Proceedings of the SAARC Symposium on

Carbon Sequestration

organized by

the SAARC Forestry Centre, BHUTAN.

Venue : Namgay Heritage Hotel, Thimphu, Bhutan

Date : 27th till 29th Nov. 2009

TABLE OF CONTENTS

Group Photo of Participants

Inaugural Session with the Chief Guest

Symposium in session

Presenters and Participants

Presenters

BHUTAN : Mr. Karma Tshering
Department of Forests.
Ph : + 975 2 323539, (Mb) + 975 1760 7176
Email : kxt123@hotmail.com

BHUTAN : Mr. Tashi Dorji
Dept. of Energy
Ph : 00 975 324404, (Mb) 00 975 1761 3958
Email : tashi.doe.moea.gov.bt

INDIA : Mr. Rajesh Kumar
Forest Survey of India, Dehra Dun
Ph : 00 91 9411101670 (Mb)
Email : rajsus1@yahoo.com

SRI LANKA : Ms. Thevaky Markandu
Ministry of Environment and Natural Resources
Ph: 00 94 0775060005 (Mb)
Email : thevakym@yahoo.com

Participants

BANGLADESH : Mr. Joynal Abedin Talukder
Ministry of Environment and Forest
Ph: + 880 27169621, (Mb) + 880 1711532646
Email : jsdev@moef.gov.bd

BHUTAN : Dr. Sangay Wangchuk
SAARC Forestry Centre
Ph : 000 975 2 365 148, (Mb) + 975 1763 7867
Email : jamkhar@yahoo.com

BHUTAN : Dr. Thinley
Department of Agriculture
Ph : + 975 1760 2441 (Mb)
Email : baap10@yahoo.com

BHUTAN : Mr. Pasang W. Norbu
SAARC Forestry Centre
Ph : + 975 2 365 148, (Mb) + 975 1711 8700
Email : pwnorbu@gmail.com

BHUTAN : Mr. Phurpa Dorji
Department of Livestock
Ph : + 975 2 322418
Email : p.dorji@moa.gov.bt

BHUTAN : Mrs. Thinley Choden
Department of Forests
Ph : + 975 2 325042, (Mb) + 975 1774 4398
Email : thinley012@yahoo.com

BHUTAN : Mr. Ugyen Dorji
Department of Geology and Mines
Ph : + 975 2 323096, (Mb) + 975 17678430
Email : ugyen@druknet.bt

SRI LANKA : Mr. LDN Kumarasiri
Ministry of Environment and Natural Resources,
Ph : + 94 0112883097, (Mb) + 94 0773561959,
Email : knilupul@yahoo.com

Key note address by the Chief Guest, Director, Department of Forests

It gives me great pleasure and I am delighted to attend the opening session of this very important symposium. I would like to personally welcome participants from India, Sri Lank, Bangladesh and Bhutan to this crucial symposium on carbon sequestration. I would also like to congratulate the SAARC Forestry Centre for conducting this important symposium.

This symposium is a great opportunity for the SAARC Member States to come together for a common cause that is facing the humanity today. We know that without one another and without acting with each other it is impossible to bring about real change.

Many western scientists simply say that the debate on climate change is over. It is time to act. Climate Change is an established fact and it has now become a common cause for the whole humanity. The very survival of humanity is in grave danger and it has become unavoidable. Since we are facing a grave global threat from climate change we need to join forces and work together to realise the full potential of remedial measures against climate change. For those of us who are gathered here today, it is important to know that climate change is expected to have devastating effects on the people of South Asia.

There are already alarming new evidences of rapid melting of the perennial ice of the north polar cap. It is attributed to human activities which if unchecked in the next decade could destroy one of the earth's principle mechanism of cooling itself. Such melting of polar ice caps could have devastating impacts to some of our SAARC Member States.

There are also evidences that human activities have caused dramatic warming of sea surface temperatures in the areas where hurricanes form. Some of our SAARC Member States can be victims of such erratic weather conditions.

Due to warmer temperature the soils and vegetations also get dried up resulting in more forest fires. This human induced effects can have a devastating impacts for some of the SAARC countries where forest fires are common. The receding of glaciers from the Himalaya is another great disturbing issues facing many of us today. The list of such impacts can go on and on.

Few years back biodiversity conservation was everyone's agenda. Now we know that in a short span of time the very survival of biodiversity including humanity is under the complete control of climate change.

Some of the Developed countries such as Australia already feels the economic impacts of Climate Change. As such they have launched the Global Carbon Capture Institute which will drive global cooperation as a key component of the solution to Climate Change.

