guide includes the topics on social infrastructure, drinking water, energy supply, etc. Additionally the possibility of a village tour and the use of further methods (e.g. transect walks or mappings) can be selected.

3.2.2. Household survey

The household survey is based on a questionnaire with open and closed questions. This makes the survey of quantitative data on the socio-economic situation of the households possible over the whole project period. The results of the household survey are interpreted and analysed in the form of a report. The household survey is carried out together with the village survey. It contains further qualitative information on the living conditions of the households, which are essential for adequate interpretation of the data collected and impact monitoring.

For household surveys the complete questionnaire develops from single modules[4], which can be combined both in complete form as well as individually according to the demands. This flexible approach makes it possible to interview households from various villages, for example electrified or non-electrified.

In general all household surveys are always divided into three income categories (poor, middle, rich).

3.2.3. Photo documentation

The photo documentation serves as a visual summary of the existing status of the villages and households and the changes that occur during the project. The documentation follows a guide/checklist (e.g. houses, infrastructure, and energy use) on village information. The photographs also serve as the visualisation of the socio-economic changes in the project area.

4. Impact monitoring packages

The components of impact monitoring can be arranged individually and according to the demand of the specific RE project. The packages presented below refer to the components, which can be selected individually or as a complete package according to the requirements of the project/programme and the capabilities of its community development workers.

INTEGRATION offers to arrange impact monitoring in such a way so that the individual components can be carried out independently from the project through INTEGRATION or with the assistance of training in cooperation with selected project workers.

There are three possible packages available (A, B and C). Comprehensive information about each individual or the whole packages can be provided on request

	Package A		**Package B**		**Package C**	
Components	INT	Project	INT	Project	INT	Project
Preparation & training	X		X	X	X	X
Village survey	X		(x)	X		X
Household survey	X		(x)	X		X
Photo documentation	X			X		X
Data entry	X	(x)		X		X
Data analyses	X		X			X
Report	X		X			X

3 Questionnaires are also possible on other administrative levels such as communal, district levels, etc.

4 The modules can also be developed and adapted for project/programmes with other fields of emphasis.

5. Tasks to be performed in advance by the project

The data collection for impact monitoring is a cross cutting task and agreement about the needs and aims of the monitoring concept, which should exist within the project/programme in advance. Generally projects can provide only limited resources (staff/budget) for monitoring, which is why INTEGRATION offers to carry out representative surveys and to train the local community workers in preparation and implementation of impact monitoring in their project/programme. Close cooperation of the INTEGRATION team with project staff and community development workers is therefore important for the success of the project.

Contact

Further Information and a comprehensive paper with descriptions of the individual packages can be obtained from the author during the conference or via email as stated below.

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Energy efficient rural houses pilot project in Heilongjiang Province of China

Robert CELAIRE and Alain ENARD

Background and partners

A pilot project of construction of energy efficient rural houses has been carried out and completed in the Northern Manchourian Province, of Heilongjiang, in the People's Republic of China.

This project is a component of the global Sino-French cooperation project on energy efficiency in buildings carried through the years 2000-2009 dealing with various subjects including institutional cooperation and industrial cooperation in energy efficient technologies along with the achievement of a few pilot projects, mostly in urban areas except for the project described hereafter.

The cooperation partners of this energy efficient rural houses component have been:

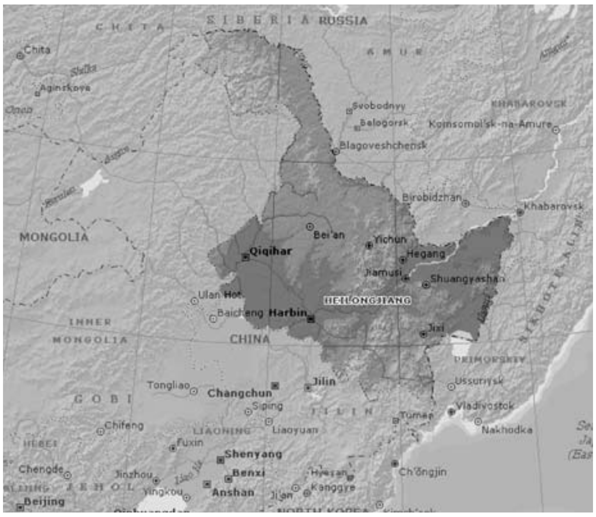
- On the Chinese side, the Construction Commission of the Province of Heilongjiang, working with regional and village authorities; design and construction teams and with the Harbin Institute of Technology (HIT);
- On the French side, the FFEM (Fonds Français pour l'Environnement Mondial) or French Global Environment Facility as a donor agency with ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie) or French Agency for Environment and Energy Efficiency as the project pilot with significant and well appreciated local support of the AFD (Agence Française de Développement) or French Development Agency.

The authors have been in charge of providing technical assistance including "hands-on" training to Chinese partners for project design and implementation. This work has been achieved through a large number of multi-years short-term field missions and distance backup advising. Their work has also lead to writing a small design assistance manual.

1. Context and environment

1.1 Project location and climate

The Heilongjiang (Black Dragon) Province of China is located at the northeastern tip of China (between 44° and 54° North latitude) along the Russian border of Eastern Siberia. It covers a surface area of 445,000 km². It experiences an extremely harsh climate with long cold freezing winters and short hot summers. This climate features:



- Huge yearly temperature amplitude (79°C in Lindian county where this project started near Daqing- in 1980 between January min and June max)
- Average yearly temperature below +5°C
- Average January temperature from -18°C to -25°C
- Typical yearly 18°C degree-days from 6000 to 7000
- Fairly dry climate - 430 mm of yearly rainfall in southern HLJ plain area
- High sunshine availability
- Winter North cold wind
- Short hot summer - average July 22°C

1.2 Current situation of rural housing in Heilongjiang

Rural housing typology

The total population of Heilongjiang (2006) is 38,2 million people amongst which farmer's population (2006) is 17,9 millions (47%). Farmers live in 440 millions m² of rural houses featuring:

- About 34% adobe brick walls with adobe & straw roof houses;
- Over 60% clay brick houses that tend to be replaced by progressively mud brick houses. They use tile roofs or more commonly metal tin roofs;
- A minority (few percent) other techniques use modern components or traditional methods (wooden-log walls covered with mud for instance in a few mountain areas). Amongst these houses only a small minority purposely include some energy efficiency designs (like a few straw bale houses).

Typical cost of clay houses are in the range of 60,000 to 80,000 Yuan (roughly 6000 to 8000 Euros)

Rural houses and energy efficiency
Main aspects of "modern" clay brick houses (and also of many old mud brick houses whenever possible) related to energy efficiency are the following:

- Favorable winter sun collecting because of southern orientation;
- Fairly good layout with respect to energy efficiency and passive solar design, with living space and kitchen in southern part of the house; storage and secondary spaces in the northern part;
- Large southern double windows allowing to collect large amount of abundant winter sunlight bringing comfort and covering a very significant part of the heating load of the households;
- Attic filled with insulating material limiting heat losses which is one of the main energy escape routes in a house. Insulating materials being wood chips, sawdust, straw, etc;
- Some houses have an air lock on entrance door.

However most clay houses that are being built at the moment also feature some energy inefficient aspects such as:

- no wall insulation even though some of the houses use double wall with air cavity in between (in these cases the cavity is very seldom filled with some insulation);
- no floor insulation whatsoever leading to high discomfort (the "cold feet syndrome");
- no specific treatment of thermal bridges in construction;
- trend of using metal-plastic double-glazing, single windows which are less energy efficient than locally made single (or double) glazing double windows; that also used to be supplemented by an additional plastic film mounted for the winter;
- Large northern windows. Farmers like these large windows no matter what the orientation is, to let in light during the day-time, but these components are large energy losers in winter. In the "modern" clay brick houses there is a very little difference in window sizes whether these are on the Southern or Northern part of the house;
- no night-time movable efficient insulation is used to decrease heat losses from windows: no shutters, no thick and tight curtains or any other movable insulations are being used;
- last, but not least, there is no ventilation control in the house leading either to access the ventilation to allow proper combustion of stove (this access ventilation leading itself to large heat losses and air streams, which is bad for thermal comfort of inhabitants) and/or plus the insufficient ventilation leading to very poor air quality in the houses, in some cases, to dangerous building up of CO due to incomplete combustion of coal.

Heating systems and heating fuels
Most houses use brick heating bed (and a few houses heating walls operating in the same way) or "*Khang*" heated by exhaust smoke from cooking stove located in the northern kitchen. The smoke is channeled through brick cavities located underneath these brick beds. This hot smoke progressively heats up this high mass of bed on which people sit in the daytime and sleep at night.

The stove is usually fired three times a day in winter so *khang* is irregularly heated up but its high thermal mass keep the house warm most of the day. Some houses have two *khangs*.

Some houses also use locally made metallic coal boilers connected to conventional thermo-siphon radiators system.

The heating fuels used are:

- Crop residues (straw, stems, small branches, corn stalks, etc) used mostly in the stoves at the beginning of the season and as long as they are available;
- Wood collected form areas where ever available and is legal (mostly in mountain forest areas of Western Heilongjiang);
- Low quality coal (lignite with a low heat value of the order of 5500 Wh/kg – values provided by former HIT professor) which is used along with crop residues.

1.3 Social, economical and environmental impacts of energy inefficient housing
The main impacts of this inefficient housing are the following:

- Houses experience very poor thermal comfort conditions in winters: typically 4°C to 12°C in the middle of winter in main rooms and in some houses the morning temperatures being much lower;
- Houses also experience poor air quality due to inadequate ventilation (death due to CO poisoning being reported)
- High portion of farmers' budget is spent on coal purchase: typically 10% to 20% of income can be spent on buying fuel while coal prices have soared from 200 Yuans/ton to 400 Yuans/ton in the last few years.

In this respect it is interesting to point out that a large scale of surveys on energy uses that have been carried out in various areas of Heilongjiang showed that coal (lignite) consumption for houses of the same typology can range from 2 tons/year to 10 tons/year. Heat load calculations have showed that 10 tons/year would be the order of magnitude of heating consumption if houses were maintained at good comfort temperatures (in the range of 15°C or 16°C): this means that when people cannot afford to spend more on coal they just have much poorer comfort conditions.

So typically poor farmers with income lower than 5000 Yuan/year will buy for instance 2 tons of coal/ year (16% of family budget), while richer families who earn 20000 Yuan/year can buy for instance 6 tons/year (12% of family budget). Families have to be fairly rich to be able to afford the amount of coal they would need to experience comfort through the whole heating season.

One of the social consequences of these harsh living conditions is the large rural exodus of farmer families to urban areas at the moment when job offers are on a decline.

Last but not least, consequence of this situation is the environmental impact of lignite consumption, which is huge with an average of 5 tons/year of CO_2 emission for a typical house burning 3 tons coal yearly.

2. Project context

2.1 Project context and objectives

In spite of official decisions from the Chinese authorities to prioritize the development of rural areas in the future, the perspective of quick improvement of living conditions in terms of thermal comfort and sub-consequent coal consumption reduction in rural areas of Heilongjiang is limited.

The road of energy efficiency in the rural housing sector does not seem to be open yet. To give a relevant example, while energy efficiency standards exist for urban housing (being enforced only in a very small fraction of cases only) they do not apply to rural housing.

In the mean time very few and isolated actions of energy efficiency project on rural houses exist and they are not coordinated.

In this respect the FFEM/ADEME project goals were:

- to demonstrate energy saving impacts of improved energy efficiency designs (minimum objective was 50% reduction of coal consumption);
- to demonstrate comfort impacts of improved energy efficiency designs;
- maintaining incremental construction costs to minimum while demonstrating the improved energy efficient designs;
- making use of components and technologies readily available in the Chinese market ;
- to transfer energy efficiency design know-how to local professionals and facilitate energy efficiency features acceptance by users;
- to provide inputs to HLJ Province Department of Construction to plan the promotion of energy efficient rural housing.

2.2 Pilot project content

The two stages of pilot project of energy efficiency improvement of Heilongjiang house design consisted in working with a local design teams to tackle the various issues of inefficient designs mentioned above while enhancing the positive aspects of traditional construction.

First step of the project lead to the construction of four pilot energy-efficient houses in Shengli village, of Daqing district, during the period of 2003-2005.

The second step lead to the construction of approximately 40 houses, amongst which 20 have been supported by the FFEM project, in the Heihe district during the years 2005-2007.

Hands-on training has been provided through the first step of the project while short-term monitoring of temperatures and fuel consumption has been carried for both project components.

The non-exhaustive list of following designs, components and systems have been implemented through the various steps of the project (table below concern the houses 1,2 and 4 of the first stage of the project while houses 5,6 and 7 are base cases)

	Walls	Roof	Floor	Window	Ventil for stove
House 1 and 2	28 cm straw pannels	40 cm wood chips	80 mm EPS	Double plastic w/ curtains	Y
House 4	14 cm straw pannels	Same as 1	80 mm EPS	Same as 1	Y
House 5	14 cm straw pannels	Same as 1	N	Same as 1	Y
House 6 and 7	Double brick wall	Wood chips	N	Double wood	N

	Average °C	Straw kg	Coal kg	Gas m3	Total consum kWh	Wh/DD m2
House 1	8,5	156	10,5		604	15
House 2	10,0	373	0,0		1306	29
House 4	11,3	343	103		1767	35
House 5	10,2	716	99		3051	65
House 6	12,4		275	185	3733	76
House 7	15,1	489	266		3175	78

House	Surface area m2	Cost Yuans/m2	Increment costs (%) w/r to 5
1 and 2	124	870	12
3 and 4	124	800	3
5	124	780	0
6	112	500 (1990)	-35
7	79	500 (1990)	-35

- wall insulation using various insulation materials (straw panels, EPS, etc)
- increase in ceiling insulation levels;
- floor insulation using mostly EPS;
- work on thermal bridge treatment with field training

(During first stage of project in Shengli village)

- improved window design including window size

Decrease in northern rooms, triple glazing windows in some cases, promotion of night insulation shutters;

- improvement of inlet ventilation for stove combustion and trials of fresh hygienic air inlet in the main rooms through *khang* preheating;

2.3 Project monitoring results

Lindian county, Daqing district houses

Site: Shengli village, Lindian county – 3 energy efficient houses (out of 4 built) plus 3 base cases have been monitored.

The monitoring campaign (March 2004) was achieved by the local team with specifications and guidance from the authors. The campaign measures were:

- Ambient temperatures
- Wood, straw and coal consumption with manual scale

The following tables show the result of monitoring which testify that energy consumption per temperature difference (Wh/DD) were 2 to 4 times lesser for the energy saving houses than for the base cases. In addition to this, the first sample of energy efficient houses has been built with only 3 to 12% incremental costs when compared. In the mean time, even though exhaustive multi-questions survey has not been accomplished, satisfaction from users has shown to be high:

- we don't have cold feet anymore said one of the users
- in one of the most insulated houses (house 2) the lady owner went through the whole first winter by using only crop residues and without having to buy any coal which lead to tremendous savings.

Heihe district houses:

Forestry villages of Daling, Daping, Sandaogou

Monitoring campaign (January 5th through 29th, 2006) of 4 houses with simultaneous measurements on one old house nearby used as reference case (but temperatures have not been measured in the last one).

The monitoring dealt with:

- Heat transfer through the walls (U value measurement);
- ambient temperatures;
- Measurement of wood, straw and coal consumption

The table in the next page reports monitoring for three houses - two energy efficient and one conventional, and the figures show once again that energy efficient houses use 2 to 4 times less fuel than the conventional ones.

Even though temperatures could not be monitored in the old house we know from experience that during such cold periods average temperatures are rather below than 10°C in such old houses, thus difference of energy consumption per degree per day between energy efficient and base case would have been even greater. Satisfactions from users have been reported well and good by Heihe construction team but we could not verify this information by ourselves. In the mean time, incremental costs when compared to base case conventional houses for construction of this second set of energy efficient houses has been very high and not significant (over 50%) due to many reasons including difficulties in using local materials for insulation and high unit costs for components.

Monitoring of rural houses in Heihe region			
	Sandaogou new house	Daping new house	Sandaogou old house
House surface area m2	82	84	80
House main orientation: South, East, etc.	South	South	South
Family living in house: YES or NO	N	Y	Y
What heating systems	Khang, heat wall, radiators	Khang, heat wall	Khang, heat wall, radiators
How many times a day fuel is fed in stove	many times	many times	many times
Monitor period: 1st and last days in January	Jan 5-Jan 29 2006	Jan 5-Jan 29 2006	Jan 5-Jan 29 2006
Weather during monitoring	sunny	sunny	sunny
Average wood consumption/day	-	23,88	-
Average straw consumption/day	22,6	-	48,56
Average coal consumption/day	13,44	-	35,52
Total en consumption kWh/day (*)	145,75	83,58	351,70
Average consumption kWh/m2-day	1,78	1,00	4,40
Average external temp during monitoring	-20,76	-20,76	-20,76
Description insulation wall	12 cm EPS	18 cm EPS	490 mm brick
Description insulation roof	12 cm EPS + 30 cm wood	18 cm EPS + 30 cm wood	30 cm wood
Description insulation floor	10 cm EPS	12 cm EPS	no insulation
Description windows	double plastic	triple plastic	double wood
Monit mini in South living room	3,5	6,8	-
Monit average temperature in South living	12,6	16,5	-
Monit average temperature in North kitchen	11,1	17	-
Monit average temperature in North bedroom	11,9	-	-
Monit average temperature in North toilet	7,2	-	-
Monit average temperature in South bedroom	-	7,2	-
Average temperature in all rooms	10,7	13,6	-
Average temperature in living + bedroom	12,3	11,9	-

** Assumptions: 3,5 kWh/kg for wood, 3,0 kWh/kg for straw and 5,8 kg for coal.*

3. Conclusion and perspectives

3.1 Lessons learned

This modest pilot project of energy efficient rural houses in the very cold Province of Heilongjiang has showed:

- Potential fuel reduction factors in energy efficient houses of roughly 2 to 4 times when compared to conventional houses, that can lead, in some cases, to the exclusive use of renewable fuels (crop residue) with subsequent substantial savings extremely significant for low income families;
- Comfort improvement with increased average temperatures in the houses .We can even certainly say that, up to a certain extent, part of fuel savings have been “spent” on increased comfort;
- Farmers satisfaction (surveys achieved in the first stage of project in Shengli show it);
- Energy efficient housing can be cost effective, with incremental costs in the range of 10% and very short paybacks due to fuel savings, provided enough detailed design work with the local teams and appropriate follow up during construction can be done (including “hands-on” training, for instance, for thermal bridge avoidance or ventilation implementation). This kind of work could be done during the first stage of project (the 4 houses in Shengli), which enhanced the use of local materials and detailed work with local teams leading to building up trust and a spirit of “working together”. It could not be replicated in the second stage of project in Heihe area where the project had been much more spread out and the

real exchange work on designs between Chinese partners and French experts has been limited and possibilities of following up construction extremely difficult.

3.2 The long road for developing a culture of energy efficiency

This project created great expectation from local farmers, local teams and authorities for scaling up the development of energy efficient and more comfortable rural houses in northern China.
However "bottle necks" are numerous and include the non-exhaustive following list of:

•Political and economical constraints:
- the fact that no energy efficiency standards exist for rural houses while they exist for urban buildings so there cannot be some kind of regulatory push;
- the fact that people have to pay for their fuel in rural areas while in the cities they pay directly only 10% of energy cost (around 3 to 4 Yuans/m2) for heating, the rest being covered but their employer which can be itself subsidized;
- there are no subsidies from central or provincial governments for energy efficient housing and only a few local initiatives exist to subsidize energy efficient rural houses;
- there are no organized financial policies that could allow short and mid-term loans for energy efficient designs.

• Technical difficulties linked to the lack of know-how, availability of affordable materials and components, etc.

•Sociological difficulties linked to the acceptance of some essential energy efficiency options to which people are not used e.g., ventilation systems, use of efficient nighttime insulation on windows, etc.

However the challenge is huge and it is a win-win-win one:

- Environmentally: over one million rural houses built yearly in Northern China and there is a (conservative) potential of 1.5 tons of coal saving for each of them, knowing that all Northern provinces of China are concerned: Jilin, Liaoning, Inner Mongolia, etc adding up to the rural population of over 100 million. And this is not to mention other very cold regions of China which are the Western Provinces which also experience harsh climates and where similar actions could be implemented.
- Socially: better comfort conditions can prevent rural exodus from the cold Chinese rural areas to cities;
- Economically: at the level of farmers, local and global level coal saving is good for families' budgets; local economy and national economy.

So we suggest that this situation is tackled by huge and long-term efforts to establish:

- consistent regulatory and financial policies supporting energy efficient rural housing;
- appropriate technical policies : training, research, etc;
- awareness policies: information action of various key actors about the benefits of energy efficient designs;
- long term field demonstration projects formatted like the first stage of FFEM / HLJ Province project in Shengli.

For instance setting up a typical 1000 energy efficient house projects in Lindian county featuring, at an experimental level, the various regulatory, financial and technical policies listed above would be a good way to expand the very promising efforts started in Lindian county and learn lessons for quick up scaling efforts at Provincial level.

Preliminary terms of reference of such a project will be developed and submitted to French and Chinese authorities by the authors.

4. Acknowledgements

The authors wish to thank the various partners, both on Chinese and French side who have brought, at different stage the designs and implementation of this very challenging project their work, knowledge, assistance, enthusiasms, support and advices.

The whole list of persons actively involved in this project is far too large to be exhaustively quoted here but the authors want to give special thanks to a handful of them whose dedication has been of utmost help to the project:

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- Ms JIN Hong, architect at HIT, rural house specialist;
- Ms YANG Yingzi, engineer at HIT, a high quality dedicated interpreter;
- Ms Mareva Bernard-Hervé of AFD;
- The owners of the 4 pilot houses in Shengli village.

Discussions and outcomes

Most of the presentations on "Energy and Household" were focused on energy efficient housing and effective use of biomass It was repeatedly stated that the technology should be simple, cost effective and easy to replicate. Such a technology has higher tendency of acceptance than highly efficient system with low cost-effective and complexity.

Energy efficient house in cold regions is built on the principle of maximizing solar gain and reducing heat loss. Many different technologies of solar gain are being introduced and promoted in Hindu-Kush Himalaya and Central Asia, namely trombe wall, attached greenhouse (veranda) and direct gain. During the day heat is stored in the walls and is released during nighttime. The walls, roof and floor are properly insulated. The insulation material could be straw, hay, wood shavings or sawdust. Cow dung is mixed with soil (25%) to make a good plaster for the outer walls.

Questions were raised on energy efficiency (fuel saving) of passive solar houses and the methodology for monitoring. It was answered that PSH reduces fuel-wood consumption by two-third. Temperature and energy consumptions are monitored and calculated before and after the house is converted into a PSH.

There was a question on extra cost of a passive solar house. The extra cost is 10% for a new building and 50% for retrofitting or renovation. Payback time is 5 years and it is based on energy saving.

Cane Reed Houses, built from cane reeds is a very energy efficient housing model, cheap to build, simple and less time to construct, highly replicable. The cane reed housing uses western model and technology. It should also promote culture and local knowledge. Microfinance and loan facilities are incorporated to upscale the technology in Kyrgyzstan.

In India, labelling of building has started in order to reduce the total energy consumption. The grading system is dynamic and flexible; there are 5 stars. Otherwise, it may confuse the consumers.

Improved metallic stoves are more efficient than the traditional stoves. It is suitable for rural areas in cold regions, because it decreases fuel consumption and pressure on forest and environment. Researches say, 60% of heat is lost through the exhaust pipe. Heat exchanger thus delays the transfer of heat into the atmosphere, and it helps to reduce household energy consumption by 50%. As a consequence, farmers are able to use the animal dung as manure in agriculture fields to improve soil fertility and nutrients. Otherwise, dung is used as a main fuel in Tajikistan and many highlands of Asia.

Biogas is renewable energy, time saving; environment and health friendly (reduces indoor air pollution). Biogas plants are simple to build; local materials and resources can be used. In cold regions like Ladakh where temperature drops down to -250C in winter, biogas production is less favorable and most of the projects are in pilot stage. Therefore, there is no best practice for cold regions on biogas production. However, it can be increased by coupling solar greenhouse and insulating the digester, and mixing warm water with animal dung. But it will add to the cost. So, there was a question on cost effectiveness of such a system.

Slurry obtained from biogas plant is better than chemical fertilizers and it can be used in agricultural lands. However, using the slurry in semi-arid areas may have adverse effect. The slurry is completely decomposed and it contains less organic matter to retain the water.

It was agreed by all that none of the technology or system is a full solution, because there is huge diversity in geography, economy, culture and climate in these cold regions. The technology has to be adopted as per climatic conditions and tradition of the region.

Energy and agriculture, productive activities

Today, more than 75% of the world's poor live in rural areas and almost half of the economically active population in developing countries relies on agriculture for their livelihood. Producing and processing food requires a high amount of energy. Modern machineries are employed for agricultural activities: cultivation, harvesting, threshing and irrigation, as well as food processing and transportation. It has been estimated that greenhouse gas emissions from agriculture sector accounts for about 22% of global total emissions, and thus largely contributing to climate change. This contribution equals the emissions of the industry sector and is even more important than transport.

In the mountainous areas of Hindu-Kush Himalayas and Central Asia, challenges are even greater: remote and socially marginalised, often not connected to the national grid, access to energy is a major issue in reducing poverty. Processing of agricultural products is done manually (mostly by women), which consumes enormous time and efforts. Otherwise, the processing takes place in the district Headquarter and it often requires long distance travelling by foot. Moreover, the temperature dips to -20°C winter, hampering the production of vegetables. Unavailability and high cost means that local people rarely eat fresh vegetables in the winter months, but instead rely on dried leafy vegetables and stored root crops.

Renewable energy and agriculture are a good combination. Hydro, solar, and biomass energy can be exploited to provide farmers with a long-term source of income. Renewable energy technologies applied to agricultural production could be a sustainable way of enhancing energy access to rural poor and mitigating climate change. While at the same time, it reduces human drudgery and improves the livelihood. Farmers can benefit from hydro energy in many ways, including generating their own electricity, and running various end-use devices such as flourmill, oil expeller, paddy huller, saw mill, carpentry machine, butter churner, fruit pulping machine and spinning machine etc. Productive use of electricity is closely related to the promotion of small and micro business; to create employment and introduce income generating activities. These activities will bring positive changes in the lives of rural population.

Solar energy is clean and unlimited, especially in places like Ladakh where sky remains cloud free for more than 300 days. Capturing the sun's energy for light, heat, hot water and electricity can be a convenient way to save money, increase self-reliance and reduce pollution. Solar greenhouse increases the growing period of vegetables. Biomass energy has the potential to supply a significant portion of energy needs while revitalizing rural economies, increasing energy independence.

Speakers

The session on "Energy and agriculture, productive activities" was chaired by Mr. Ralph Pfoertner – Integration, Germany. Six presentations were given by speakers coming from different countries, representing various organisations: local, national and international NGOs as well as the local government. The speakers presented their innovative approaches in terms of energy access and management in agricultural production, food processing and income-generating activities. Topics varied from livestock management, processing of seabuckthorn berries to the introduction of passive solar greenhouses for vegetable production in winter and management of small-scale irrigation systems.

1) Dr. Nitya S. Ghotge and Dr. Sagari Ramdas – ANTHRA, India made a joint presentation on "Livestock, remote mountain areas and climate change". Climate change can have adverse impacts on mountain ecosystem and livestock rearing. However, local livestock production systems may have the ability to withstand the impacts of climate change. They emphasised on effective use of animal manure (waste) to reduce dependence on external inputs.

2) Mr. C. Balaji - Divisional Forest Officer, Leh (Ladakh) gave a presentation on seabuckthorn plant and the processing potentials of its berry. Seabuckthorn is a hardy plant grown in wild, which has high economic potential in cold arid regions, such as Ladakh. He presented a government scheme implemented in Ladakh, where line departments were responsible for the organisation of processing and marketing of the seabuckthorn. Parts of funds generated were returned to the villagers for public works.

3) A third presentation was jointly given by Mr. Dorje Dawa, Mr. Vincent Stauffer (GERES) and Mr. Mohammad Deen (LEHO), India on "Passive solar greenhouse – bringing better nutrition in cold regions of Western Indian Himalayas". They presented the basic concept of passive solar greenhouse, including the design (orientation, wall angle, double wall, roof inclination, night cover and ventilation). Improved Greenhouse (IGH) is an alternative to support food security and income generating activities. IGH have helped in improving nutrition and income levels of many families in the high mountainous areas of Ladakh and Lahaul & Spiti.

4) Mr. Stanzin Tsephel - BORDA, Germany shared BORDA'S experience in China and India on Hydraulic Ram Pump. He presented the technical components and operational principles of Hydram. Its key features are direct use of hydraulic energy, easy installation, low maintenance and highly reliable. Hydram is appropriate for decentralised water supply for drinking and irrigation purposes in isolated and scattered villages.

5) Mr. Hari Gopal Gorkhali - CRT, Nepal presented the fifth presentation on "improving livelihoods of rural mountain people through promotion of Pico-hydro technologies". He focused his presentation on promotion of Pico-hydro (up to 5kW) technologies in Nepal as a source of electricity and a way to improve livelihood of rural people. The installed capacity of the Micro Hydro ranges from 5kW to 100kW. He also shared CRT's experiences on improved watermill, which is coupled with generator/alternator to produce electricity. Various end-use applications such as grinder, paddy huller, oil expeller and saw mill are operated either electrically or mechanically. Till date, about 6978 Pico and Micro Hydro Units were installed generating 8.98MW; supplies electricity to more than 25,000 households. By mid-2008, Nepal has 5597 improved watermill in full operation, generating 6.7MW of power.

6) Mr. Oliver Haas - Integration, Germany presented the project "Productive Use of Renewable Energy (PURE)" implemented in Badakhshan, Afghanistan. 1kWh of productive used electricity generates 1.5USD of village GDP. Productive use of energy will enhance income and livelihood, and increases the plant's load factor. Various phases, methods and challenges of PURE were discussed. A systemic approach should be undertaken by linking energy access with promising economic or business activities adapted to the rural people's needs.

Livestock, remote mountain areas and climate change

Dr. Nitya S. GHOTGE and Dr. Sagari RAMDAS

Abstract

The cold areas of Asia which include the mountainous regions of Central Asia, Mongolia, China, Hindu-Kush, Karakoram and Himalayan ranges, will feel the impact of climate change and the impending fossil fuel crisis affecting their future development. A number of development options in the past have been energy and fossil fuel dependant and an energy crisis can have far reaching consequences for the poor and vulnerable in these regions. A characteristic of these cold regions are extensive pastoral livestock rearing systems. In the climate debate, livestock rearing is often viewed negatively. Traditionally though, energy obtained from livestock has played a key role but does not normally feature in modern development programmes. Successful integration of livestock into the cycle of energy and agriculture needs to be given more attention in the future. This means taking a fresh look at livestock development programmes in the regions; ways in which it supports agriculture, nutrition and feeds present and future energy demands. Critical areas are the effective use of draft animal power, effective capture of methane generated by animals for household energy requirements and the integration of animal waste into agriculture systems thereby reducing use of chemical fertilizer.

Context

The cold areas of Asia include the mountainous regions of Central Asia, Mongolia, China, Hindu-Kush, Karakoram and Himalayan ranges. The cold and harsh climate as well as the difficult terrain has made agricultural and industrial development difficult. Thus these areas are characterized by economies which are largely dependant on livestock rearing and products which emerge from livestock rearing. Extensive pastoral livestock rearing systems as well as some degree of settled livestock rearing are found in all these areas. Livestock and livestock based livelihoods contribute anywhere from upwards of 35.7 % of the total income and in certain areas even up to 80%.

Transhumant herding is common throughout this region; there are two main situations: full-time herders who follow a transhumance cycle between high pastures and lowlands throughout the year; and settled farmers, within reach of high pastures, who send their stock there in summer. The transhumance systems are similar throughout in that they are of the classical, vertical type, where stock over winter in warmer zones, the plains, foothills or the desert fringe, moving upwards as the weather warms until they reach mountain or alpine pastures in summer. Over wintering in the lowlands gives herders access both to markets and to opportunities for seasonal employment.

Species reared range from camels, yak, sheep, goat, cattle, buffalo, pig depending on the region, the community residing there and the religious preferences. Small ruminants are the basis of most systems, although the Gujjars in Pakistan and India migrate with buffalo and cattle; Camels are important in Baluchistan and Afghanistan; while the yak is more prevalent in Ladakh and parts of Nepal and Tibet. Buffalo is found in India and Nepal and essentially in lower regions where forest and rainfall are more. Cattle and yak dominate where the climate is more dry of greater altitude or arid.

The improved greenhouse (IGH) is designed to maximize the capture of solar energy during the day, while minimizing heat loss at night so that the crops do not freeze. The greenhouse is heated by solar energy alone, and there is no supplementary heating. This is achieved using standard ideas from passive solar architecture, enabling solar heat gain, heat storage, natural ventilation, and reduced heat loss.

Impact of climate change on these regions

These mountainous regions are likely to feel the impact of climate change and the impending fossil fuel crisis extremely severely as many modern development options which have been energy and fossil fuel dependant will no more is possible. A number of development options in the past have been energy and fossil fuel dependant and an energy crisis can have far reaching consequences for the poor and vulnerable in these regions. For example the dairy farming model of the Indian plains which relies heavily on high inputs such as fodder, concentrates, medicines and other services being transported to the individual farms and high outputs; milk being collected and transported twice a day to a collection center is not feasible as many villages are remote and do not have access to roads. Similarly programmes which attempt to sedentarize pastoralists or introduce commercial poultry units may also fail as they are not sustainable and will not be able to with stand the effects of climate change or a fossil fuel crisis

Instead these regions will have to come up with systems which recognize the local ecology, its strengths and limitations, the natural resources within and build on these thereby decreasing the dependency on external systems. A system which relies on local livestock resources, local production systems which includes pastoral systems of livestock rearing , value addition of local resources is therefore desirable and to be advocated. This paper will touch on some of these aspects.

Climate change and livestock rearing

In the climate debate, livestock rearing is often viewed negatively. This is primarily because of the negative consequences of industrial livestock production systems. On the other hand; well designed local systems can in fact contribute positively thereby mitigating the effects of climate change in numerous ways. Some of the ways local systems become climate friendly are:

1. Local breeds of livestock and the use of draft animal power reduces demand on fossil fuels and also reduces green house gas emission.
2. Pastoral systems make use of seasonal availability of resources and thereby reduce the need for transporting inputs to area of production
3. Effective recycling of animal manure helps recycle carbon to the soil ,thereby closing the carbon cycle
4. Return of valuable bio mass to the soil ensures water retention thereby reducing risks posed by sudden periods of drought
5. By encouraging crops which require less water the need for fuel and energy driven irrigated systems. is reduced
6. Locally grown fodders crops can be are integrated into farming systems thereby reducing transportation costs.
7. Growing local crops aids local carbon sequestration
8. Local markets reduce transportation costs and thereby carbon foot prints.

Energy and livestock rearing

The main needs of energy in cold climates are heating, cooking, agriculture, transport and lighting. Traditionally, energy obtained from livestock has played a key role in societies living in cold Himalayan mountain ranges. Animal dung has been used for cooking, heating, lighting as well as for agriculture. Animal power has been used for transport as well as for important agricultural operations. However, energy efficiency may have to be increased to make the systems more efficient and sustainable.

Biogas for cold climates

Bio gas is an effective way of recycling wastes and generating energy. Biogas units for cold climates need to be designed differently from those for hot climates as they have to enable proper fermentation and subsequent gas production. In certain areas as water also may be scarce the model designed must be as efficient as possible. The advantage of biogas is its thermal efficiency is 60% as opposed to 11% for dung cakes and 17% for fuel wood. Not only

Energy need	Traditional use	Suggested improved use
Space Heating	Burning of animal dung cakes	1. Insulation of houses. Waste animal hair / wool may be used in plaster 2. Use of bio gas
Cooking fuel /heating water etc.	Burning of animal dung cakes	Bio gas plant which is built underground and which is covered on top by a green house
Agriculture	Draft animal power of dzo's , bullocks etc	To continue
Fertilizer	Animal dung applied to fields	To use composted animal manure or slurry from bio gas plant
Transport	Ponies, mules, yak, camel, bullocks	To continue
Lighting	Burning lamps using animal milk fat	Biogas generated energy

is it more efficient but it's more hygienic as wastes which can potentially lead to animal and human disease are not allowed to build up in the environment and the slurry can be used as chemical fertilizer. The two basic designs which seem to have worked in cold climates at high altitudes both have a green house to capture solar energy and aid fermentation. The Bolivian model has a tubular digester and has been used in the altiplano at 4000 meters above sea level. These digesters are kept inside a green house. The Chinese ecological courtyard model combines greenhouse, pigsty, and toilet and biogas digester. The typical structure consists of a greenhouse built in the yard, below which buried underground is the digester. A toilet in the yard is directly connected to the underground pit and wastes from the pig sty are also directly channelised into the underground pit. Thus there is no accumulation of wastes above the ground. Biogas generated is used for domestic cooking and lighting and the slurry is used to fertilize the vegetable plot in the green house.

Target group

The bio gas units are suggested for all livestock rearing communities in these cold climates both pastoral as well as settled. They can be designed at an individual level as well as at a community level depending on the situation. The gas generated can also be stored for future use. It is much cheaper to store gas than to store electricity. The cost of the Bolivian model is estimated at $150.00 (Rupees 7,500) per unit however, with appropriate design and use of local materials it may be possible to bring down the costs.

Expected impact

Locally raised livestock and livestock products have high intrinsic social and cultural importance,. They also help conserve biological diversity .Local livestock products takes care of the immediate nutrition especially of vulnerable groups like young children, the elderly and sick. Handicrafts and by products from local produce including carpets, woolen apparel, special cheeses, leather goods have high value, items which need to be nurtured and encouraged as they provide local livelihood opportunities for many.

The environmental value of local livestock productions systems become more apparent through the energy they produce in terms of traction and draft animal power, thereby reducing the need for fossil fuels. Local systems also effectively utilize crop residue and plant by products thereby reducing the demands on land (Mishra and Dixit 2004). Pastoral grazing has lower greenhouse gas (GHG) emissions associated with production than intensive systems (van der Nagel et al., 2003; Casey and Holden, 2005).