I think there is no single solution to climate change. We need to act on every front to find solutions to the challenge of climate change. As such, gathering of this nature can contribute to knowledge sharing on the best possible methods which are relevant to our region. Carbon Sequestration is a key technology in reducing the global emission of CO_2 gas.

The time for coordinated, accelerated actions on Carbon Sequestration has truly come. We cannot afford to waste another year. That is why it is extremely crucial for the SAARC Region to come together and act jointly for a common cause. As such today's gathering here in Bhutan, I think is very crucial.

We are still not late to act but the urgency is getting more important by the day. We are all aware that the predictions of Climate Change scientists are coming true – the rising of sea level, rise in global temperature and the erratic weather patterns.

Carbon Sequestration technologies are vital technologies in the fight against Climate Change. It is crucial that the SAARC Member States make use of these technologies to address climate change. Through such forums SAARC Region should take the leadership role in Regional Climate Change mitigation measures. The world's best climate scientists tell us that if we don't do something now, we are heading for a catastrophic climate change.

Last but not the least I have great hope that every one of you will bring out your energy, your talents, your expertise, your networks and collective efforts to make this symposium a great success and the fruits of this success be helpful to the citizens of our region. There is enormous responsibility on our collective shoulders and I hope that you will rise to that challenge.

Thank you and Tashi Delek.

SAARC Action Plan on Climate Change

A. Introduction

The Fourteenth SAARC Summit (New Delhi, 3-4 April 2007) expressed "deep concern" over the global climate change. As a follow up action, the New Delhi Declaration called for pursuing a climate resilient development in South Asia. As a way forward and a first step, Bangladesh proposed to organize an expert meeting.

At the Twenty-ninth session of the SAARC Council of Ministers (New Delhi, 7-8 December 2007), the issue of climate change, particularly the increasing vulnerability of the region due to environmental degradation and climate change were discussed. The ministers felt that given all vulnerabilities, inadequate means and limited capacities, we need to ensure rapid social and economic development in our region to make SAARC climate change resilient. They welcomed the offer of Bangladesh to hold a SAARC Ministerial Meeting on Climate Change to be preceded by an Expert Group Meeting on Climate Change.

After detailed discussion, the Expert Group Meeting recommended a draft SAARC Action Plan on Climate Change as follows:

B. Objectives of the SAARC Action Plan on Climate Change

The action plan would seek to achieve the following objectives:

- To identify and create opportunities for activities achievable through regional cooperation and south-south support in terms of technology and knowledge transfer.
- To provide impetus for regional level action plan on climate change through national level activities.
- To support the global negotiation process of the UNFCCC such as the Bali Action Plan, through a common understanding or elaboration of the various negotiating issues to effectively reflect the concerns of SAARC Member States.

C. Thematic Areas of the Regional Action Plan on Climate Change

Specific areas of action in the regional action plan for climate change for SAARC region are to be identified according to the priorities outlined and actions envisaged in the national action plan of the SAARC Member States. However, with a view to facilitate the process of formulating Action Plan, consistent with the national action plans of SAARC Member States, possible thematic areas are, below:

Thematic area one: Adaptation to Climate Change

- Adaptation to climate change impacts and risks in vulnerable communities, locations and ecosystems,
- Adaptation in sectors (e.g. water, agriculture, fisheries , health and biodiversity)
- Adaptation to extreme climate events (e.g. flood, cyclone, glacial lake outburst, droughts and heat and cold waves)
- Adaptation to climate change impact (e.g. sea level rise, salinity intrusion, glacial melt and coastal and soil erosion,)
- Adaptation suited to urban settlements, coastal structures and mountain terrain.

Thematic area two: Policies and Actions for Climate Change Mitigation

- Sharing of best practices on nationally appropriate mitigation actions (e.g. energy, waste management and transport)
- Capacity building for developing CDM projects including DNA and stakeholders.
- Sharing of best practices on sustainable forest management based on experiences.

Thematic Area Three: Policies and Actions for Technology Transfer

- Technology needs assessment including R&D and capacity development
- Assessing barriers to technology development for adaptation and mitigation options.

Thematic Area Four: Finance and Investment

- Methods for assessing financing needs to deal with climate change in the short, medium and long term,
- Climate change projects should be given priority and be financed as per SAARC norms.
- Determine the quantum of additional funding required to implement the action plans as identified under various thematic areas.

Thematic Area Five: Education and Awareness – New Delhi Work Program

- Development of a tool kit on mass awareness raising on climate change
- Incorporating climate change awareness in educational curricula
- Involvement of the mass media on climate change issues with adequate information

Thematic area Six: Management of impacts and risks due to climate Change

- Climate risk modeling and capacity building in the region on impact assessment of climate change.
- Sharing of information and capacity building in the management of climate change impacts and risks through cooperation among SAARC member states in early forecasting, warning and adaptation measures,
- Cooperation amongst the SAARC member states in exchange of information on climate and climate change impacts(e.g. sea level rise, glacial melts, droughts, floods, etc.).
- Cooperation and sharing of good practices in disaster management.