If livestock rearing is effectively integrated into ecological agriculture programmes the benefits can be enhanced. The systematic recycling of animal waste which is advocated in ecological agricultural programmes has two benefits a). Application of Farm yard manure reduces the use of chemical fertilizers b) biogas generated further reduces the need for fossil fuels.
By burning biogas generated this way you not only have a more efficient system as compared to burning dung cakes, methane produced in a biogas unit which is 22 times more potent than CO_2 is efficiently consumed into useful domestic energy. The slurry from efficiently designed bio gas plants can be recycled into household agriculture / vegetable gardens / horticulture. Further and very importantly bio gas units prevent the accumulation of waste and thus help maintain hygiene and sanitation. Biogas also avoids smoke in the living quarters thereby leading to improved health.

Replicability

Local livestock systems are region dependant and make use of locally available resources and build on them. They are not cut and paste solutions which can be easily transplanted from one region to another. On the other hand the bio gas units have been tried in other countries and need to be further developed for these regions. To bring down costs the use of locally available material needs to be explored.

The way forward

Successful integration of livestock into the cycle of energy and agriculture needs to be given more attention in the future. This means taking a fresh look at livestock development programmes in the regions, ways in which it supports agriculture, nutrition and feeds present and future energy demands. Critical areas are the effective use of draft animal power, effective capture of methane generated by animals through well designed bio gas units for household energy requirements and the integration of animal waste into agriculture systems thereby reducing use of chemical fertilizer as energy.

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Passive solar greenhouse – bringing better nutrition to the cold arid regions of Western Himalaya

Vincent STAUFFER, Dorje DAWA and Dr. Mohammed DEEN

1. Context

Ladakh, Lahaul and Spiti lies in the northwestern part of India in the western Himalayas. The high altitudes (above 3,000 m) and low rainfall mean that fresh vegetables and other crops can be grown outside for only about 90 days in the summer. In winter, with temperatures falling below -25°C, vegetables would freeze and die. To supplement, fresh vegetables have to be imported by truck in summer or flown in by air during winter. The unavailability and high cost means that local people rarely eat fresh vegetables in the winter months, but instead rely on dried leafy vegetables and stored root crops.

Despite the sub-zero temperatures, the cloudless skies guaranty over 300 sunny days per year. Therefore, there is plenty of sunshine for crops to grow even in winter, provided that they can be prevented from freezing. There have been programmes to provide greenhouses to extend the growing season, but these have had limited success, because the greenhouses were not adapted to local conditions and the users were not well-trained to use them.

2. Technology (solar greenhouse)

Ten years ago the French NGO GERES (Groupe Energies Renouvables, Environnement et Solidarités) started working with Ladakh Environmental Health Organisation (LEHO), Ladakh Ecological Development Group (LEDEG), Leh Nutrition Project (LNP) and Society of Knowledge and Responsibilities for Culture, Health, Environment and Nature (SKARCHEN) and Spiti Trans-Himalayan Action Group (STAG) to develop improved greenhouses better adapted to the climate, which could help local people to substantially increase their crop production.

The improved greenhouse (IGH) is designed to maximize the capture of solar energy during the day, while minimizing heat loss at night so that the crops do not freeze. The greenhouse is heated by solar energy alone, and there is no supplementary heating. This is achieved using standard ideas from passive solar architecture, enabling solar heat gain, heat storage, natural ventilation, and reduced heat loss.

- Firstly, the greenhouse is orientated very carefully along an East-West axis, so that there is a long South-facing side. The transparent cover on the South-facing side is made from heavy duty polythene, which has extra stabilizer in it to resist the intense ultra violet (UV) light which penetrates the thin atmosphere. The polythene should last for at least five years. In particularly cold places a double layer of polythene is used.
- Secondly, the side and back walls of the greenhouse have a high thermal mass, so that they (and the soil) absorb heat from the sun during the day and release it at night to keep the inside of the greenhouse at a suitable temperature.
- Thirdly, to minimize heat loss, the side and back walls are cavity construction, and the 100 mm wide cavity is filled with insulation of either straw or sawdust. The back of the roof is sloped at 35° to avoid blocking any direct sunlight in winter, and it is covered with thatch to minimize heat loss. In addition a cloth or tarpaulin is used to cover the polythene at night in order to reduce heat loss.
- Fourthly, the inner atmosphere is controlled by natural ventilation through vents in the walls and roof, to avoid excess humidity and overheating.

The greenhouses are designed to be simple and robust. The walls are generally constructed of mud bricks, made locally, although in areas of high snow-fall more resilient walls of stone and rock are needed. Rammed earth is also used. Local masons are employed to build the walls and when necessary specialized training is provided. The roof is made from locally available poplar wood for the main frame, with willow for the struts and straw or water-resistant local grass for the thatch. The rear and west-facing walls are painted black inside to improve heat absorption, whereas the east-facing wall is painted white to reflect the morning sunlight onto the crops. There is a door in the wall at one end, and ventilators are incorporated into the roof, the door and the wall at the other end, to enable control of humidity and prevent overheating.

Two standard sizes of greenhouse have been developed. The normal domestic type is 4.5 m deep and 9.7 m long in the East-West direction. The larger commercial type has a similar depth (4.8) but is 27.3 m in length.

A wide range of vegetables is grown in the greenhouses. Local spinach and coriander are very popular. Besides, garlic, radish, onion, lettuce and strawberries are also grown in winter. In spring the greenhouses are used for grow seedlings, and in autumn it is used to extend the growing season for crops like tomatoes, cucumbers and grapes. Some families also grow flowers and indoor plants.

How users pay
£1 = Rs 73 (Indian Rupees). US$1 = Rs 50 (April 2009)

GERES estimates that the total cost of a domestic IGH is about Rs 30,000 (£410 or US$600). Half of this is for materials sourced locally such as wood for the roof, mud bricks, stones and thatch. These can often be collected rather than purchased, and must be provided by the prospective owner. The owner is also expected to provide the labour to build the walls and roof, either directly or by paying a skilled mason. GERES pays for and provides the door, air-ventilators and the UV stabilized polythene, which represent about 25% of the total cost.

Item	Indian Rupees
Ventilators	2,700
Insulated Door	2,300
UV stabilised polythene	2,000
Labour	7,000
Materials (mud bricks, wood etc)	16,000
Entire improved greenhouse	30,000

The timing of greenhouse construction is arranged carefully to fit in with the agricultural year. New owners are selected in the spring, so that they have the opportunity to collect materials, make mud bricks and bake them in the sun during the summer. At the end of the summer, when the main crops have been harvested, there is time available to construct greenhouses, and money from the sale of cash crops to pay for other materials and labour.

3. Community mobilization and implementation methodology

3.1 Training and support
Selection and training of greenhouse owners is one of the most important parts of the programme. It is coordinated by LEHO and managed by other local partner NGOs. GERES provides the methodology, design and development, monitoring, review and reporting.

Project partners have worked with the local community to select 64 greenhouse owners to act as local resource persons (RPs). Some are trained to supervise IGH construction, and others to advise owners on agricultural management. They receive some payment for their work and expenses, typically Rs 70/month per greenhouse. The other owners are supported by the RPs and also have direct access to their local NGOs, usually by phone. The phone number of a contact person is painted above the door of each greenhouse.

The selection of the people that own a greenhouse is carried out with care, in consultation with the local communities. Selected families must be living below the poverty level of US$1/day per person, and must have a suitable site to construct the IGH. The family must be motivated to demonstrate the use of greenhouse as a success story, and also to share the produce with the wider community through sale or barter. Potential owners are taken on an exposure visit of existing greenhouses before they make a final decision about owning one.

3.2 Management, finance and partnerships
In Ladakh, Lahaul & Spiti, GERES works very closely with the NGO network. GERES provides oversight and guidance for the overall project including IGH design and development, progress monitoring and reporting. Project partners are in charge of coordinating the implementation, which includes training for local resource persons (RPs) and other local NGOs, and it also manages discussions with local government. The local NGOs work closely with the 165 villages in the selection of IGH owners, and the RPs supervise the construction and advise on the agricultural site during running of the greenhouses. GERES has a long-term commitment to Ladakh, but is gradually handing over responsibilities to local NGOS.

The work has been funded by the EU with co-funding from Fondation Ensemble. Although funding ends in May 2009, other sources of financial assistance have already been secured. Specifically the French NGO Solidarités and the Indian government's National Rural Health Mission have confirmed assistance, and the voluntary carbon credit trading organisation myclimate.org is providing carbon finance until 2013.

4. Result and Benefits

4.1 Numbers
A total of 586 improved greenhouses have been built since 2005, seven of them are large commercial size IGH and the remaining are for domestic and additional income use. Nearly all are still in use. A few minor problems have occurred, for instance some roofs have collapsed because of water damage.

4.2 Environmental benefits
Some of the vegetables which are grown in the improved greenhouses replace imported vegetables which were previously brought in by truck or airplane. This avoids the greenhouse gas emissions associated with transport. However, the main purpose and value of the IGH programme has been to improve the quality of life by increasing the quantity and variety of fresh vegetables, and not just substituting locally-grown produce for imports. It is therefore appropriate to estimate the greenhouse gas savings as what would have been obtained if all the vegetables produced had been transported to the region.

GERES assumes that about 28% of vegetable would have been transported by truck and 72% by air, for an average distance of 620 km. Using standard transport emissions per tonne of freight suggests a saving of about 0.835 tonnes/year of CO_2 per IGH, or 460 tonnes /year of CO_2 for the 560 greenhouses in use.

Additional environmental benefits have come from improved soil fertility, mainly by the use of better composting techniques pioneered by GERES, and in improvements in soil quality and organic content, which reduces soil erosion.

4.3 Social benefits
The provision of fresh vegetables in the winter months is a great benefit in the region. Surveys carried out by GERES suggest that about 300 tonnes/year of extra vegetables are produced locally, or about 0.5 tonnes/year per greenhouse. Studies have shown that consumption of vegetables during the winter has grown by a factor of eight for families who own an IGH, allowing fresh produce to be eaten two or three times a week in contrast to twice a month in the past.

The average greenhouse owner provides nine other families and exchanges vegetable through barter with a further six. Overall it is therefore estimated that the diet of over 50,000 people, or about 25% of the local population in the area, has been improved through the availability of vegetables. In some areas, such as Zanskar or Lahaul that are inaccessible in winter, it is the first time that fresh vegetable have been available at all in winter.

There is an increasing awareness of the health benefits of the improved diet which is also endorsed by local doctors. There is substantial anecdotal evidence and some survey evidence of improved health in those consuming the fresh produce.

Greenhouse owners gain social standing in their communities, by providing vegetables for the wider community for regular consumption and festive season. One of the aims of the project was to provide new opportunities for rural women. This is being achieved since the greenhouse owner is usually the

woman of the family, and is responsible for providing nutritious meals to the members and the increased family income from the sale of produce. In the orthodox Muslim dominated region of Kargil, women were not only able to sell vegetables in the market, but also received encouragement from their Imams (religious heads) to do so. As a result of the improved financial position some families are able to afford to educate their children for the first time.

4.4 Economic and employment benefits
Locally produced winter vegetables are now available in markets at lower prices, typically Rs 35/kg to Rs 40/kg compared to Rs 60/kg for imported vegetables. Surveys suggest that families save between Rs 500 - Rs 1,000 on vegetable purchases in winter. Because of the added nutrient value of the fresh green vegetables families have the option of not buying expensive non vegetable items and hence make further savings.

The Ladakh region has limited opportunities for employment, so any other alternative of generating additional income is welcome. The income from sale of produce varies between families, depending on how much is consumed by the extended family and neighbours, how much is bartered and how much is sold for cash. Surveys have found that the average increase in family income from the sale of vegetables and seedlings is Rs 8,250/year (US$1 65/year) or about 30%. This means that the time to pay back the entire cost of the greenhouse is less than four years. If a family has been able to gather construction materials and therefore provided only 25% of the cost in cash, then this cash investment is paid back in less than one year. In a few cases, 80% of a family's annual income can come from greenhouse produce.

There are a few commercial greenhouses in the scheme and the income from these is over Rs 35,000 (US$700) in a season. This is a substantial income in a region with limited earning opportunities, where the typical wage of labour is about Rs 150/day.

Locally 221 masons and 15 carpenters have received training and have benefited from the scheme, both through income and the acquisition of the new construction skills.

5. Potential for growth and replication

GERES makes the greenhouse designs available free of cost, and this encourages replication by others in India and elsewhere. A community of practice has been launched through a website 'solargreenhouse.org'. Most of the materials and skills can be found in other similar locations. One component which needs to be sourced carefully is the polythene cladding material. This needs to be both mechanically tough and UV resistant. SILPAULIN, the Mumbai ¬based manufacturer, made polythene with additional UV block for GERES, LEHO and partners.

GERES estimates that there is a potential demand for at least 3,000 IGH in Ladakh, and possibly 6,000 if provision of vegetables for the large military presence in the area is included. Many owners are keen to build a second greenhouse with their own financial resources. In the coming year LEHO will focus on promoting the commercial potential of the IGH with a target of 60 commercial units, including 30 in the Markha valley, a new area of activity.

The adoption of the IGH design by other organizations has been encouraged by GERES, and there is evidence of take up in other countries, notably Afghanistan, Tajikistan and China, as well as in other areas of India. The basic principles of passive solar gain, high insulation and high thermal mass have been incorporated in other domestic and public buildings in Ladakh.

Improving livelihood of Nepal rural mountain people through promotion of pico-hydro technologies

Hari Gopal GORKHALI

1. Background

Nepal is a country with enormous water resources. It is estimated that the rivers flowing from Nepal contribute about 71% of the dry season flow and 41% of the total annual average flow of the Ganges. The annual average run-off within the Nepalese territory is estimated at 174 billion cubic meters. The change in elevation from the high Himalayas in the North to the plains in the South over a short width of 150 to 230 km generates substantial hydraulic head for development of hydropower. Nepal's hydropower potential has been estimated at 83,000 MW based on average river flow (Shrestha, H.M., 1966). The total potential in terms of installed capacity and annual energy of these identified projects are respectively 43,000 MW and 180,000GWh. Hydropower utilization is currently about 1.3% of the proven potential. The total installed electricity generation is about 613.5 MW out of which hydroelectric generation capacity is around 557 MW. Of this total generation of electricity, 603 MW are hooked to the national grid. As of mid-July 2007(Mini-Grid Year Book of Nepal, 2007) about 40 mini hydro plants (100-1000KW), about 651 microhydro (5-100KW) and about 1206 pico-hydro sets (up to 5 KW) serving remote areas of the country particularly in hill and mountain. The energy generated is utilized mainly by the urban population through central grid connection. Due to the difficult and mountainous terrains, national grid electricity has not reached to the majority of needy rural population. Thus they are left far behind from such centralized energy development efforts. Their energy requirements, mainly for cooking, heating and drying, are met from traditional sources such as fuel wood and other biomass resources. Energy requirements for lighting, agro-processing and other small scale industrial activities are also met through following traditional options:

1. Week lamp, locally called "Kerosene Tuki" for lighting,

2. Hand operated stone grinder locally called "Jnato" and traditional water mill locally called "Ghatta" for cereal grinding,

3. Hand and foot operated ponder locally called "Dhiki" for paddy hulling,

4. Manually operated oil press locally called "Kol" for extracting oil seeds

For this rural families spend enormous time and efforts mainly by women or they visit long distance to get their agro-products processed in diesel mills. Such a practice is neither efficient and productive nor desirable from environmental considerations as well as social justification. Therefore there is a need to develop alternative strategies to improve the traditional energy system by introducing alternative and decentralized renewable energy supply systems that are both appropriate and affordable for the people of hill and mountain of Nepal.

Micro-hydro and Pico-hydro are two such hydro-based improved technology systems that has potential for improvement with scope for local innovations that have been gaining momentum in the country. Up to 100 kW, it is considered as Micro-hydro while up to 5 kW it is considered as Pico-hydro. As compared to Micro-hydro, installation of Pico-hydro is much more suitable and affordable by the rural community due to it's comparatively low investment, disturbs little to local setting and can easily be operated and managed by local community. Peltric (small pelton turbine coupled with generator) and Improved Water Mill are two such twin and complementary Pico-hydro technologies that have been quite popular in Nepal, especially among the rural population in mountain. Generation of energy from Improved Water Mill is achieved mainly through the improvement of existing traditional water mills by replacing wooden parts with metal parts, to produce increased power, by more than 100 %, not only to operate mechanical appliances such as cereal (maize, wheat, millet etc.)

grinder, paddy huller, oil expeller, saw mill etc. but also to produce electricity by coupling it with electric generator.

Peltric, on the other hand, is an in-built compact system where a Pelton Turbine is coupled with induction generator to produce electricity for households and community uses. Both these Pico-hydro technologies are site specific. Peltric system runs with high head and low water flow while Improved Water Mill runs with low head and high water flow.

Recently CRT/N has initiated a project on "Meeting Energy Need of Rural People of high hill for Household Lighting through Development and Promotion of Motor Dynamo Based Family Hydro (MDFH) in Nepal" with support from Lemelson Foundation, USA with a concept of generating electrical power of 60-100 Watt, on using a 12 V motor cycle/car dynamo, as a generator, a small pelton wheel runner as turbine and with discharge and vertical head of 1-2 liter per second and 20-30 meters respectively. The generated power can be used for lighting about 10- compact fluorescent lamps of 6-10 Watts each.

A number of organizations including government, donors, and non-government as well as private bodies have been involved in the promotion and dissemination of Pico-hydro technologies in Nepal since more than a decade ago. By the middle of 2007, the country has about 1206 Peltrics supplying decentralized energy services mainly electricity facilities to the rural population of hill and mountain areas. The power output of each installed Peltric ranged from 0.5 kW to 5 kW. Likewise, with technical support from CRT/N the country now has about 5597 Improved Water Mills supplying decentralized energy sources, mainly for running mechanical devices to provide efficient agro-processing facilities and electricity generation to the rural population. The power output of each installed Improved Water Mill ranged from 0.5 kW to 3.0 kW.

Promotion of Pico-hydro technologies has brought positive changes not only in the life style of the rural people living in hill and mountain areas, but it also has positive impact at the national and global level. At the local level, it has helped the rural entrepreneurs to generate income and employment opportunities and improve their social and economic living standard. The entrepreneurs' technical and managerial capabilities have also been increased due to the application of these technology innovations. The technologies have helped in substantial reduction of local drudgery and improve their life style, especially of women who else would have to manage with traditional options or diesel mills requiring enormous time, efforts and money. The lighting facilities have helped them to increase their working hour, to combat health hazards else would have faced from wick lamp, to assist their children in study affairs, to improve their sanitation conditions, to run electrical appliances such as radio, TV, etc. The time and efforts saved to rural population especially to women, due to use of new agro-processing opportunities has been used for other socio-economic activities such as taking care of children, fodder/fuel wood collection, household sanitation, looking after the farm activities, running small scale enterprises etc.