Thematic area Seven: Capacity building for international negotiations

- Capacity building of Member States in the international negotiation process.

D. Priority Action Plan

- Capacity building for CDM Projects
- Exchange of information on disaster preparedness and extreme events
- Exchange of meteorological data.
- To consider capacity building and exchange of information on climate change impacts (e.g. Sea level rise, glacial melting, biodiversity and forestry).
- Mutual consultation in international negotiation process.
- Media briefing as and when required.

E. Duration – Time Line

The Action Plan is proposed for an initial period of three years (2009-2011).

F. Implementation Responsibility

The primary responsibility for implementing the Action Plan on Climate Change rests with the national governments. With regard to regional cooperation, a mechanism should be agreed upon to effectively use the existing institutional arrangements of SAARC by giving clear directions and guidance. As for national level implementation, each government has to undertake its regulatory measures, technological interventions, stake holder's participation and institutional arrangements.

G. Reporting and Reviewing

The review of the action plan should be periodically undertaken by the appropriateinstitutional mechanism in SAARC at the technical level. Their national reports on the implementation will be submitted to the SAARC Secretariat for subsequent consideration by the Ministers.

Day 1 (27th Nov. 2009)

Theme I - Carbon Trading

Concept of carbon trading and its present status

Presenter : Ms. Thevaky Markandu, Sri Lanka.

Abstract.

Carbon trading refers to a system to control the emission of carbon dioxide whereby governments or international bodies set an overall limit on the amount of carbon that can be emitted. Companies who will be emitting more carbon than they have permits to emit must therefore buy additional credits on the open market, while those who will emit less can sell their credits.

Sri Lanka has been a non polluting country due to its age old inherent life style. Per capita CO2 emission is 0.6 Mt. Further attempts will be taken not to increase the carbon foot print.

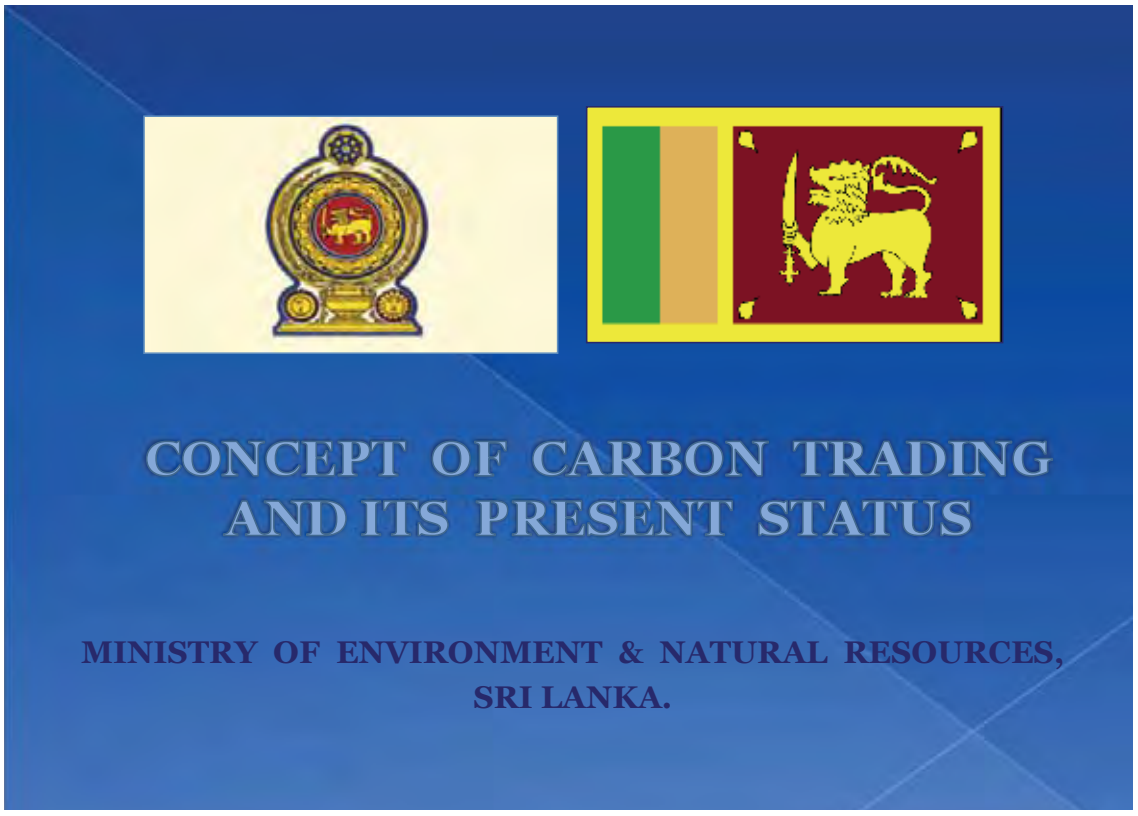
Sri Lanka's potential for emission reduction is estimated around 6,232,468 tons of CO2 per year and accordingly, total revenue of US$ 74,789,616 per year can be expected.

Sri Lanka Carbon Fund (SLCF) was formed by a Cabinet decision under the Company Act No. 7 of 2007. 51% of equity of this company is owned by the Government, while the balance share capital is raised from other sources including the private sector. The objectives of SLCF follows as:

- To provide technical and financial assistance to the CDM Project developers for the preparation of project documentations.
- To facilitate bundling of small CDM projects.
- To facilitate access to capital funding for CDM projects through commercial banks.
- To provide investment capital for CDM projects.
- To engage in carbon trading through purchasing and subsequent sale for carbon credits.

The Fund can assist in emission reduction in the sectors such as, Renewable energy (Hydro, Wind, Solar, Biomass power generation), Energy conservation, Sustainable Transport, Industries, Agriculture, Forestry, Municipal / Solid Waste Management.

Main presentation



Our Natural Resources

- Natural Forest Cover 23%
- Other Tree cover 7%
- Bio diversity hotspot
- Coastline of 1660 km
- Coral reef, lagoons, mangroves
- Rich minerals.

Green Cover Act As a Good Carbon Sink

Article 17 Of The Kyoto Protocol

- It allows developed countries to exchange emissions obligations, leading to Emission Trading (ET).
- Emission Trading is "a market-based approach to achieve environmental objectives that allows those reducing Green House Gas (GHG) emissions below what is required to use or trade the excess reductions to offset emissions at another source inside or outside the country.

  Trading can occur at local, international and intra -company levels" but only developed countries can participate.

Concept Of Carbon Trading

- Carbon trading markets are the most popular solution for reducing GHG emissions, and in particular carbon dioxide emissions, which are the largest constituent of GHG emissions.
- Carbon trading refers to a system to control the emission of carbon dioxide whereby governments or international bodies set an overall limit on the amount of carbon that can be emitted.

  Companies who will be emitting more carbon than they have permits to emit must therefore buy additional credits on the open market, while those who will emit less can sell their credits.

CONT / -

CARBON TRADING

ECONOMIC SOCIAL & POLITICAL

EMISSION REDUCTION

SRI LANKA'S CARBON FOOT PRINT

- Sri Lanka has been a non polluting country due to its age old inherent life style.

Per capita CO_2 emission is 0.6 Mt.

- Further attempts will be taken not to increase the carbon foot print.

Potential Carbon Trading

- Sri Lanka's potential for emission reduction is estimated around 6,232,468 Tons of CO_2 per year and accordingly, total revenue of US$ 74,789,616 per year can be expected.

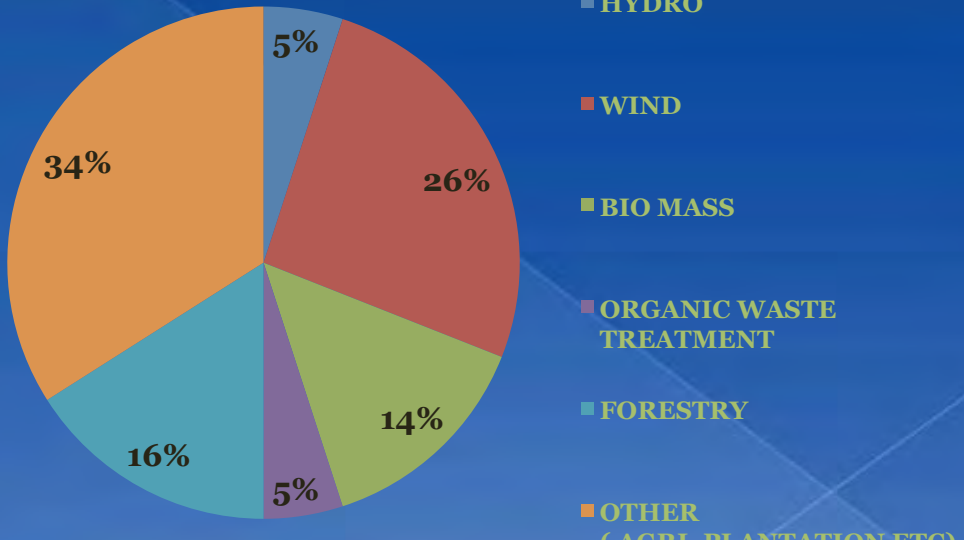
Sri Lanka Carbon Fund (Pvt) Ltd

- This company was formed by a Cabinet decision under the Company Act No. 7 of 2007.
- 51% of equity of this company is owned by the Government while the balance share capital is raised from other sources including the private sector.