At the national level, promotion of about 6803 units of the Pico-hydro technologies in Nepal has contributed to produce about 8.98 MW of decentralized power. This provided the opportunity to serve about rural 25,000 households with lighting facilities and about 300000 rural households in hill and mountain areas with efficient agro-processing facilities. Undertaking various activities at the national level to promote these technologies has significantly contributed to add not only the national income but also the employment opportunities. Globally, promotion of the technologies has contributed to some extent in checking the environmental degradation by checking carbon emission in the atmosphere that would have occurred due to entering of diesel mills and required fossil fuels to meet the service demand of the rural population in the country. It has made possible to explore the feasibility of carbon trading in the world market for the benefit of the rural people in the country. The efforts to promote Pico-hydro technologies in Nepal have honored the view of Millennium Development Goals (MDGs) that stresses to use renewable energy as a means of economic development, poverty eradication, environmental protection and gender equity.

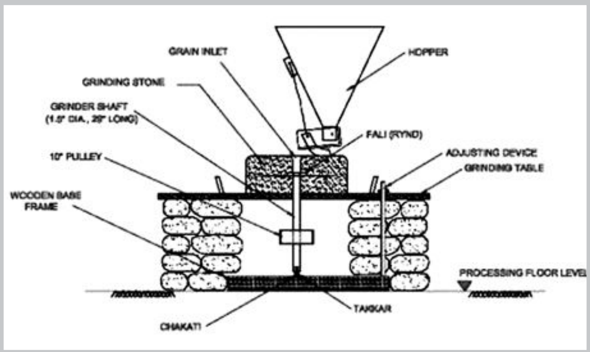
2. Pico-hydro technologies

Improved Water Mill and Peltric Set have been quite popular in Nepal, especially among the rural population in the hills and mountains. Both the twin technologies are designed and developed within the country. The country has full technical capability to manufacture these Pico-hydro technologies locally as per demand from the potential entrepreneurs.

A. Traditional Water Mill (TWM)

More than 25, 000-30,000 traditional water mills, are in operation in the country and have been part and parcel of villager's life as source of rural energy and closely interrelated with their tradition and culture since age They have wooden runner and derives its power from the water pressure caused by its head.

Water flows through chute to strike the wooden blades attached along the wheel. Operational efficiency is very low.

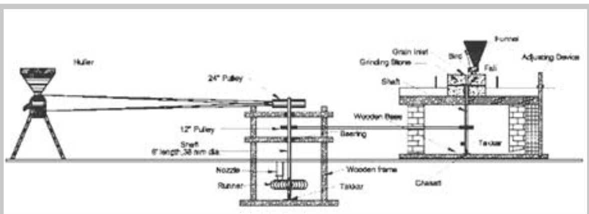


Sketch of traditional water mill

B. Improved Water Mill

Improved Water Mill is mainly the improvement of existing traditional water mills to produce increased power not only to operate mechanical appliances such as cereal (maize, wheat, millet etc.) grinder, paddy huller, and oil expeller, saw mill etc. but also to produce electricity by coupling it with electric generator.

The improved water mill is a modified version of traditional water mill. Improvement of traditional water mill is done by improving its various parts but the major break through is made by replacing the traditional wooden runner with hydraulically better shaped metallic runner having cup shaped blades. This increases its operational efficiency as well as making it more useful with additional machines. After the improvement, the water mills have increased capacity by more than 100 %.



Sketch of an improvedwater mill

C. Peltric Set

Peltric Set is, on the other hand, the simplest form of an in-built compact system where a Pelton Turbine is coupled with induction generator to produce electricity. The turbine derives its power from the water pressure caused by a high head which flows through a nozzle and strikes a number of especially designed buckets attached round the periphery of the wheel. The induction generator produces electric power when it revolves at its designed speed. A Peltric Set is suitable for installation also with multiple nozzles that lowers the cost per unit of power produced. The power generated is used only for lighting purposes.

D. Motor Dynamo Based Family Hydro (MDFH)

Motor Dynamo Based Family Hydro (MDFH) is also an in-built compact system where a small Pelton Turbine (weighing about 1.25Kg.) is coupled with 12 V car dynamo to produce electricity ranging 60-100 Watt depending upon the site. Derives its power from the water pressure caused by high head of 20-30 meter with discharge of 1-2 lps. The power generated is used only for lighting and charging 12 v batteries.

3. Comparative technical parameters of the technologies

The Pico-hydro technologies, mentioned above, are site specific. Peltric Set runs with high head and low water flow while Improved Water Mill runs with low head and high water flow. The rpm of shaft in traditional water mill is very low while it is medium in the case of improved water mill and very high in the case of Peltric Set and MDFH. The intake, canal and penstock system for the technologies are similar. However their functions are different. The comparative technical parameters of the Pico-hydro Technologies are given in Table 1 while their functional features are given in Table 2.

Table 1. Comparative technical parameters of Pico-hydro technologies

Comparison Parameters	Traditional Water Mill	Improved Water Mill	Peltric Set	MDFH
Length of Canal	Not Specific	Not Specific	Not Specific	Not Specific
Working Head (Meter)	3-7	2-15	25-50	20-30
Water Discharge (lps)	30-100	10-100	2.5-20	1-2
Speed (rpm of shaft)	60-90	110-210	1500	1800
Output Power Capacity (kW)	0.2-0.5	0.5-3	0.5-5	60-100 watt
Grinding Stone	Local	Local	-	
Thickness of Grinding Stone (inches)	3-10	5-15	-	
Diameter of Grinding Stone (inches)	24-34	24-34	-	
Operational Efficiency (%)	Below 25	40-50	50-60	30-35
Repair/Maintenance	High	Low	Low	Low
Life Span	2 Years	10 Years	10 Years	10 Years
Investment	Low (NRs.25000) US$.312	Medium (NRs.45000-50000) US$.625-650	High (NRs.150000-175000/KW) US$.1875-2187	Low (NRs.18000-20000) US$.225-250
Pay Back Period	2-3 Years	3-5 Years	5-7 Years	2-3 Years

Table 2. Comparative functional features of Pico-hydro technologies

Technology	Functions and Capacity
Traditional Water Mill	Grinding cereals (maize, millet, wheat, rice etc.), 10-20 kg/hr (maize)
Improved Water Mill	Grinding cereals (maize, millet, wheat, rice etc.), 20-50 kg/hr (maize) Dehusking/partial polishing of paddy (50-70 kg/hr) Expelling oil from oilseeds (10-15 kg/hr)
Peltric Set	Generation of electricity (12V-DC and 220V-AC, 0.5-3 kW) Generation of electricity (220V-AC, 0.5-3 kW)
MDFH	12V-DC (60-100 Watt)

4. Possible end-uses

After the installation of Pico-hydro technologies, it is possible to operate a number of equipments for productive and income generating purposes. With Peltric Set, because of additional reactive power required for initial priming it is not possible to operate high power required equipments. However, in the case of Improved Water Mill, as the equipments are operated directly with mechanical driving, it is possible to operate various machineries and equipments requiring power up to 3 kW. Some of the possible end-uses that can be operated in Improved Water Mill are given in Table 3.

Table 3. Power requirement for various end-uses

Equipment	Power (kW)	Capacity
Cereal Grinder, No. 1	1.0	40 kg maize/hr
Cereal Grinder, No. 2	2.0	70 kg maize/hr
Paddy Huller, No. 1	2.0	80 kg paddy/hr
Paddy Huller, No. 2	3.0	200 kg paddy/hr
Baby Oil Expeller	2.5	25 kg mustard/hr
Bitten Rice	2.5	75 kg roast. paddy/hr
Paddy Thresher	1.5	100 kg paddy/hr
Circular Sawing Machine, 350 mm	1.4	
Pliers Machine, 150 mm	0.7	
Lethe Machine, 300 mm	0.7	
Dynamo, DC 12 Volt, 300 Watt	0.3	
Dynamo, DC 12 Volt, 500 Watt	0.5	
Induction Generator, AC 220V, 1kW	1.0	
Induction Generator, AC 220V, 2kW	2.0	

5. Support for promotion of Pico-Hydro Technologies

A. Improved Water Mill

In the case of the Improved Water Mill, German Appropriate Technology Exchange (GATE) initiated its promotion and dissemination during the 1980s as a pilot in one of the hill districts called Dhading. Centre for Rural Technology, Nepal (CRT/N), a national technical non-governmental organization established in 1989 with an aim to promote and disseminate appropriate technologies suited to rural conditions, took the lead role in the promotion and dissemination of the Improved Water Mill during the early 1990s with technical and funding support from GATE and German Technical Cooperation (GTZ).

After the termination of GATE/GTZ supported program in 1999, CRT/N continued its promotional efforts with the support from various development agencies within the country that included government organizations, I/NGOs, private entrepreneurs etc. The momentum of its promotion gained when CRT/N launched Nepal and Netherlands Government supported national "Improved Water Mill Support Program" in 2003.

The Improved Water Mill has been recognized by UK based Ashden Award in 2007 for contribution on enhancing the livelihood and checking of carbon emission in the atmosphere.

B. Peltric Set

Agricultural Development Bank, Nepal (ADB/N) has played a very instrumental role in the initiation towards promotion and dissemination of Peltric Set during middle of 1980s, mainly with its technical and financing support, when Government of Nepal announced a provision of subsidy for its installation.

The momentum for its promotion geared up only during late 1990s when Alternative Energy Promotion Centre (AEPC) of Nepal Government launched the national Energy Sector Assistance Program (ESAP) in the country for the promotion of RETs including Peltric Set with the technical and funding support of DANIDA.

C. Motor Dynamo Based Family Hydro (MDFH)

Center for Rural Technology with support from the Lemelson Foundation, USA, has conceptualized and implemented the project "Meeting Energy Need of Rural People for Household Lighting through Development and Promotion of Motor Dynamo Based Family Hydro (MDFH) in Nepal"; from January 2007. The pilot project has been successful to install 12 units of MDFH in hill and mountain areas. Family Hydro was installed at the average power generation of 60-100 W (DC Power), through the use of Motor Dynamo coupled to the shaft of a Pelton runner designed and developed in CRT/N with support from Katmandu University.

With an aim to disseminate the technology, 100 more MDFH will be installed in remote mountains of Nepal during 2008-09 with support from Lemelson Foundation, USA, through Local Partner Organizations. The overall objectives of the project are to familiarize the technology among the potential users and to create a market for further promotion in mountain areas.

6. Institutional and technical support

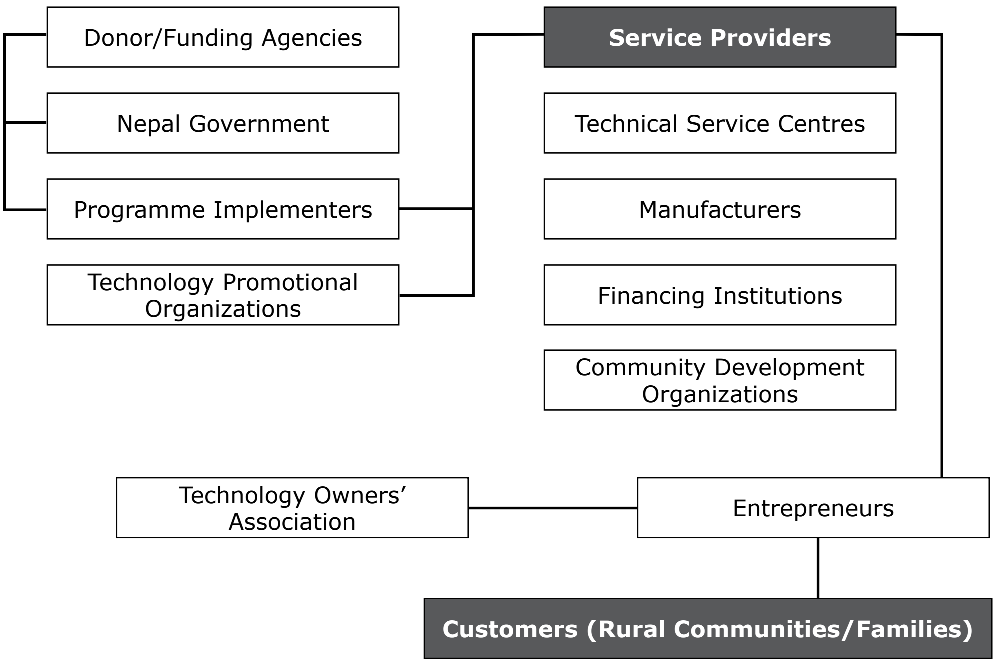
The main focus of the Pico-hydro development programs was to develop institutional and technical capability of various local level Service Providers for sustainable promotion of the technologies. The other focus of the program was on providing the quality services to the end users.

In order to provide the required institutional and technical support services to the Service Providers, a number of stakeholders within the specific program on the Pico-hydro technologies have been involved. Nepal Government provided the policy guidelines and monitoring support while the donors such as GTZ and Netherlands Government in the case of Improved Water Mill and DANIDA in the case of Peltric Set provided the required technical and financial supports.

ESAP and CRT/N implemented the Peltric Set and Improved Water Mill promotion program respectively. Various government line agencies, INGOs and NGOs provided the promotional efforts. All these stakeholders have played their respective roles to strengthen the capabilities of Service Providers such as Technical Service Centers, manufacturers, financing institutions, private companies, community development organizations etc. in a coordinated way to make them able to promote the technologies in an efficient manner.

While the Service Providers provided required support services to local entrepreneurs and end users in the installation, operation and maintenance of the technologies. Presently, technology owners' associations such as Water Mill Owners' Association and Peltric Set Owners' Association are being formed for the sake of sharing their voice with the concerned bodies for their own security and benefit. The institutional linkages among the program stakeholders are presented below.

7. Institutional linkages among the program stakeholders



8. Subsidy Support

In order to expedite the promotional activities and to support the entrepreneurs to make them able to invest in installing the technologies, the program has provided the subsidy support as shown in Table 4. The rest of the investment required to install the units is borne by the entrepreneurs themselves.

Table 4. Subsidy support to the entrepreneurs

Particular	Purpose	Subsidy available	Unit cost
Improved Water Mill installation On mechanical component (to install short shaft only)	Cereal grinding only	NRs. 12000 (US $150) per unit, additional subsidy for transportation in very remote districts	NRs.25000.00 (US$.312)
Improved Water Mill installation On mechanical component (to install long shaft)	Cereal grinding, paddy hulling, oil expelling	NRs. 27000 (US $337) per unit additional subsidy for transportation in very remote districts	NRs.50000.00 (US$ 625)
Improved Water Mill installation On add-on electrical component	Add-on household lighting facilities	NRs.60000 (US $ 750) per kW electrical power produced or NRs.6000 (US$.75) per household	NRs.200000-350000 (US$.2500-4375)
Peltric Set Installation	Household lighting facilities only	NRs. 97500 (US $1219) per kW electrical power produced or 12000 (US$.150) per household.	NRS.325000-750000 (US$.4062-9375)
MDFH	Household lighting facilities only	NRs.6000 per unit (US$.75)	NRs.18000-20000 (US$.225-250)

9. Programs implementation activities

- Identification of potential stakeholders and developing linkages among them
- Establishment of Support Units in the program districts/areas
- Identification and selection of local level Service Providers
- Making awareness among the potential rural entrepreneurs and users about the technologies through organization of Orientation/Demonstration activities
- Capability development of Service Providers
- Inventory making of the potential demand
- Feasibility survey
- Arrangement for financing support, subsidy support and hardware supply
- Installation of the technologies
- Capability development of the entrepreneurs for efficient operation of the technologies
- Monitoring and follow-up of the technologies installed

10. Achievement and its implications

A. Improved Water Mill

By Dec, 2008, the country has about 5597 Improved Water Mills supplying decentralized energy sources, mainly for running mechanical agro-processing devices to facilitate the rural population and to reduce the drudgery of women. There are also a few units that provide electrical facilities to local population.

The power output of each installed Improved Water Mill ranged from 0.5 kW to 3 kW that is substantially high as compared to the power output of traditional mill having power output generally below 0.5 kW. This has made the Improved Water Mill possible to operate various devices that operate up to 3 kW.

The total power generated so far from the installed sets is about 6730 kW, the average power output per unit being about 1.2 kW. The distribution of Improved Water Mill installations by year is shown in Table 5.

Districts wise installation of Improved Water Mill

B. Peltric Set

By the middle of 2007, the country has about 1206 Peltric Sets supplying decentralized electrical facilities. The power output of each installed Peltric Set range from 0.5 kW to 3 kW. The total power generated so far is about 2248 kW, the average power output per unit being about 1.86 kW. The distribution of Peltric Set installations by year is also shown in Table 5.

Districts wise installation of Peltric Sets

Table 5. Distribution of Improved Water Mill and Peltric Set installations by year

Improved Water Mill			Peltric Set		
Year	Installation No.	Power Generation (kW)	Year	Installation No.	Power Generation (kW)
1984-88	80	101	1991	46	43
1991-93***	54	62	1992	13	12
1993-95***	211	221	1993	-	-
			1994	79	100
			1995	115	171
1996	40	49	1996	130	203
1997	18	21	1997	84	144
1998	94	96	1998	97	185
1999	124	128	1999	123	226
2000	91	97	2000	112	214
2001	107	134	2001	36	81
2002	58	73	2002	61	141
2003	65	85	2003	80	184
2004	634	761	2004	66	140
2005	886	1063	2005	48	101
2006	868	1041	2006	46	101
2007	1164	1397	2007*	70	202
2008**	1168	1401	2008	NA	NA
Total	5597	6730		1206	2248

**Till mid-July; ** Till mid Dec ***Breakdown not available*

C. Implications

The promotion of Pico-hydro technologies has resulted into positive changes in the socio-economic conditions of not only the entrepreneurs but also the local communities, especially rural women. The technologies have changed the settings of the villages and have also significantly helped in checking the environmental degradation of the rural areas that would have happened due to encroachment of non-renewable energy sources. The major implications are:

Implications at the community and village level

Pico-hydro technologies have helped local level entrepreneurs to generate substantial income and increase their living standard. Their social status in the society also increased as they provided enormous services to the local community. The entrepreneurs' technical and managerial capabilities also increased substantially to run the enterprises efficiently.

The technologies have reduced substantially local drudgery, especially of women who else would have to manage spending enormous time and efforts. Or they would have to travel long distance to have access to diesel mills to process their grains and oil seeds. The lighting facilities have helped them to increase working hours, to prevent health hazards (accidents from kerosene wick lamp), to assist children in study affairs, to improve sanitation conditions, to run electrical appliances such as radio, TV, etc. The new agroprocessing opportunities have helped the communities to save substantial time which they have been using for other socio-economic activities such as taking care of children, fodder/fuel wood collection, household sanitation, farm activities, running small scale enterprises etc.

The promotion programs have given the local service providers in the villages more employment and income generating opportunities with their increased and efficient service delivery capabilities. Furthermore, the technologies have helped the villages to maintain its ecological setting by checking the entry of diesel and kerosene operated machines and appliances.

Implications at the national and global level

At the national level, promotion of the Pico-hydro technologies has contributed to produce about 9.00 MW of decentralized power. It has provided about 25,000 rural households with lighting facilities and about 300000 rural households with efficient agro-processing facilities. Such services have drastically reduced the drudgery, especially of women, and enhanced the life style.

Promotion of the technologies has supported the national policy to develop renewable energy technologies to reduce dependency on imported energy. The efforts have also helped to indirectly integrate with other development activities for rural poverty alleviation. To promote these technologies has significantly contributed to add not only the national income but also the employment opportunities as well.