OBJECTIVES OF SLCF

- To provide technical and financial assistance to the CDM Project developers for the preparation of project documentations.
- To facilitate bundling of small CDM projects.
- To facilitate access to capital funding for CDM projects through commercial banks.
- To provide investment capital for CDM projects.
- To engage in carbon trading through purchasing and subsequent sale for carbon credits.

IDENTIFIED SECTORS AND ANNUAL CO2 ABATEMENT (TONS)



THEMATIC AREAS

The Sri Lanka Carbon Fund can assist in emission reduction in the sectors such as:

- Renewable energy.
  (Hydro, Wind, Solar, Bio mass power generation).
- Energy conservation.
- Sustainable Transport.
- Industries.
- Agriculture.
- Forestry.
- Municipal / Solid Waste Management.

BENEFITS OF CARBON TRADING FOR FORESTRY

- Expansion of the forest area of a country .
- Reforestation becomes profitable.
- Energy substitution:

  Firewood / dendro energy could replace electricity and coal.

Approach to Forestry Mitigation Projects in India.

Presenter : Mr. Rajesh Kumar, India.

Abstract

The presentation covered the approach for forestry mitigation projects in India by determining factors for such projects. It highlighted the carbon sequestration potential in India as found out by different authors. Agreed definitions of different terms and activities were explained. Areas which are eligible and which are not during the first commitment period, were also presented.

Steps and prerequisites for preparing mitigation projects with regards to CDM criteria were listed. The presentation also highlighted on different types of carbon sequestration and conservation projects. It was also shared that whether farm forestry based projects are economically viable. Certain policy issues were also considered by the house.

Main presentation

Determining Factors

- Current status of forest & forest resources
- Existing set up of forest management
- Identifying the potential
  - area available for forestry projects
  - market
  - scale of projects
- incentives for implementation

Forest resources

- 20.55 % of geographical area
- entirely government owned. Only 3% under corporate bodies, communities or individuals
- standing volume of
  - India 74 cu.m /ha, regional-126 cu.m/ha,
  - intense biotic pressure
- 0.8 billion rural population dependence on forest
- 38% in 10-40% canopy cover, 38% in hill districts, 36% in tribal districts
- more than 70% wood supply met from farmlands

Demand and Supply

- Fuelwood most important product
- 131 million tonnes of fuelwood obtained unsustainably
- industrial wood also in short supply
- demand and supply gap is increasing

Concerns for management

- Improved productivity of forest ecosystems
- imventory of forest resources
- efficient utilization of resources
- technology
- valuation & accounting of non tangible benefits

Forest policy

- National forest policy promotes tree plantation on non forest lands
- emphasis on managing forests for services rather than harvesting or revenue gains (< 1% contribution to GDP)
- fate of industrial plantation companies
  - mobilised huge investment
  - failure due to low internal rate of return

C sequestration potential in India

- Kant and Katwal (2003)
  - *Reforestation* of Shifting cultivation and encroached lands
    - 0.6 m ha & 0.1 m ha ($43.5 m annually @ $15 per t C)
- TP Singh
  - *Afforestation* of farm lands of UP- 19.79 Mt C in 1.01 m ha (1979-94).
  - Productivity @38.3 to 45.9 m3/ha, rotation 8-10 yrs

Potential contd.

- Sathaye and Ravindranath (1998)
  - total (forestry and energy) - 8753 Mt C
  - land suitable for forestation - 53.2 m ha
  - 233 Mt C by 2012; 753 Mt C by 2030
  - < $ 20/t C zero Mt C by 2012; 120 Mt C by 2030
- Forest Protection
  - Joint forest management program
    - 62,800 FPC's protecting 14.4 mha which is 45.6% of open forest cover in the country (25.8 m ha)
    - conservation could sequester 120 Mt C per annually for next 5 years

Potential (contd.)

- Siyag (2003)
  - 23 million tonnes of C annually
  - total CDM investment in India -$ 0.5 billion to 1.5 billion
  - agroforestry potential-$235 million (24 to 85 tC/ha; 240 m ha area under agriculture)

Definition of forests

- LULUCF defines

  forests as minimum area of land of 0.5 to 1.0 ha with tree crown cover (or equivalent stocking)of more than 10 to 30% with trees or regeneration with the potential to reach 2 to 5 m in height at maturity

Option – forest is minimum area of land of . 05 .03-10 ha……

Definitions-forestry activities

- First commitment period only (2008-2012) *Afforestation* and *Reforestation* eligible
  - *Reforestation*-raising forests on lands not containing forests as on 31.12 1989
  - *Afforestation*-conversion of land which has not been forest for last 50 years through planting seeding or human induced promotion of natural seed sources

Reforestation-optional definition

- Reforestation is the direct human induced conversion of non forest land to forested land through……*on land that was forested but has been converted to non forested land.*
  - For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest for a period of at least 10 yrs immediately prior to the moment of registry of project activity or on 31st Dec 1999.
  - For subsequent commitment periods 10 yr limit as on date of registry shall apply

Areas eligible as per definition

- Farm forestry
- *Agroforestry*
- Shifting cultivation
- Encroached lands
- Wastelands-gomal, panchayat lands
- private land-industry

Ineligible (first commitment period)

- Existing deforested and degraded forest areas (10 to 40% canopy cover and defined as forests) where maximum potential exists on government owned forests excluded at least in the short term

Mitigation Projects

- C sequestration
  - increase productivity by creating
    - new forests or
    - increasing productivity of degraded forests
- C conservation
  - conserve carbon of existing forests
    - tropical deforestation rate- 1.6 pg C /yr
- C substitution
  - transfer of forest biomass C into products

C-sequestration type projects

- Projects under farm forestry, agroforestry and common lands
  - small scale (approx 500 ha to 1000 ha)
  - private ownership
  - through co-operatives/forest departments
  - capacity building
  - longevity of project
    - dependent on opportunity cost of land,
    - land tenure

C conservation and sequestration type projects

- Wastelands and degraded forest lands (if eligible)
  - could be large scale projects (> 1000 ha)
  - bio energy projects to replace use of fossil fuels
    - timber production projects
  - government ownership
  - large technical inputs to increase productivity
  - low opportunity cost of land

Industrial plantations

Incentive-farm forestry?

- Case study from Haryana
  - poplar, 8 years rotation.
  - Productivity = 54 t/ha/yr
  - Gross return =Rs. 161888 per ha/yr
  - Net return/ha/yr= 110256
  - Investment= 51652/ha
  - Stocking= 550 stems/ha
  - Spacing =5 x 4 m

Farm forestry

C sequestered

- High productivity (Farm Land Intensive management)
  - 27 t C/ha/yr
  - @ $20 per t C it is equivalent to $540/ ha /yr
  - current gain through sale of wood is $2000 per ha per annum
- **Forest Land (**low survival, non intensive management)
  - 8.04 t C/ha/yr
  - @$20 per t C it is equivalent to $160/ha/yr
  - current gain is $560 per ha/yr

Policy Concerns for CDM

- Participatory and co-management approaches
- framework for sustainable forest management and its incorporation into CDM
- synergy between forests and other sectors such as energy, poverty alleviation, empowerment, food security