Globally, the technologies have contributed to some extent checking the carbon emission in the atmosphere that would have occurred due to entering of diesel mills and fossil fuels to meet the service demand of the rural population in the country.

11. Conclusion

The efforts to promote Pico-hydro technologies in Nepal have substantially contributed in the development of the country as a whole. As such, more efforts are required to include more rural villages within the decentralized energy supply systems. There is potential for the transfer of these technologies among the mountainous countries all over the world. Expanding access to energy services for the poor in developing countries requires a range of efforts such as strengthening policy, regulatory, institutional, infrastructural, financial and human resource conditions. Capacity development at all levels is critical to successfully expanding access to decentralized energy services. Once the capacity has been built, it becomes a resource, which the country can continue to build upon, continuously strengthening its capacity to deliver or improve energy supply system.

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Productive Use of Renewable Energy (PURE)

Oliver J. HAAS and Ralph PFÖRTNER

Approaches in rural electrification

There are four principle alternative situations or approaches in rural electrification observed which will determine the options and activities of promoting the productive use of electricity there.

1. Extension of the public grid in rural areas
In this case the owner of the public grid or the leaseholder who has the right to transmit and distribute electricity through this extension to the new accessible rural area would have a strong interest to promote - next to the consumptive use - the productive use of electricity to increase his sales in the new area.

He could do this either directly by establishing his own internal service of "productive use marketing" or by facilitating contacts between potential clients and related existing external public or private services to use electricity productively. The consequences of those two options will be dealt with below.

2. Electricity supply by an IPP to the public grid
This case is a slight diversion from the first one. The IPP takes initiative. He will not only sell to the public grid, but will also assure the distribution of electricity within the vicinity of his transmission line between the location of electricity production (e.g. Hydro power station, bio gasifiers or digesters) and the public grid. This case will only apply if the owner of the public grid will not take own initiative or will sub-contract the new area to the IPP.

3. An isolated or stand-alone local grid in remote rural areas or in single villages
In this case the owner of the local grid (Rural Energy Service Company – RESCO/ REE - or a commune based organisation – CBO) will provide electricity to its immediate rural area / neighbourhood/ village or number of villages. He has a great interest to maximize the sales of electricity by promoting its productive use next to its consumptive use targets. In particular in the case of a hydro power 24 hour service he needs to identify opportunities at low consumption periods (after midnight or during day times) to increase the load factor. In any case the RESCO or CBO needs to cover cost and to generate some profit to remain sustainable.

4. An individual household electricity supply situation

In this case the owner runs its own electricity supply (diesel generator, SHS, wind or water turbine, bio gasifier, etc.) for direct use or recharging batteries for later use. All these systems could be used – next to consumptive applications such as lighting, TV or radio – for some income-generating activities such as soldering, welding, grinding, sewing, hair cutting etc by appropriate productive use applications as well.

Productive use approaches

Productive use of electricity is closely related to the promotion of small and micro business promotion to create employment and introduce income-generating activities.

This could be done by activities such as
- rapid appraisal of rural business potentials and markets;
- accessing small investment opportunities (pre-feasibility studies);
- providing micro credit facilities or small investment loans,
- demonstration of appropriate technologies in local / regional trade fairs or road shows;
- Others such as a technology catalogue (Mongolia), marketing support, etc.

Not all those opportunities might necessarily use electricity, but most of them are closely linked. (Processing of agricultural or forest products, repair or other services such as restaurants, accounting, transport etc.)

As to those four rural electrification situations several approaches of the RESCO, the public energy supplier or concerned government agencies to enhance the productive use of electricity could be considered:

1. Facilitating contacts to existing public or private services such as commercial banks, credit unions, Small Business Development Agencies, urban hard ware dealers/ suppliers, chambers of craft trades, commerce or industry, concerned NGOs, etc. In this case the RESCO could either ask the service providers to assess the situation themselves or provides information on its own rapid assessment of likely opportunities in his area of operation.

2. Setting up own PU promotion services. If the area of new electricity supply is substantial (e.g. 2 – 3 MW capacity to about 10,000 rural households), it could be feasible/cost-covering for the RESCO to establish its own services to promote the productive use of electricity (activities: see above). In particular in cases where already a larger number of diesel-driven engines or electricity generators exist, it could demonstrate the use and advantage of electric engines or the direct use of plough-in productive use of electricity. The RESCO could become a dealer of this equipment and provide cheap repayment facilities/ loans.

3. Providing special government services. In the case of small REE and commune-based isolated grids or in the case of individual households it might be useful that the government through its BDS agencies or in cooperation with donor-funded rural electrification programmes would intervene to encourage the productive use of electricity to create new income opportunities. E.g. providing information on available equipment and technologies, cheap loans or contacts to banking facilities, marketing support, etc.

The choice of promotional approaches depends on the existing situation and must be decided case-by-case. There are many options which have not been elaborated here.

PURE – The case of Badakhshan, NE-Afghanistan

Situation:

- Remoteness of buying and selling markets
- Low education, vocational and entrepreneurial skills
- Social order determines economic position in rural communities
- Low cash income (subsistence and barter economy)
- Hampered access to technology (affordability, accessibility, lack of know-how)
- Crime (weak property rights)
- Inefficient energy use (heating, cooking, boiling, lighting, businesses).

Socio-economic pattern:

- Consumption comes in most HH first (esp. house improvement)
- Saving time and money for domestic and subsistence work can lead to potential for productive use. This is more when HH do not lack essential needs such as nutrition and health care. Therefore it is more plausible to focus with PURE promotion more on middle income households rather than on very poor (at least for enterprise promotion).
- Role of opportunity costs is crucial. Household poverty remains high and people chose their livelihood strategies according to existing opportunities. They often have to maximize short term benefits (incomes).

Preconditions for PURE:

- Quality energy necessary. 200-300 KW/meter, 3-phase connections available, stable electricity at reasonable prices (QEP).
- Community activation and participation during planning and implementation of energy supply.

PURE Approach - Sequences:

- Matching supply (hydro-power potentials) with demand (energy demand in businesses)
- Community based implementation of MHP: Additional income by cash for work in the community
- Circulation of funds in the community by local operation of MHP
- Consumptive savings on fuels on HH level
- Substitution of inefficient energy sources in micro-businesses
- Gatherings of businessmen for awareness creation
- Business trainings for PURE
- Promotion of business plans with pro-poor potentials
- Productive Finance

Which products can have success on the market and on which market?
1. Import substation
2. Value addition or enhancement in productivity in agriculture and livestock
3. Product improvement (enhancement)
4. Product innovation (additional products) / changes in market structures etc.

Challenges:

- Avoid crowding out and one thing more: avoid it!
- Link remote areas with (prospering) economic centres
- Facilitate responsible finance – avoid abusive or inappropriate finance for PU
- Show innovate business start-ups and how to replicate them

Guidelines for interventions:

- Structures and measures need to be transparent
- Access to technology should be sustainable (without the project)
- Market interventions should be replicable (feasible)
- Business perspectives need to be promising (viable)

- Interventions should focus more on production rather on services in the beginning of PURE

Challenges

- As an energy programme there are only limited funds for PURE promotion
- Most rural people will invest savings and additional incomes in livestock and house improvements and not (re-) investment in micro-businesses
- Unawareness of natural resources (herbs, spices, semi-precious stones etc.)
- Drug economy hampers business growth by providing very high opportunity costs
- Economic logic needs to meet ecological logic. Poor and deprived people will mainly follow economic incentives and accept positive ecological impacts as an extra benefit.

Monitoring:

- It makes no sense to monitor until something is found fulfilling the indicators. Monitoring has to be something which is done as part of the programme management and as a guiding function, esp. in business promotion.

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Discussions and outcomes

The importance of livestock in supporting farmers' livelihoods plays a key role but does not often draw attention of development practitioners. Successful integration of livestock into the cycles of energy and agriculture should be given more attention. While intensification and industrialization is required to reach higher levels of production (through cross breeds for instance), however, introduction of this system would probably not be adapted to cold regions and thus not sustainable. For instance, water requirement for a cow raised under the intensification model is 100 litres per day, which is not conceivable in areas where water is already a scarce resource.

Seabuckthorn is a hardy, multipurpose plant, whose sustainable use has high economic potential. In Ladakh, local people are paid for collection of fruits, whereas government institutions organize the processing and marketing. In Nepal, seabuckthorn fruits are collected and pre-processed as syrup, which is later purchased by companies for juice production. Communities with the support of local government should take advantage of these untapped potentials by developing efficient value-chains. However, regulation for sustainable harvest of the berries should be established to avoid overexploitation

Passive Solar Greenhouse has positive environmental and economical impacts. However, pest management in the greenhouse is a major issue of discussion. Aphid infestations have been controlled by regular ventilation to avoid overheating and excess of humidity, and applications of organic pesticides.

Nepal can take advantage of the many rivers and streams in the country to produce about 43,000 MW through hydro-power. So far, only 1.3% of this potential source of energy has been tapped. The development of Pico-hydro power stations in remote areas of Nepal supports the development of productive activities (through watermill or dynamo-based motor) such as oil expelling, cereal grinding or rice hulling and thus helps improve the livelihoods of mountain communities. The challenge lies now in improving the technology's efficiency. Building the capacities of end-users and technicians remains an issue of major concern and requires specific attention. Maintenance, an essential activity in the sustainability of the project was also brought on for discussion. In the case of watermills, the responsibility was shared by different stakeholders: implementing agencies, manufacturers and users associations.

There is a need to link energy with productive activities to promote small and micro enterprises, in order to create employment and introduce income-generating activities. Identifying the opportunities could be done by conducting an appraisal of rural business potentials as well as access to small investments and markets. There was a question on whether the economic viability in remote mountainous areas should be the main criterion for investment. It was answered that several criteria should be taken into account and particularly the adequacy of the investment to the communities' needs as well as the social acceptance. Another question was raised on financing issue; whether the project supported investments by providing loans or grants. Depending on the type of activity, the size of the investment and the risk involved, some business creations were funded by the project while others were partially subsidized.

Energy in public buildings

In high altitude cold regions, winters are long and harsh. Under such conditions, space heating is a primary requirement to create a comfortable working environment. Government buildings like offices, hospitals and schools are often heated with conventional methods through use of fossil fuels, mainly coal, wood, kerosene and dung. The costs of such heating systems are as high as 30% of the total running cost, including staff. These expenses can be considerably reduced by assimilating passive solar technology in the buildings.

Governments cannot afford to arrange heating systems for all the public buildings; recurring costs are too high, which will only add extra pressure on the budget. Very few existing schools, health centres and public offices are insulated. As a result, schools remain closed for at least two and half months in a year, from mid December to March. The working conditions in clinics and health centres are miserable.

Energy efficient schools that combine active and passive solar, and insulation are an effective and affordable technology. The insulation can be implemented in priority for the windows, roof, walls and floor. Then the heat loss can be reduced by 60%. The working conditions in schools are drastically improved for both pupils and teachers. Such rooms are 10°C warmer than the normal non-heated rooms. The monitoring of passive solar buildings shows that even simple interventions can lead to comfortable living conditions in winters, besides saving 40 % to 60% of fuel wood, fossil fuels and electricity for space heating. The repayment period such a new building is 3-6 years, whilst the additional cost is 10%. An energy efficient building is, therefore, highly cost effective.

It is necessary to create awareness among the public, policy makers and planners about the benefits of passive solar technology. In order to promote the technology, engineers and contractors should be trained in design and implementation. Government should also make it bylaw to integrate some features of passive space technology in all the government and semi-government buildings. Advocacy and lobbying by civil societies is crucial.

Speakers

The Working Session on 'Energy in Public Buildings' was chaired by Mr. Robert Celaire, Concept Energy (France). There were three interesting presentations, covering wide range of geographical area – Tajikistan, Himachal Pradesh (India) and Afghanistan.

The first presentation was given by Mr. Dag Arne Hoystad, Norges Naturvernforbund, Norway. His presentation was focused on "Energy efficiency in education and window restoration in Central Asia". In Central Asia, thermal quality of windows and doors is very poor. Hence, the heat is lost by air infiltration and transmission through single glass. Improvement of windows (air tightness, double glass) is quick, simple and cheap; thereby the indoor temperature is increased by 3°C to 10°C. He shared the objectives and results of SPARE Project (School Project for Application of Energy and Resources), which is implemented by Norges Naturvernforbund (Friends of the Earth Norway) in 20 countries and 5000 schools.

It was followed by a presentation by Dr. S. S. Chandel, State Council for Science, Technology and Environment, Government of Himachal Pradesh (India). It was focused on "Implementation of Solar Passive Housing Technology in Western Himalayan State of Himachal Pradesh". The "Solar House Action Plan" was approved by the state government in 1994, and it is mandatory to construct all government and semi-governmental buildings as per passive solar technology. He shared the strategies, features and follow-up actions concerning the policy. More than 200 Solar Passive buildings (schools, government, hostels etc) were constructed since the introduction of the law.

Mr. Riaz Ramin, GERES Afghanistan, presented the third and final presentation of the Working Session on "energy in public buildings'. His presentation was focused on "dissemination of energy efficiency best practices in the construction sector of public buildings (health and education) in Afghanistan". The project is supported by ADEME and FFEM. He shared the objectives and results of each component of the project: development of standard design of energy efficient health centre; implementation of 160,000 square metre of energy efficient building in education and health sectors; training of engineers and contractors in designs and implementation; supports to materials suppliers and communication. He also shared the opportunities in energy efficient projects in Afghanistan, with some exemplary ventures of GERES Afghanistan and its partners.

Insulation of school buildings: windows and doors

Dag A. HOYSTAD

Doors and windows are weak parts regarding buildings ability to retain heat. Typically around 40 % of the heat losses are through windows and doors. In many school buildings these figures can be even higher. Constructions of poor quality have big gaps and cracks. Years without maintenance make the situation even more critical.

Sealing of cracks, replacement of broken glass and installation of double glazing will improve the heating situation substantially. To heat buildings with substantial air leakages require often much more fuel than available. This results in cold and unhealthy learning environment in schools. Indoor temperature often drops down to +10°C or below. Simple sealing of cracks can raise the indoor temperature by 3-10°C without consuming any extra fuel. Our work in Central Asia has focused on window restoration as the fastest, cheapest and simplest way to improve energy efficiency in school buildings.

General introduction

After the collapse of the Soviet Union, Countries of Central Asia faced serious difficulties to provide the population with energy for heating, cooking and lighting. This new energy crisis has hit Tajikistan and Kyrgyzstan particularly hard. These two countries, unlike the other three (Kazakhstan, Uzbekistan and Turkmenistan) do not have their own oil and gas resources. The inefficient and heavily subsidized centralized system for fuel supply was too expensive and impossible to keep for the new independent states. Lack of access to affordable energy services and regular power supply affects all vital activities of local communities and reduces their ability and capacity for further development. Village residents use firewood, scrubs, dry dung and other biomass for space heating and cooking. Of late, an increasing degradation of rare forest resources has been observed around many mountain settlements as a result of repetitive cutting of trees.

Especially remote mountain villages are heavily hit by the cut of energy supply from outside. The severe shortage of energy sources in mountain villages deprives the population of the most basic means of subsistence and community development. Moreover, the use of oil or paraffin lamps and candles for lighting negatively affects the village residents' health and also becomes a major factor of poverty aggravation: the families spend a significant part of their resources on such lighting devices and fuels. Therefore availability of lighting would have a positive effect on improving comfort and health, children's performance at school, small business development and activation of the communities in general.

In the same way, access to communications (no telephones) in remote mountain villages is difficult. Access routes (usually dirt roads) are often blocked and transportation is extremely difficult in winter period.

During Soviet period the emphasis was on ever expanding big production facilities. Building quality and small scale energy production was neglected. Energy was greatly subsidized and looked upon as a more or less free commodity. No wonder then that people's attention and knowledge on energy efficiency and small scale utilization of renewable resources was low. Still government and academic institutions do not significantly involve in demand-side management nor improved efficiency and quality in traditional energy and building techniques. They focus on the modern western life style, but have no ideas how to bring this to the majority of the population.

Winterization (heat insulation) of schools

Because of low temperature in classrooms in wintertime, it has unfortunately has become quite common that many children have to wear overcoats even during classes. The problem of heating schools during the cold season is among the most urgent ones. In cities, district heating systems have stopped working due to high fuel prices. In Tajikistan and Kyrgyzstan, electricity has to a certain level substituted for district heating in towns. Nevertheless heating is insufficient and expensive.

The most difficult situation exists in schools of remote mountain villages. Electricity supply in such areas is severely limited during the winter period to 3-4 hours per day and some villages are not connected at all to the centralized electricity distribution network. This results in many schools using firewood, coal and dry dung for heating in wintertime.

During the cold season, heating has to be used on a continuous basis to maintain proper temperature and comfort. In mountain villages, schools are usually heated by burning coal and firewood. This results in depletion of natural and fossil resources, as well as atmospheric pollution. Moreover, if the winter is cold the heating season (normally from late October up to late March or early April) has to be extended. Some schools have to close down temporarily during the lowest winter temperatures.

The environmental organization Little Earth, working with support and assistance from the Norwegian Society for the Conservation of Nature under the SPARE Project (School Project for Application of Energy and Resources), has identified the areas of highest concern with regard to energy conservation in schools.

School buildings lose vast amounts of energy due to a number of reasons. This is largely associated with the structure of school buildings and materials used to construct them. Many schools are constructed based on a standard design of bricks or concrete slabs from the Soviet time. In the past, all schools in cities and larger towns were connected to a centralized heating supply network. For schools in remote mountain villages, there used to exist a centralized system of fuel supply. This system worked more or less fine for several decades. In the situation when energy sources and heating were in constant supply, the issue of thermal insulation of school buildings was not regarded as an urgent one.

Now that the centralized system has collapsed, we are facing all the consequences of its irrationality: the problem of heat conservation and shortage of energy sources has emerged to prominence. Nevertheless, even now local authorities and school administrations do not pay sufficient attention to energy efficiency, and new buildings are constructed without paying due attention to energy conservation possibilities. It is no wonder that most energy in schools during the cold period is used for heating.

Heat losses in school buildings

The most common reasons for heat losses in classrooms are as follows:

- Poorly insulated and hermetic windows and doors
- Outer walls (particularly in buildings made of precast panels)
- Ceilings and floors to the ground

In many schools, single window frames, cracked and broken panes or complete lack of glass in some rooms constitute a major problem. On the other hand, slits in windows, doors and junction areas of the building structure are other significant sources of heat losses. All of this results in the fact that schools use up much more energy than they really need. Losses of heat in schools of the republic exceed the standards by several times.
When heat leakages from a building are high, one has to spend a lot of energy to maintain comfortable indoor temperature. This is why it is essential to reduce energy losses as much as possible. In this case we can save energy without sacrificing the comfort.

Windows restoration

Windows are normally the weak part of building thermal insulation. In average about 40 % of the heat leaks trough the windows. In many buildings this figure is considerably higher do to big air leakages. The leakages can occur between the wall and the frame, between frame and windows and around the glass.

The situation can result from bad window design, poor quality of the construction work or lack of maintenance. Often we find bad design, built with poor quality and seriously damaged through years without maintenance.

In schools without any maintenance budget, it is also common to find cracks in glasses or broken glass. Too often broken glass was not replaced properly.

Working method depends on window quality. Anyway, the work is relatively simple and can be achieved by volunteers, teachers, older pupils and parents, after demonstration and some training.

1) Sealing of possible gaps between wall and frame can be done with expanding foam or clay mix.
2) Window glasses are taken out, frame cleaned and glass put back, sealed with silicone and fixed
3) Sealing of gaps between window and frame by adjustment and strips

The technique for sealing windows by strips depends much on the type and quality of the windows. Often tapes are used in preparation for the winter. This is effective, if previous points 1) and 2) have already been implemented. Nevertheless tape has some drawbacks: it will not be possible to open the window and tape glue often doesn't last for the whole winter.

The Energy brigades launched by environmental NGOs in Central and Eastern Europe in the 90's have introduced a high quality method. This method has also successfully been used in Central Asia. It results in durable solution (10 + years), it looks good and allows for opening of the windows.

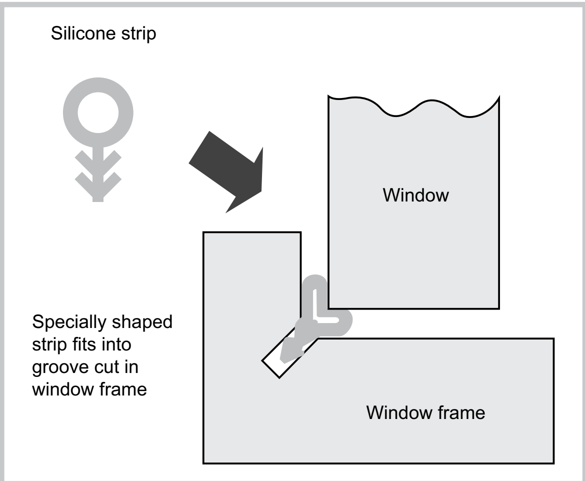
Installation of permanent silicon strips

By using an electrical hand tool, it is possible to cut a groove in the window frame. This is made all around the window. A silicone strip with adapted profile (see illustration) is then fitted into the groove.

Silicone strips are available in different sizes in order to fit the gap (6-8 and 10 mm). The air filled tube shape of the strip makes it very flexible in order to adjust to and fill the actual gap between the window and the frame. Doors can be sealed in the same way.

The method is suitable for most timber, although sometimes the quality of windows is to low for any sensible restoration.

The drawback of the method is mainly that the electrical hand tool and the silicon strips can be difficult to find on the local market and experienced trainer should be available to oversee the work.



Financing

Financing of the activities has mostly been shared between donors (equipment and materials) and the local community (work). After demonstration in one classroom or one school, it is possible for the Municipality to try to find financing for continuation. This is sometimes found in local school budget or collected from the parents.

Results

All schools in the region face problems of insufficient fuel, draft and low indoor temperature during the winter season. Within the last 2-3 years Norges Naturvernforbund and partners in the six Central Asian countries have improved the windows in nearly 100 schools. Sealing of doors and windows will results in improved indoor climate in the winter season. All schools report positive results. Comfort heat has been reached during winter time and fuel consumption reduced. Experience shows that the sealing alone increases the temperature with 4-10°C. For schools connected to district heating, the main results are increased temperature in classrooms. Schools using wood for heating also report fuel savings between 30% and 50%.

Improved comfort is important for the quality of the education. The teachers also pointed out that pupil's absence because of cold-related diseases decreases.

Energy efficiency measures in the schools are always implemented together with education activities on energy efficiency, renewable energy and climate change mitigation. The educational program includes practical tasks as monitoring and simple practical efficiency tasks. In this way, improvement's results combined with children's knowledge and experience with improved efficiency standard can result in increased awareness and new activities at in schools and homes. More on the educational activities at www.spareworld.org

Example: school in Labijai village, Tajikistan

The secondary school of general education #95 in the Western part of mountain village of Labijai in Karatag gorge (100 km from the city of Dushanbe) was selected after several fact-finding trips to the area. The school was constructed in 2000. The school building is a one-storey structure, rectangular in plan view which consists of two classrooms and a staff-room. Walls are 40 cm thick made of adobe bricks and quarry stone. The total area of the building in plan is 54 m^2. Floors are wooden made of edged tongue-and-groove boards. The deck is wooden. Ceilings are made of wood-fiber board.

The school does not have funds for reconstruction and purchase of additional fuel. The school used to spend about 15 cubic meters of firewood during the heating season. There were droughts in the classrooms; window frames had slits and window panes were broken in several places. Besides, there was no water drain (trough) to evacuate water from the roof. In absence of a platform, the back wall of the school building would get wet up to 1.5 from the ground.

Neither the school nor the entire Labijai villages are connected to the centralized power supply network. The school had 36 primary school children in grades

1 through 4. It is envisaged that in the future the school will have school children of grades 1 through 9. The school works in two shifts. The staff consists of five teachers.

Implemented activities

Prior to starting heat insulation of the school per se, "Little Earth" conducted several meetings with the school headmaster and chairman of the jamoat. In July, 2007, based on the understanding that had been reached, an agreement on implementation of the project was made with local authorities and school administration. The agreement stipulated that "Little Earth" was to provide the necessary materials for thermal renovation of the building (installation of windows and doors) and the local authorities and the school administration were to make available workers to implement water-proofing, drainage, removal of water from the roof and to monitor correctness of work.

Replacement of windows

Based on the results of building assessment it was decided to replace single-pane windows with double glazed ones. In August 2007, three school windows sized 1.17 x 0.75m was replaced by double-glazed ones with wooden frames. Although windows were new from the carpentry, total renovation was in order to meet insulation standards. The windows were also insulated using silicon sealer.

Replacement and winterization of doors

All three doors of the school building were winterized using heat insulating padding. One of the doors was completely replaced with a new one and then winterized. Door openings were also winterized using silicon tube to improve thermal insulation and prevent droughts.

Drain installation

A channel system was installed on the roof of the school building. Melt rain and storm water is now collected in troughs and evacuated through water pipes mounted on corners of the building. This helped to avoid wetting of walls and foundation of the building which affected the temperature inside the classrooms.

Hydro-insulation of the back wall

Since the back wall of the school kept getting wet on account of melting snow and rain water, it was decided to waterproof it. Waterproofing was done by affixing rubberoid to the wall from 1.5 meters high to bottom using asphalt mastic. After that, a drainage system was constructed.

Solar panels for lighting

In wintertime when the weather is cloudy, it becomes dark in classrooms on account of a rather small area of window openings. This often happens in the afternoon during the second shift. On such days paraffin lamps get used in school, which results in additional emission of soot, carbon monoxide and unpleasant smell of paraffin oil.

With this in mind, "Little Earth" decided to provide the school with electric energy by installing solar panels (with the total capacity of 100 watts) and equipment for transforming the low voltage direct current (12V) into alternating 220 volt current and to equip the classrooms with daylight lamps. This equipment is used for lighting of the classrooms and could be used to run one desktop computer with LCD monitor (school doesn't have any) for 5-6 hours.

Results of the intervention

After the above activities were implemented, the temperature inside the school rose on the average by 7 degrees in wintertime. Temperature readings taken in late December 2007 and January 2008 showed that temperature in the winterized classrooms were about 18-20°C while the outside temperature was around 4-5°C.

A more comfortable temperature resulted in improvement of the education process and academic progress of the pupils. This is demonstrated by interviews with the school teachers. According to the school teachers and their headmaster, they have been using much less firewood ever since the school was winterized and the temperature in classrooms has risen considerably. The heat insulation has led to reduced pollution inside the classrooms and, consequently, decreased the risk of diseases children used to develop from the smoke generated by stoves heating the classrooms. The teachers also pointed out that pupils went less often down with cold-related diseases this winter. Thermal insulation of the school also helped reduce consumption of firewood. At present we are trying to obtain more accurate data on the amount of saved fuel.

Implementation of passive solar housing technology in Himachal Pradesh

S.S. CHANDEL

Abstract

Himachal Pradesh is the first state in India to take a political decision to make passive solar housing technology mandatory in governmental and semi-governmental sector. Following the decision, a number of residential, office, hospital and school buildings have been constructed. In order to provide technological backup, specialised training programmes were organised for architects, engineers of state housing agencies. In order to propagate the technology in cold regions of the state, carpenters and masons were trained in the construction of simple solar space heating systems like Trombe wall, attached green houses and solar thermo-siphoning heating panels using local materials. Retrofitting of rural houses was undertaken in Chamba, Kinnaur and Spiti region of the state. A massive campaign was launched in the state for creating awareness among the public, policy makers and planners about the benefits of this environmentally friendly technology. The monitoring of passive solar buildings shows that even simple interventions can lead to comfortable living conditions in winter besides saving 40 % to 60% of fuel wood, fossil fuels and electricity for space heating. The modification in the building byelaws to incorporate passive solar features has been carried out so as to make the technology initiative self-sustainable. This experience of passive solar building programme implementation in Himachal Pradesh is presented. The long term strategy for continuous research & development, capacity building and technical manpower development for the successful propagation of the passive solar technology, in the Himalayan states and Asian countries is outlined.

I. The context

The State of Himachal Pradesh lies in the Western Himalayas and extends from snow covered mountains separating from Tibet in the North to plains of Punjab in the South and West. The State with a geographical area of 55673 sq km is located between latitudes 30° 22′ 40″ to 33° 12′ 40″ North and longitudes 75° 45′ 55″ to 79° 4′ 20″East. The altitude ranges from 250 m to 6975 m above mean sea level. Due to peculiar topography and snowfall in high altitude regions, the state experiences severe winters. Areas above 2000 meters receive light to heavy snow fall whereas alpine zone remains under snow for 5-6 months in a year.

About 92% of the population of the state lives in villages and largely depend on fuel wood for space heating, water heating and cooking. About 4.82 million tons of fuel wood is used in the state annually for cooking, space heating, water heating, tarring of roads etc. out of which 4.5 million tons is used by the rural population. This requirement has resulted in large scale denudation of forests posing serious threat to the environment. Wood, charcoal, coal, kerosene, LPG and electricity are mainly used for cooking and space heating during winters. In tribal areas of the state, firewood, coal and kerosene are supplied on subsidy to public resulting in serious burden on Govt. exchequer.

In high altitude regions, Govt. buildings like offices, hospitals, require electric/ firewood/ fossil fuel based heating systems to create comfortable indoor conditions during winters. The installation and annual running costs of such heating systems are quite high. This cost can be considerably reduced if a building is designed incorporating passive solar features. Contrary to popular belief, 250-300 days of sunshine per year are available in Himachal Pradesh, with 7-8 mean hours sunshine per day, as such solar energy can effectively be utilized for space heating.

II. Activity-technology: passive solar heating for cold regions

Passive solar Housing is a climate responsive architectural concept. The concept incorporates features like orientation of buildings, shading devices and uses appropriate building materials in order to conserve energy used in heating, cooling and interior lighting of buildings by utilizing sun energy. In cold climates, the strategy is to maximize heat gains from the sun, make provision for heat distribution, storage of solar energy within the building and minimize heat losses.

Solar building design strategy also includes day lighting strategy. The use of natural light is important in buildings which reduces electricity consumption. Govt sector is the biggest consumer of energy for space heating and day lighting in cold regions. The adoption of this technology not only creates comfortable living conditions but also results in savings of conventional fuels like fuel wood, coal, charcoal, electricity required for winter heating.

III. Implementation methodology

In order to demonstrate the benefits of passive solar housing technology, a political decision was taken by the Govt which was catalysed by the Solar Energy Research Group of the Himachal Pradesh State Council for Science, Technology & Environment [HPSCSTE]. A Solar House Action Plan was formulated, which was approved by Govt and Himachal Pradesh became the first state in the country to take a policy decision in the year 1994 vide which all the govt and semi-govt buildings are to designed and constructed incorporating passive solar heating and natural day lighting features. A Technical Project Management Cell was setup in HPSCSTE and detailed guidelines were prepared for the implementation of the Solar House Action Plan [1].

In order to demonstrate the efficacy of the passive solar technology for winter space heating, 25 govt building were identified for which the funds for construction were available. A team of experts were involved with the architects and engineers of the concerned agencies for the preparation of the building designs after carrying out the detailed micro-climate and site analysis. Specialised training programmes were organised for architects, engineers, scientists, masons, carpenters and builders to ensure the sustainability of the programme. The constructed passive solar buildings were monitored during winters for thermal comfort evaluation. The solar radiation data which is required for the simulation of solar buildings was generated using sunshine hour data [3].

The retrofitting of houses with passive solar heating systems in high altitude areas of Bharmour, Spiti, Kinnaur were carried out through the rural artisans. The main aim of training rural artisans in the construction of passive solar systems like Trombe wall, attached green houses etc. is to sustain the technology in rural and high altitude regions where this technology is needed at most. The training for the rural artisans is being organised regularly at the Appropriate Technology Centre of the HPSCTE.

The passive solar design features have been incorporated in the building bye-laws so that the technology is adopted in all buildings like hotels, industry and houses also.

IV. Financing

The passive solar building programme was financed by the HP Govt, Ministry of New & Renewable Energy (MNRE), Government of India and under USAID and ICIMOD funded projects. The funds were obtained only for capacity building, training and fabrication of solar heating systems. The funds for building construction were provided by the concerned agencies or the house owner. The MNRE provides incentives for detailed project preparation of a solar building and for incorporating passive solar features. The Govt Sector is the biggest consumer of energy for space heating and day lighting in cold regions.

V. Results

More than 200 passive solar buildings including offices, hospitals, schools, houses were constructed under the programme which has resulted in 40% to 60 % of energy required for winter heating. A number of engineers, architects were trained in the design and construction of solar heating systems. Rural Artisans trained were actively involved in house construction in rural areas. Awareness about the energy saving technology has been created. The Passive solar building programme is being successfully implemented in the state and the experience gained in implementing the technology can be shared among other cold regions of Asia. Inputs were provided to some states of India namely Uttrakhand, Sikkim, Manipur, Nagaland and Arunachal Pradesh.

The current status and strategy leading to the success is outlined as follows:
Based on the successful implementation of Passive solar housing technology, Himachal Pradesh Govt. took another policy decision for the implementation of Passive solar building technology in the State on Aug.18, 2000 according to which for all departments including Corporations, Boards, Universities, Public works Department, Himachal Pradesh Housing Board will design and construct buildings above 2000 meters by incorporating passive solar design features.

The passive solar building programme was reviewed on Oct 14, 2005 and a decision was taken that all buildings, industrial complexes, tourist resorts, hotels in government or semi-government and private sector must incorporate passive solar heating and cooling, Earth Quake Resistant and Rain Water Harvesting Structure features in the State of Himachal Pradesh. It was also decided to set up computerized design cells in government agencies. Besides, building byelaws for making provision for passive solar features, solar space heating systems, solar access to buildings, colonies and new townships will be modified by Department of Country & Town Planning, Municipal Corporations and other concerned agencies. The State Govt is considering another policy decision so as to make passive solar heating features mandatory in houses and private buildings which are large consumers of energy like hotels, industry etc.

5.1 Case Studies of Passive solar buildings

The monitoring of the constructed passive solar buildings was carried out to study thermal comfort conditions, efficacy of passive solar features and actual energy savings. The monitoring of constructed Passive solar HP Co-operative Bank, Himurja office and MLA Hostel buildings shows that buildings are comfortable in winters and dependence on the electricity for heating has been reduced considerably. The users have also expressed satisfaction over the comfort level.

i. HP Co-operative Bank building

The multi-storey bank building located in Shimla is oriented to 10° West of South [Fig 1]. This building had little choice for orientation as well as availability of sunshine. Consequently roof top solar air collector with an electrical backup heating system was also installed, along with two sunspaces, solar heat collecting wall, double glazed windows. The cost of passive solar features was only 5% of the total cost with a pay back period of 3-5 years due to saving in fuel bills.

The monitoring of the building shows a temperature rise of 10-17°C above the ambient temperature and the electric backup is required only for one to two hours during extreme cold and partially cloudy days.

iii. Himurja office Building

The building located in Shimla is exposed to winter sun and has day lighting features, sunspace, thermo-siphoning heating panels, and double glazed windows, solar water heating and solar photovoltaic lighting features [Fig.2]. This building does not require any auxiliary heating in winter. The monitoring of building shows inside temperatures of 18°C to 28°C with ambient temperature variation from 9°C to 15°C.

iv. Passive solar buildings in tribal regions

A number of passive solar schools, teacher's hostels and rural houses have been constructed in Tabo, Kaza, Sagnam, Dhankar, Rangrik, Kibber, Hansa and Losar in Spiti Valley at altitudes from 12,500 ft to 14,500 ft where the minimum temperature drops to -40°C in winters. The Solar Trombe wall which is effective in providing night time heating was installed at Tabo Monastry Residential Complex [Fig 3].

v. Retrofitting of traditional houses

Under the Plan, a number of traditional houses were retrofitted with locally fabricated and low cost thermo-siphoning air heating panels, sunspace and Trombe wall heating systems in the tribal areas of the HP in Sangla Valley, District Kinnaur and Bharmour, Distt Chamba which resulted in wider awareness and acceptability for people. One Women training Centre was retrofitted with a Sunspace which resulted in providing comfortable working space for rural women during winters [Fig 4].

VI. Impact

6.1 Social change

The passive solar building programme has led to greater awareness among people to adopt the technology in house construction. The dependence on traditional fuels like wood, coal, electricity, LPG has considerably reduced leading to better living conditions besides preserving women and children from indoor smoke pollution. The training of rural masons in Solar house construction led to upgrading of their skills with better income opportunities [Fig 5 & 6].

6.2 Economics of passive solar buildings

In the passive solar buildings constructed in the state, there is only a marginal increase in the cost ranging from 0 to 10 % depending on the nature of passive solar features adopted. This minor increase in cost further reduces, if proper site planning, design and selection of materials are done at initial stages. Due to continuous saving of fuel / electricity required for space heating/cooling in such buildings, this additional cost can be recovered within 2 to 3 years. The passive solar buildings can be classified in to three main categories:

i. Solar Buildings with no additional costs

In case of buildings for which there is freedom for proper site planning, appropriate building materials and efficient functional planning at initial stages, the cost of passive solar design features can be 0 to 5%.

ii. Solar Buildings with incremental costs of 5-10%

Buildings for which there is less independence in site selection and orientation, the incremental cost can vary from 5 to 10%.

iii. Buildings requiring retrofitting - back up electric heating systems

Buildings like hospitals or offices, in extremely cold sites above 3000 m requiring roof collector solar space/air/water heating systems with electric back ups or in which passive solar systems are to be retrofitted, the cost can go up to 15%. However, due to lesser fuel consumption this incremental cost can be recovered in 2 to 3 years. Thus the technology costs are not high; however incentives of govt to public for adopting the technology can lead to faster adoption of technology.

6.3 Environmental impact

The adoption of environmentally friendly passive solar housing technology for space heating in entire Himalayan region countries will lessen the burden on firewood thus saving the forests from extinction besides creating pollution free environment leading to decrease greenhouse gas emissions.

6.4 Lessons learnt

Being the coordinator of the Solar House Action Plan for the State Of Himachal Pradesh, it was difficult to change the mindset for adopting the new technological inputs and orient architects and engineers, especially in govt sector, to incorporate the technology. It requires long term technological backup besides continuous trust and zeal to promote this technology and ensure the availability of motivated technical manpower in order to sustain the programme.