Indian approach

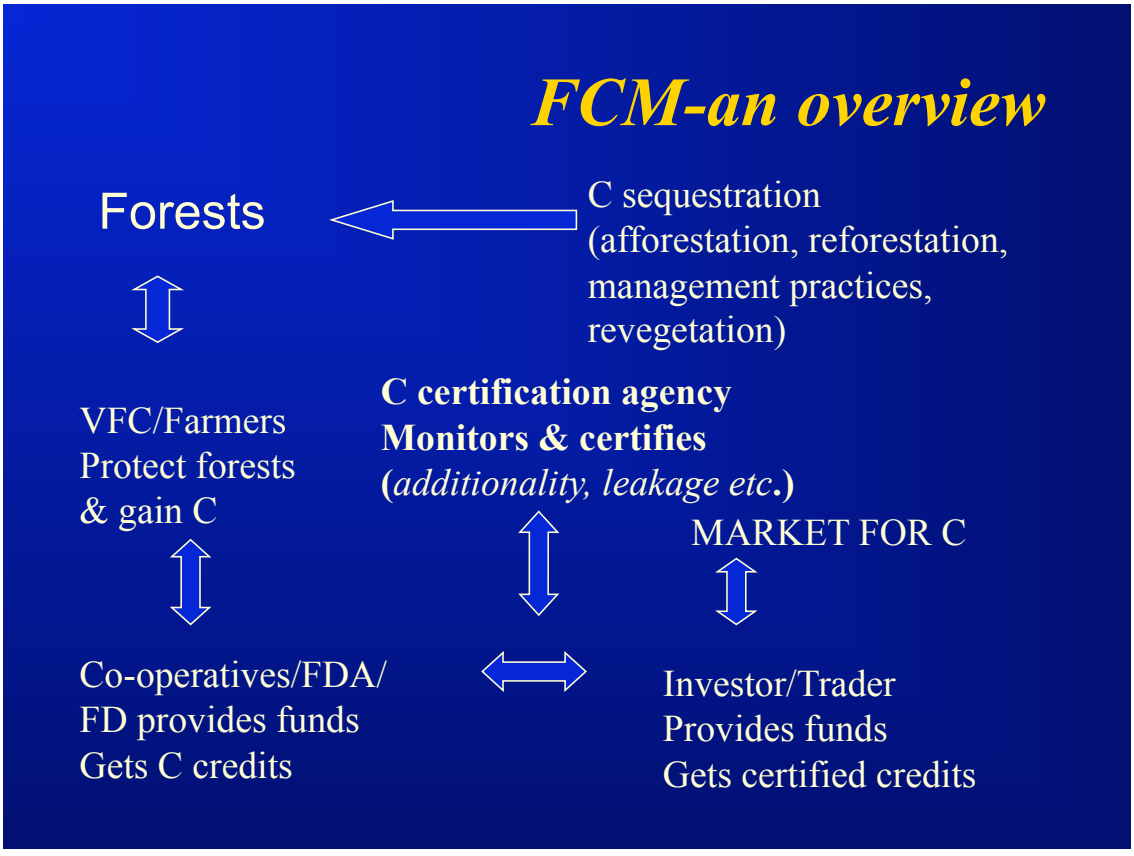
Manage existing forest resources for carbon mitigation and integrate the projects in existing set up for holistic rural development and ensuring sustainable development of forests and those dependent on it