6.5 Replicability

The passive solar building programme has been successfully implemented in the Western Himalayan state of Himachal Pradesh and the experience gained can be shared and replicated not only in the hill states of India like Uttrakhand, Sikkim, Jammu & Kashmir, Manipur, Meghalaya, Arunachal Pradesh, Nagaland but also in other cold regions of Asia like Tibet, Nepal, China and Afghanistan etc. The Policy decision and implementation strategy adopted in the Western Himalayan State can be followed in the Cold region countries for wider dissemination of the technology which leads to comfortable living conditions in cold regions.

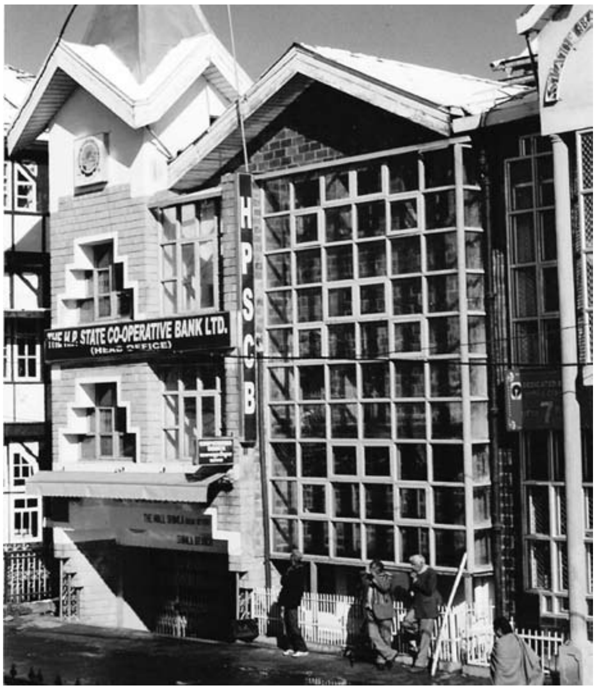


Figure 1. Passive solar bank building in Shimla

Fig 2. Passive solar office building in Shimla HIMURJA

Fig 3. Solar trombe wall system Tabo monastery, Spiti

Fig 4. Retrofitting of women training centre in Kinnaur

Fig 5. Construction of PSH by trainee masons

Fig 6. Training of masons in cavity wall construction

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Renewable energy in rural areas of Tibet: energy efficiency in schools

Li YANGHUA and Vincent STAUFFER

1. Objectives

The winter is very severe in Tibet Autonomous Region (TAR) and the schools are cold from October to April. The project aims at demonstrating four energy efficient schools by combining insulation, active and passive solar measures. The indicators of results are
1. Temperature and dung combustible consumption:
- In non-heated school, energy efficient rooms should be either 7°C warmer than the conventional rooms or above the comfort level of 10°C in November and December,
- In heated school, dung combustible consumption should be reduced by 50%.

2. Well being: teachers should consider the passive solar classrooms are comfortable from 9 am to 6 pm during the month of November and December.

3. Additional costs of energy efficiency measures: the additional cost (or over-cost) implemented in a new construction shall be less than 20% of the cost of a conventional school.

2. Climate and passive solar school

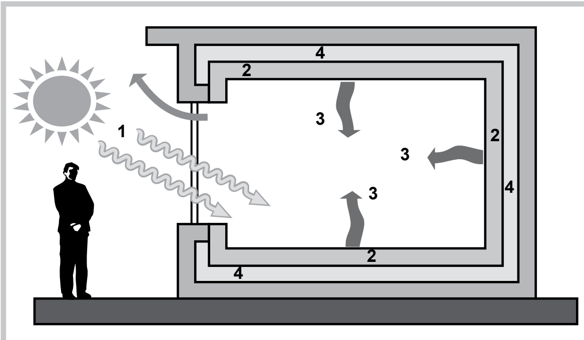
2.1. Climate
The Tibet Autonomous Region (TAR) is a cold desert with sunny winter months. Lhasa, the region capital, is located 29.7 N, 91.1 E and 3,649 m above sea level. The climatic data of Lhasa are presented in the table at the bottom of this page.

The project area is located in the Dang Xiong County between 4,200 m and 4,500 m above sea level. During winter, the climate is slightly cloudier than in Lhasa and 6°C colder.

2.2. School schedule and heating in conventional school
In TAR, winter holidays are during peak winter, from 25th December to 1st March. However October, November, December, January, February, March and April are very cold months with freezing temperatures. Therefore schools are usually very cold until 2pm and the conditions to study are difficult. Some schools are heated by dung burnt in a stove, but in theses cases indoor air is very smoky and filling the stove is time-consuming for the teacher.

3. Solar and insulation technique

3.1. Passive solar concept
There are four inter-related components in passive solar buildings, which work together to make the buildings efficient regarding use of energy:
1. Collection and absorption of the maximum amount of solar radiation during the day
2. Storage of the heat collected from sun radiation during the day
3. Release of this heat into the interior of the building during the night
4. Insulation of the whole building to retain as much heat as possible inside the building



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Maximum Temperature (deg. C)	6.9	9.0	12.1	15.6	19.3	22.7	22.1	21.1	19.7	16.3	11.2	7.7
Mean Minimum Temperature (deg. C)	-10.1	-6.8	-3.0	0.9	5.0	9.3	10.1	9.4	7.5	1.3	-4.9	-9.0
Days with Rain	0.2	0.2	0.5	1.3	5.3	9.6	14.8	15.3	10.0	2.3	0.4	0.2
Mean Daily Sunshine Duration (hours)	8.3	8.1	7.9	8.3	9.0	8.7	7.3	7.3	7.9	9.1	8.9	8.5

3.2. Insulation

Very few existing schools are insulated and heat losses are high. The following table shows the heat loss distribution for a typical single storey school with a cement brick wall and sheet metal roof. Insulation shall be implemented in priority for the windows (only 11% of the heat loss but cheap improvement), the roof (38% of the heat loss), the walls (21% heat loss, important investment) and the floor. Then the heat losses can be reduced by 60%.

	Percentage
Wall	21%
Roof	38%
Windows	11%
Thermal bridge[1]	16%
Floor	7%
Air change	7%

[1] A thermal bridge is created when materials that are poor insulators come in contact, allowing heat to flow through the path created, which is problematic when one of the materials is in direct contact with the exterior.

Window insulation

South windows provide heat gain during the day but also produce main heat loss during day and night. Window shall have a double glazing and moveable night insulation shall be added.

Roof insulation

The roof is the most important part to be insulated:

- The main heat loss of a single storey building occurs through the roof,
- Investment is reasonable and the payback period is limited (often less than 2 years),
- Implementation is easy, even for the renovation.

Possible roof insulation techniques are:
Iron roof with false ceiling: a 10cm layer of EPS (expanded polystyrene) supported by the false ceiling, RCC (Reinforced Cement Concrete) slab. The insulation is above RCC slab and can be either:

- Lightweight perlite concrete (1:3:20 i.e. 20 cm layer protected by 3 cm concrete or tarfelt)
- polystyrene: a 10 cm layer of EPS (with a density 20 kg/m3) or better 10 cm layer of XPS (extruded polystyrene) protected with 5cm of concrete and tarfelt.

Wall insulation

Possible wall insulation techniques are:

- Internal insulation: a 5 cm layer of polystyrene EPS is fixed on the inner side of the wall and is protected by 10 mm plywood. This technique is suitable for both new construction and renovation. It is easy to implement but thermal bridges are difficult to reduce. The thermal mass is nil therefore such rooms can be very quickly heated but do not retain heat and may be very cold in early morning.
- External insulation: a 5 cm layer of polystyrene EPS is fixed on the external side of the wall and is protected by a waterproof board. This technique is suitable for both new construction and renovation. Due to the thermal mass, such rooms are warmer in early morning but are slower to heat.
- Double wall: the insulation, e.g. 5 cm polystyrene EPS, is implemented between 2 walls. This technique is difficult to implement in renovation. Links between 2 walls are important for earthquake resistance. It is very durable. Due to the thermal mass, such rooms are warmer in early morning but are slower to heat.

Internal wall insulation in Wu Ma

External wall insulation in Qu Deng

Perlite roof insulation in Yan Ba Jing

Floor insulation
The floor insulation techniques are:
- vertical insulation: a 5 cm EPS layer located vertically on the inner or outer sides of the foundations limits the cold infiltration from the foundation.
- horizontal insulation: a 5 cm lightweight concrete floor insulation (e.g. perlite) covered by a 5cm cement slab will not only improve the thermal comfort but also increase the efficiency of the floor thermal mass so that the classroom remains warm after sunset.

3.3. Solar gain

Four passive solar and one active solar measure are implemented: Thermosyphoning Air Panel (TAP), trombe wall, veranda, convective loop and active solar air heater.

Thermosyphoning Air Panel (TAP)
A Thermosyphoning Air Panel (TAP) is a quick way to heat the space of a classroom by convection. It is implemented on the external side of the south wall and is composed by an insulation layer, a black painted sheet iron, an air gap and a glass cover. Openings are made in the top and bottom of the panel. During the day, the black painted iron sheet absorbs solar radiation and gets very hot. The heat is transferred to the air trapped between the glass and the iron sheet. Therefore the hot air rises and convection current flows: the cool air of the room is drawn into the lower part of the TAP and returned to upper part of the room, with a significant increase in temperature.

Trombe wall
A Trombe wall is a south-oriented black painted glazed wall. The black painted wall catches sun radiation and by the glass covering, the wall remains insulated from the exterior. Heat is stored and migrates slowly to the inside. Therefore, the solar wall is a system of delayed heating: the energy stored during the day will be released at night after a lag period. The temperature of the main room can be maintained after daylight. There can also be openings at the top and bottom of the wall. The convective system is similar to the TAP one but is less efficient.

Veranda
A veranda is an attached greenhouse. It is a warm place during the day but cold during the night. The heat inside the veranda is partly transferred to the adjacent room by convection (vents, window), transmission (wall) and direct solar radiation (window). Veranda is a relevant passive solar measure since it is a mix of a direct system (radiation, convection) to gain heat as soon as sun rises, and a delayed heating system (transmission through the wall) so that the temperature remains acceptable in the morning.

Veranda in Dang Xiong

Convective loop
If a veranda is built on 2 storey and is continuous without partition, the hot air raises up to the 2nd storey, warms the upper classrooms, gets colder, then goes down to the ground floor classrooms and goes again in the veranda. It is a convective loop process.

Solar Air Heater
Solar air collectors are installed on the roof. The warm air is blown to the classroom through pipes. Such active system is very efficient to heat the classrooms as soon as the sun rises.

Solar air Heater in Dang Xiong

4. Implementation in 4 schools

4.1. Presentation per site

The energy efficient measures are implemented in 4 existing schools selected by the Education Bureau in Dang Xiong County. They are presented below.

4.2. Presentation per technique

4.2.1. Solar gain

Technique	Site
Veranda	Qu Deng, Dang Xiong
Full TAP	Qu Deng, Wu Ma
Trombe Wall	Wu Ma
Convective loop	Yan Ba Jing
Air Collector	Dang Xiong

Yan Ba Jing school

Implementation of energy efficient measures in 4 existing schools

location	Wu Ma	Qu Deng	Dang Xiong	Yan Ba Jing
Type	Central school, one storey	Teaching point, one storey	Vocational training center, one storey	Central school, two storeys
Altitude	4,480 m	4,350 m	4,460 m	4,300m
Structure	Wall: 35 cm cement block Roof: false ceiling and double slope GI cover	Wall: 45 cm stone Roof: flat, RCC slab	Wall: 35 cm cement block Roof: flat, RCC slab	Wall: 35 cm cement block Roof: flat, RCC slab
Rooms size	Classroom: 7,5 *5,7 m and 4,4 *5,7m	Classroom: 8,8*4,2 m and 5,9 * 4,2 m	Main room: 23,6 * 8,0 m	Classroom: 7,6*5,7 m
Orientation	S-10°E	S-20°E	S	S-15°E
Renovation year	2007	2008	2007	2007
Measures implemented	- Internal wall insulation - False ceiling insula-tion - Floor insulation with perlite - TAP - Half TAP - Trombe Wall	- External insulation of walls - Roof insulation above RCC slab - Veranda - TAP	- Internal wall insulation - Roof insulation above RCC slab - Veranda	- Internal wall insulation - Roof insulation above RCC slab - Floor insulation by perlite - Veranda and con-vective loop
Classrooms ren-ovated	4 classrooms	4 classrooms	3 classrooms	12 classrooms
Additional cost (RMB ,%)	- Implementation: 59,339 RMB or 25% - Extrapolation to new construction programme: 30,766 RMB or 13%	- Implementation: 108,740 RMB or 40% - Extrapolation to new construction programme: 52,673 RMB or 19%	Without solar air heater: - Implementation: 114,210 RMB or 23% - Extrapolation to new construction programme: 86,869 RMB or 18% With solar air heater: -Implementation: 261,210 RMB or 54% - Extrapolation to new construction programme: 233,569 RMB or 48%	-Implementation: 293,561 RMB or 25% - Extrapolation to new construction programme: 192,632 RMB or 17%

4.2.2. Insulation

Roof insulation

Technique	Site
False ceiling insulation with EPS	Wu Ma
Perlite insulation above RCC slab	Yan Ba Jing, Dang Xiong
EPS insulation above RCC slab	Qu Deng

Wall insulation

Technique	Site
Internal insulation	Wu Ma, Dang Xiong, Yan Ba Jing
External insulation	Qu Deng

Ground insulation

Technique	Site
Horizontal Perlite	Wu Ma, Yan Ba Jing
Vertical outside	Qu Deng

5. Cost

An energy efficient building shall be cost effective. The designs have been developed so that the additional costs of solar and insulation measures are less than 20% of total standard construction costs. The reference cost of conventional school is 1,500 RMB/m² for single storey building and 2,700 RMB/m² for double storey building. The cost of renovation for pilot construction is always much higher than for large new construction programme. Therefore the cost shall be extrapolated to new construction: a methodology is developed three steps:

1. actual cost of implementation in renovation: the real cost of the improvement during the renovation based on the bills of the contractor.
2. extrapolation to new construction: the actual cost of renovation is extrapolated to new construction. The extra items that are required in renovation but that are already included in the conventional new construction are reduced (e.g. new paint of wall during renovation).
3. new construction in a large programme: the present project is limited to few pilot buildings: the material and labour cost are high due to small quantity and lack of experience in such innovation. In a larger programme, materials are purchased in bulk in Lhasa and labour is more efficient.

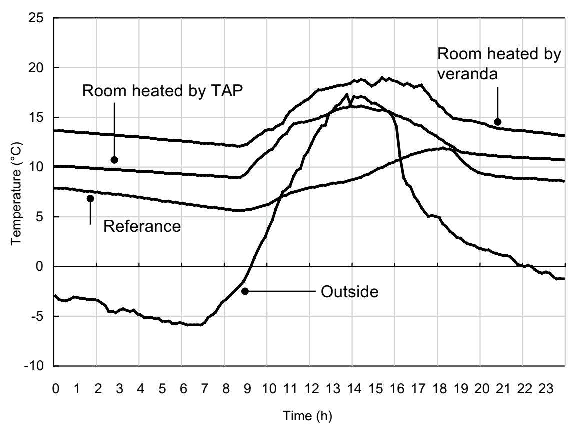
Site	1	2	3
Wu Ma	25%	19%	13%
Dang Xiong without air heater	23%	20%	18%
Dang Xiong with air heater	54%	50%	48%
Qu Deng	40%	29%	19%
Yang Ba Jing	25%	19%	17%

1 Actual implementation in renovation
2 Extrapolation to new construction
3 New construction in a large programme

6. Temperature and social benefits

The temperatures are comfortable in energy efficient rooms. Monitoring shows that such rooms are 10°C warmer than standard non-insulated rooms.

Temperature in Qu Deng during a sunny day on 10th November 2008



In all schools, teachers and pupils mentioned that the classrooms are much warmer than during winter time in former years. The teachers and pupils don't need excessively thick clothes inside the classroom or gloves when writing. The fingers are not clumsy any more. The hand writing of pupils improved. The parents mentioned that they are very happy because they feel that their children are well protected in school against strong coldness in winter time.

In Wu Ma, before renovation, the rooms were heated. After renovation, no more heating is required and pupils do not have to provide dung. The preparation of the classroom is not as tiring for the teachers as before. They do not have to heat the stove with dung before each lesson. That saves them about 15 minutes per lesson. Students and teachers feel better because there is no smoke in the class room any more and their eyes get less infected. Coughing of students is reduced as well.

Wu Ma primary school

Qu Deng teaching point

7. Analysis and recommendations

The average cost distribution of the energy efficiency measures are:
1. solar gain: 50%
2. roof insulation: 15%
3. wall insulation: 35%

The performances of the energy efficiency measures can be ranked as follow:
1. roof insulation
2. solar gain (Veranda, then TAP/Trombe wall)
3. wall insulation

Veranda is slightly more efficient that TAP (1,5°C warmer) but is 50% more expensive.
Then according to cost-benefit ratio, the priority of implementation is:
• roof (3% additional cost),
• solar gain (TAP, 7% additional cost, or veranda, 10% additional cost),
• wall insulation (7% additional cost).

Based on the budget availability, recommendation to select energy efficiency measures are:

Overcost	Width: > 4 m <5 m	Width: > 5 m < 6m
<20%	Roof insulation, wall insulation, veranda or TAP	Roof insulation, wall insulation, veranda
<15%	Roof insulation, wall insulation, large double glazed south window	Roof insulation, wall insulation, TAP
<10%	Roof insulation, large double glazed south window	Roof insulation, TAP
<5%	Roof insulation, large double glazed south window	Roof insulation, large double glazed south window

Recommendation to select energy efficiency measures

Curtains and foundation insulation are always included if applicable. Passive solar measures are efficient if the width of the classroom is lower than 7m. For larger width (> 6 m), active solar measures shall also be included.
For large building (> 700 m²), a system with solar air heater, wall and roof insulation presents an additional cost lower than 20%.

8. Conclusion

Energy efficient schools, that combine active, passive solar and insulation, are effective and affordable solutions for the cold areas of TAR. Several technologies were demonstrated in 4 schools located in Dang Xiong County with an additional cost limited to 20%. Working conditions are drastically improved for pupils as well as teachers. Monitoring shows that such rooms are 10°C warmer than usual non-heated rooms.

Dissemination of energy efficiency best practices in the construction sector of public buildings

Riaz RAMIN

Abstract

During period of wars, Afghanistan lost most of its forests; its public buildings and infrastructures have been destroyed. The urgent need to provide Afghans with quantities of schools and clinics stressed the international community providing short terms solutions in which Afghan climate and context were not taken into account, especially for clinics. At the beginning of FFEM (French Fund for World Environment) program, the country reconstruction was at fast speed with hundreds of clinics and thousands of schools built. In Afghanistan 70% of the population face hard winter with temperature falling below 0°C. The clinics are not built to face such climate and only one or two rooms of the clinics are sporadically heated to save fuel. For the same reasons, schools are not heated and Ministry of Education closes them during winter. School designs focus on cost-effectiveness, but should consider bioclimatic buildings for comfort improvement. In the long term Afghans will face problems to pay the energy bill of all these unsustainable buildings.

FFEM project aimed to demonstrate that energy efficiency in clinics and schools is technically possible and necessary for the sustainable reconstruction of the country. Within 3 years, the FFEM project convinced Ministry of Public Health to adapt its standards and to implement thermal insulation in its new buildings. For schools, GERES in partnership with Turquoise Mountain Foundation provided an architectural solution following bioclimatic concepts.

The project promoted efficiently the need of Energy Efficiency and demonstrated the technical feasibility in 275 energy efficient buildings and offered dozen of trainings in various kinds of technical solutions. It reached its objective and provided a significant contribution to the reconstruction in Afghanistan.

Initial objectives and results

Below is a short reminder of the initial objectives defined at the project starting time, in 2005. The objectives are listed with more details in the 1st progress report.

1. Support the implementation of 100 energy efficient public buildings (38,000m²)
The project collaborates with the Ministries of Public Health and Education (MoPH and MoE) to identify which buildings should benefit from the proposed improvements.

According to 2005 cost estimation, the direct over costs for 38,000 m² is about 1,225,000 €. 200,000 € are provided by the FFEM to cover a fraction of the over costs, 16.3% on average.

To reach this objective, the project raises awareness of Ministries and donors through trainings. It provides also training to implementers about thermal insulation and solar architecture (window sizing, building orientation, overhang, etc). The project aims to introduce thermal insulation over cost in proposals of donors and Ministries and to insert energy efficiency techniques in standard drawings.

Contractual documents give to the project the following framework:

- Over cost limited to 12%, to be split between FFEM and donors
- Technical assistance to donors and implementers by GERES and Ministries
- Control, supervision and commissioning by GERES and Ministries

Major results:

- More than 270 buildings or 173,000 m² are thermally insulated with technical support from GERES (with MoPH, MoE, MoD, caritas Germany, GTZ, IbnSina, Misereor, etc)
- About 16,145 tCO_2/yr are saved thanks to implementation of bioclimatic architecture or thermal insulation on above mentioned buildings (based on theoretical estimation for each contracted project)
- Thermal insulation is integrated into the standard of Ministry of Public Health (MoPH)
- Budget is approved by Ministry of Finance (MoF) and parliament of Afghanistan to cover thermal insulation over cost in Basic Health Clinics (BHC) and Comprehensive Health Clinics (CHC) of MoPH
- A pilot bioclimatic school constructed by GERES and TMF (Turquoise Mountain Foundation) with use of local thermal insulation materials will become part of Ministry of Education (MoE) standard plan for future projects

Brief list of projects

Objectives	Planed	Achieved or in way of achievement
Health posts and hospitals	60	13
Education buildings	40	28
Administration Buildings	0	70
Energy information centers, Museum	0	3
Dormitories	0	161

The work was carried out on schools, clinics, Ministry of Defense training centers, energy information centers and a museum.

2. Training, upgrade of local capacities and presentations

Technical trainings on various types on thermal insulation techniques (wall insulation, windows double glazing and roof insulation) and solar architecture were also given to ministry employees, major implementers. Site visits to nearby exemplary buildings complement the lectures. Lectures and site visits are also be provided to students of Kabul universities.

Major results:
- Tools prepared for each training and new standards for BHC and CHC designs of MoPH
- More than 20 trainings and presentation given to different organizations (governmental and non government)
- Totally, about 1170 people attended lectures or trainings.
- More than 20 local construction companies and NGOs are able to implement thermal insulation on public buildings.
- 3 construction companies are theoretically and practically trained and now are able to implement Façade insulation system with the technology of a German company (STO) for the first time in Afghanistan

3. Support for thermal equipment and thermal insulation materials

Technical and marketing support is provided to local and international manufacturers or providers of thermal equipment such as thermal insulation materials, solar water heaters, stoves, etc.

Major results:
- One Afghan company is able to start and run a polystyrene (thermal insulator) factory for the first time in Afghanistan.
- One Afghan company is importing STO insulation materials from Germany for the first time in Afghanistan.
- A few companies are able to import thermal insulation materials and solar water heaters as well as solar panels
- Use of cotton, sheep wool, reeds has been experimented as thermal insulation materials by GERES and partners

4. Promotion of the concept of energy efficiency

Promotion of energy efficiency is achieved using all means of communication. Targeted public includes donors, ministries and implementers but also the wide public. Press actions give visibility to the program and to the Afghan French German Energy Initiative.

Major results:
- Presentation of the project in national and international workshops and seminars
- Two steering committee meetings hold in 2006 and 2007 in Kabul, Afghanistan
- June 30th 2008, steering committee meeting hold at the French Ministry of Foreign Affairs in Paris (in presence of MoPH, MOE, MoEW, NEPA representatives from Afghanistan)
- July 2nd 2008, presentation of the project at the International Energy Workshop held in the International Energy Agency, Paris (MoPH, MOE, MoEW, NEPA representatives wore present from Afghanistan) by Riaz RAMIN from GERES Afghanistan
- July 4th, presentation of the project at Cologne University of Applied Sciences (GERMANY)
- Presentation of FFEM Afghanistan project in Nepal, India, Bangladesh and Afghanistan in 2006, 2007 and 2008
- December 13th 2008, presentation on “Toward an Energy Efficiency Policy in Afghanistan”, 40 participants. It was published in the press and broadcasted on national TV. Workshop report was given for consultation to 8 ministries, NEPA, the World Bank, the Asian Development bank GTZ, and USAID.
- Presentation of the project at the 2nd Second USAID SARI/Energy Application Workshop on Efficient Energy Management and Renewable Energy hold on November 17 - 19, 2008 at Hotel Sheraton, Dhaka, Bangladesh.
- 4 issues of the Afghan, French, German Energy Initiative (AFGEI) Newsletters were printed and distributed
- Booklet presenting the FFEM project was distributed at presentations and seminars held in different countries

- 19 sets of FFEM project Visiting Cards for Afghan partners
- 15 set of paper posters and 16 set of plastic posters (A1 Size) on Energy Efficiency and Renewable Energy in collaboration with Ministry of Energy and Water, NEPA and GTZ were printed and distributed
- Energy efficiency guidelines for public buildings both in Dari and English were prepared
- A demonstration house was build in MoEW, opening ceremony with Minister of Energy and water, deputy minister of MoEW, French Ambassador in Afghanistan, head of departments from 6 ministries and about 600 participants 6 and was broadcasted in 6 TV channels.
- Logo of the AFGEI, designed by French designer
- 219,267 communications in English through press and flyers and 88,007 in Dari
- 30 technical leaflets "local materials for insulation"

Next steps of the project

1. To produce a technical guide for implementers.

2. To support MoPH and MoUD for standard bioclimatic designs according to Afghanistan climate zone (3 sets)

3. To support MoPH to implement of thermal insulation and energy efficiency in 160 health facilities 2010- 2013

4. To support MoE to include local material construction schools in MoE standards

5. To provide trainings, workshops, seminars for implementers as well as governmental officials about use of new standards and Energy Efficiency technologies.

6. To start and run the energy efficiency policy with key ministries and National Environmental protection agency (NEPA) of Islamic republic of Afghanistan

7. To monitor fuel consumption and temperature in FFEM pilots buildings

8. To hand over the project to the international community and Afghan institutions.

Discussions and outcomes

The presentations were mainly focused on dissemination of energy efficiency in public buildings, such as schools, offices and health centres.

It is an easy and effective way to insulate the windows of schools. While doing so, it leads to a temperature rise between 3°C and 10°C. There were a number of discussions on availability of materials and differences in terms of energy efficiency of various construction materials like aluminum and wood.

Passive solar building is very effective way to create a comfortable living and also reduce fuel-wood consumption. Working with government and politicians is important and Himachal Pradesh state in India had a huge success. All governmental and semi-governmental buildings have to be mandatory designed and constructed in passive solar technology. It was important to bridge the gap between education and politics, but also to build the demand side from people.

There are huge problems of deforestation in Afghanistan due to high energy costs and limited resources. Many schools and clinics have to be renovated and built after the political crisis. It is possible to implement energy efficiency with reasonable costs, to have the expertise with local contractors, to have the material available and to raise the awareness of the stakeholders and the public. The old buildings in Afghanistan are quite energy efficient. However, because of the situation in Afghanistan and the amount of destroyed buildings, the quality of the buildings and also the energy efficiency standard got low. So old traditional building skills and methods are important to keep in mind.

Conclusions and way forward

Mr. Robert Angioletti,
Senior Energy Expert, ADEME, France

"We have shared a lot of experiences on the situation of Himalayan and Central Asian Regions in the seminar. The world mostly talks of ideal situations, while ignoring the facts about the mountainous regions.

ADEME will support the initiative taken to make the voice heard by others. Particularly, we will sponsor a side event during the Copenhagen conference in December 2009. We welcome any interested partner to participate in the side event, where we will present the results and outcomes of this seminar."

Ms. Tundup Angmo,
Climate Change Coordinator, GERES, Ladakh, India

"GERES India will conduct a comprehensive baseline survey in cold arid region on climate change adaptation. Then, a pilot project will be proposed on adaptation possibilities such as artificial glacier, efficient stoves, etc. Finally, the project will be monitored for 5-10 years, and the success stories will be documented for proper dissemination in Central Asia and Himalayan regions."

Mr. Ralph Pfoertner, *Integration, Germany* and **Mr. Stanzin Tsephal**, *BORDA, Germany*

"Integration and BORDA will organise a network on Micro Hydro projects in the Hindu-Kush Himalaya. Everybody is invited to join the network to share the experiences. We will try to exchange information regularly through e-mails and newsletters. After 2-3 years, we hope to organize a similar conference to see what we have been able to achieve so far.

To participate in the network is as good as being an active partner. Why should you participate in the network is because, BORDA has a 'Standard Operating Procedure', and 'Quality Management System' for Micro Hydro projects. Secondly, we will conduct trainings for engineers and technicians and prepare training manuals. These training manuals will be shared with members of the network. Finally, a network will function only when somebody takes the lead responsibility. In this respect, Ralph and I are willing to offer our service as team leaders."

Mr. Robert Angioletti, *Senior Energy Expert, ADEME, France* and **Mr. Vincent Stauffer**, *Country Director, GERES India, Ladakh*

"Many works have been done to develop energy efficient technologies and designs. Now we need to combine these typical designs of the houses and integrate the efficient technologies. ADAME will support the combining of the technologies to demonstrate typical houses for commercial buildings and schools.

ADEME has partnered with Bureau of Energy Efficiency to rate the energy efficient technologies. We will launch the concept of integrating the efficient technologies in some states of India, particularly in Ladakh (J&K) and Himachal Pradesh. We have the experience and some tools that will help us to start off the proposal.

In addition to that, GERES will share its best practices on improved stoves, solar gain and insulation with others."

Mr. Dorje Dawa and **Mr. Vincent Stauffer**,
GERES India, Ladakh

"In order to disseminate solar greenhouses in Hindu-Kush Himalaya and other cold arid regions of Asia, GERES will launch a website, www.solargreenhouse.org. Interested persons can download the manuals on construction and running. Some of them are multilingual i.e. English, Tajik and Russian. In the future, these manuals will be translated into Ladakhi language as well. This website has an online forum to discuss and exchange information, so as to improve the existing technology."

Closing remarks

The closing session was chaired by Mr. Alain Guinebault, General Manager, Groupe Energies Renouvelables, Environnement et Solidarities (GERES), France. He invited the seminar partners to say few words to conclude the seminar.

Mr. Alain Guinebault was joined by Mr. Abhijit Chatterjee (GTZ), Mr. Robert Angioletti (ADEME) and Mr. Jigmet Takpa (LAHDC) on the podium.

Mr. Abhijit Chatterjee, *Representative of Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Germany*

"First of all, I would like to thank everyone on behalf of GTZ as well as EAGA Energy India for taking the trouble of coming here. I have observed that when you have an event in a remote place, only the die-hard and dedicated manage to come.

The outcome is very clear. Three days of deliberations have been very productive and encouraging, for myself as a participant. And I think I speak of every one of you. There is excellent sharing of knowledge and there is a commitment to the cause; not only of energy security but also of climate change and issues of mountain regions.

Finally, I would like to congratulate and join others in congratulating GERES India, Mr. Vincent Stauffer and his colleagues. In the month of March, I did see the way they were preparing for the event and I tell you honestly that it is not simple to organise an event of this size and caliber, from a place which has electricity of five hours and office which had to operate on backup energy, hardly any Internet to speak of and I found it very difficult. Let me congratulate everyone in GERES India."

Mr. Robert Angioletti, *Representative of Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME), France*

"I would like to thank GERES and all the staff members, particularly people in-charge of the seminar. The seminar was very well organised, including the reception, food, and programme.

Thank you also to local NGOs. I was really impressed by their works and achievements. We visited some project sites of the NGOs and it was really impressive. The good results are obtained by the involvement of villagers. You should carry on the good work.

Last but not the least; I would like to thank all the participants and the speakers. There were many interesting experiences to share, bringing hope for the future, which is very important for us. ADEME is in charge of organizing and managing projects on energy efficiency and climate change mitigation. We have learnt a lot from you. So, thank you very much."

Mr. Jigmet Takpa, *Representative of Ladakh Autonomous Hill Development Council, Leh (India)*

"Respected panelists and distinguish delegates from various agencies. When I first came to know that an international seminar on 'energy and climate change' is to be held in Ladakh, I was overwhelmed. After 3-days of deliberations, there was no doubt that this seminar was one of the most successful events being organised in Ladakh. It was very fruitful and successful. Therefore, I want to thank, especially the organizer of this seminar and all the participants who have shared their knowledge, experiences and expertise. It was a good exposure for Ladakhis that an international seminar happened right here in Ladakh.

The seminar was highly structured, with the stress on impacts of energy in development, climate change mitigation and adaptation strategies, role of carbon market in catalyzing revenues for clean energy investments and role of civil society in capitalizing the carbon market.

It was an opportunity to share our best technology and practices to deal with climate change. Personally for me, as an administrator, it was learning experience and good exposure to other contemporary works that are taking place in similar situations. Holding seminar in Ladakh sends a strong message to the world community about the vulnerability and the catastrophic effect of climate change that can affect the livelihood and civilization of the cold regions. The problems and challenges faced are similar across the cold regions of Asia. Therefore, we must not only focus on climate change. Other issues relating to livelihood should be shared on a common platform.

As of now, there is no organisation or institution that knows the cause of cold region. When people talk of climate change, they talk of melting ice caps, rising of sea level, indentation of islands. People living in the cold regions who are dependent on glaciers; it has never been discussed. The policies on cold regions should be taken firmly and adaptation strategies should be discussed at both national and international levels. So, I on behalf of Ladakh Autonomous Hill Development Council, thank the organisers and all the participants for coming all the way to Ladakh and sharing your experiences.

Any tourist coming to Ladakh for the first time falls in love with serenity and placidity of the place. There is a saying in Ladakh, 'The mountain passes are high; the land so barren. Only a dear friend or a serious enemy will reach here'. So, we consider you all as our dear friends and we invite you again to discover Ladakh. In the end, let me say a few wordings from a Ladakhi song called, 'Tashispa'- 'Today we depart with the hope to meet again and again, may the sun always shine on you. May peace and prosperity come from all four directions, may almighty bestow all his blessing for your bright future'. With that wording, I thank you again for coming to Ladakh and hopefully we meet again."

Appendix A. List of the participants

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Appendix B. Acronyms and abbreviations

ADB	Asian Development Bank
ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie
AFD	Agence Française de Développement
AFGEI	Afghan, French, German Energy Initiative
Ah	Amp hour
asl	Above sea level
BEE	Bureau of Energy Efficiency
BORDA	Bremen Overseas Research and Development Association
BSP	Biogas Support Program
CBO	Community Based Organisation
CEE	Centre for Environment Education
CFL	Compact Fluorescent Lamp
CGI	Corrugated Galvanised Iron
CO	Carbon Monoxide
CO2	Carbon Dioxide
CRT	Centre for Rural Technology
DESD	Decade of Education for Sustainable Development
DG	Diesel Generator
DIHAR	Defence Institute of High Altitude Research
DRE	Decentralised Rural Electrification
EC	European Commission
EECCA	East Europe, Caucasia and Central Asia
EEP	Energy Efficiency Program
EMC	Electricity Management Committee
EPS	Expanded Polystyrene
ESD	Education for Sustainable Development
EU	European Union
FFEM	Fond Français pour l'Environnement Mondial
GB	Government Body
GEF	Global Environment Facility
GERES	Groupe Energies Renouvelables, Environnement et Solidarities
GHG	Greenhouse Gas
GJ	Giga Joule
GLOF	Glacial Lake Outburst Flood
GOI	Government of India
GoN	Government of Nepal
Govt.	Government
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
GWh	Giga Watt Hour
H.T.	High Tension
HFH	Habitat for Humanity
HH	Household
HKH	Hindu-Kush Himalaya
HP	Himachal Pradesh
ICIMOD	International Centre for Integrated Mountain Development
IGH	Improved Greenhouse
INR	Indian Rupees
IPCC	Intergovernmental Panel on Climate Change
JNPT	Jawaharlal Nehru Port Trust
km^2	Square Kilometre
KVa	Kilovolt ampere
kW	Kilowatt
KWh	Kilowatt hour
KWp	Kilowatt peak
LAHDC	Ladakh Autonomous Hill Development Council
LED	Light Emitting Diode
LEDeG	Ladakh Ecological Development Group
LPG	Liquefied Petroleum Gas
LREDA	Ladakh Renewable Energy Development Agency

MHPU	Micro Hydroelectric Power Unit
MHRD	Ministry of Human Resource Development
MNRE	Ministry of New and Renewable Energy
MoE	Ministry of Education
MOEF	Ministry of Environment and Forests
MoPH	Ministries of Public Health and Education
MOU	Memorandum of Understanding
MW	Megawatt
NAPCC	National Action Plan on Climate Change
NGO	Non-Governmental Organisation
NRM	Natural Resource Management
PA	Practical Action
PDD	Project Design Document
PSH	Passive Solar House
PV	Photovoltaic
QEP	Quality Electricity Plus
RCC	Reinforced Cement Concrete
RE	Renewable Energy
REDCO	Renewable Energy Development Cooperative Limited
RESCO	Rural Energy Service Company
RP	Resource Person
S&L	Standard and Labelling
SCSTE	State Council for Science, Technology and Environment
SECMOL	Student's Educational and Cultural Movement of Ladakh
SGP	Small Grant Programme
SKUAST	Sher-E-Kashmir University of Agriculture Sciences and Technology
SPARE	School Project for Application of Energy and Resources
SPV	Solar Photovoltaic
TAP	Thermosyphoning Air Panel
TAR	Tibet Autonomous Region
T-HELP	Trans-Himalayan Environment & Livelihood Program
TMF	Turquoise Mountain Foundation
TV	Television
UN	United Nation
UNDP	United Nation Development Programme
UNESCO	United Nations Eductional, Scientific and Cultural Organisation
USA	United States of America
USAID	United States Agency for International Development
USD	United States Dollar
UV	Ultraviolet
VEC	Village Energy Committee
VHG	Village Hybrid Grids
W	Watt
WECF	Women in Europe for a Common Future

What's on the DVD

On the DVD you will find:

- A short documentary film on the Seminar
- Most of the PowerPoint shows that the speakers used during their presentations
- A PowerPoint slide show of photographs
- A PDF file of this proceedings