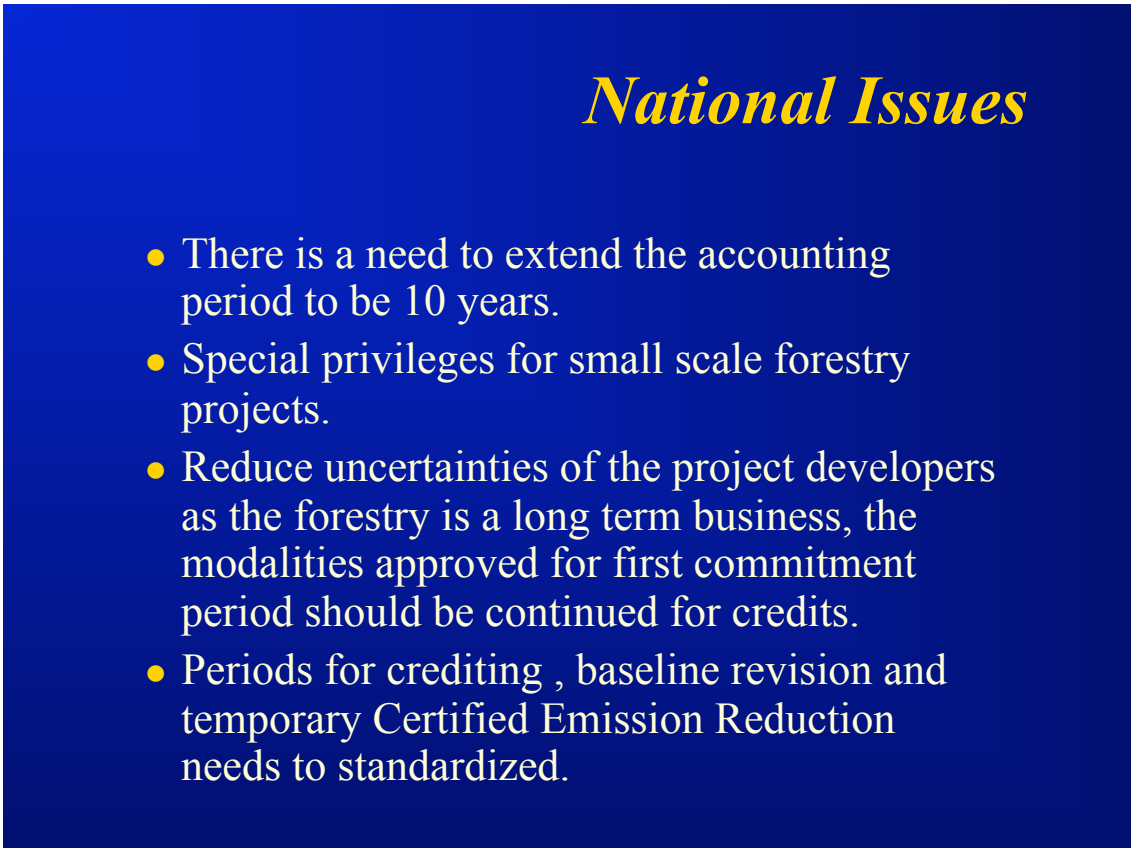
Suggestions-policy

- Negotiate the inclusion of 'forest management practices in open forest areas' in first commitment period itself to meet the sustainable development criteria
- Inclusion of local community or JFM communities or else the existing national efforts will erode
- Frame/modify rules to ensure that local communities/stakeholders are part of C deals
- Seek CDM inputs for technological enhancement, capacity building and institutional reforms

Suggestions-Carbon pricing

- Price should reflect the domestic cost of C in Annex 1 country rather than a cheap option for emission reduction in Non Annex countries
- Dual regime of free market forces and informed regulation
- Monitoring and certification/transaction costs onus on buyers


FCM-an overview
Forests
C sequestration
(afforestation, reforestation,
management practices,
revegetation)
VFC/Farmers
Protect forests
& gain C
C certification agency
Monitors & certifies
(additionality, leakage etc.)
MARKET FOR C
Co-operatives/FDA/
FD provides funds
Gets C credits
Investor/Trader
Provides funds
Gets certified credits


National Issues
There is a need to extend the accounting period to be 10 years.
Special privileges for small scale forestry projects.
Reduce uncertainties of the project developers as the forestry is a long term business, the modalities approved for first commitment period should be continued for credits.
Periods for crediting , baseline revision and temporary Certified Emission Reduction needs to standardized.

National Issues

- There is need to develop a pipeline for easy replicable projects with widely standardized baseline.
- National and state policies should be revised to be supportive to project implementation or to offer CDM projects.
- Need for national CDM regulations creatively designed to enhance the sustainability benefits.
- Need of strong research to look in to the liability for carbon stock built by CDM be transferred in the context of an eventual Indian accession to the annex I after 2020.

Issues

- Social and environmental impact assessment should be precondition to eligibility of CDM forestry project;
- Excessive reliance on plantation projects should be avoided as risk is high. Forest management projects should be equally high priority;
- enhanced training and capacity building eg. promotion of reduced impact logging practices
- Experimental approach should be avoided

Steps with regards to CDM criteria

- Baseline
  - Regional or national baselines
  - Inventory of specific model types to establish baselines
  - Biomass and C stock assessment of existing landuse types eg. forestry
    - Use existing growing stock figures, wood density figures, remote sensing and actual measurements
    - Models for assessing changes in Carbon in aboveground and belowground biomass

Permanence

- Biological resources are non permanent. Therefore "Longevity' of CDM forestry projects rather than permanence be argued about.
  - Based on rotation
    - Management
    - Physical
    - Longevity of carbon in wood products
    - Release of carbon from wood in terms of residence time

Leakage

- Should be inbuilt in project framework. The certified emission reduction (CER's) can be calculated based on expected leakage due to project activity.
- System for accounting negative leakage should also be adopted for example if a fossil fuel based energy source ultimately becomes replaced by bio-energy resulting in reduced emissions in project area.

Presentation Number 3.

Carbon Sequestration, Trade and Funding Mechanism.

Presenter : Mr. Karma Tshering, Bhutan.

Abstract

The presenter made a brief presentation covering the Carbon Sequestration, Trade and Funding Mechanism. Five elements of the Bali Action Plans on climate change, namely, a shared vision for long term cooperative action, enhanced action on adaptation, enhanced action on technology development and transfer to support action on Mitigation and Adaptation, enhanced action on provision of financial resources and investment to support action on Mitigation and Adaptation and Technical Cooperation and enhanced national and international action on mitigation of climate change.

The presentation also touched on the bleak outcome of the COP 15 at Copenhegan where Annex I countries and Annex II countries could be at logger heads and coming to an agreed terms could be very difficult. It was also highlighted on the issues which would be decided at the COP 15 such as, temperature level (1.5°C, 2°C?), global action by 2050 (-50% to -80%, from 1990?), developed country targets in 2020 (from 25% to at least 45%, vs 1990?) and 2050 (from 80% to at least 95% vs 1990?), global peaking (by 2013, by 2020, next 10-20 years?), and how to review progress over time, etc.

Three important questions of discussion that would take place in Copenhagen, namely, new institutions and funds, need for function to facilitate matching action and support and who pays - only developed countries or also developing countries were also highlighted.

The presentation also covered the Long Term Cooperative Action (LCA) which touched upon new sectoral carbon market mechanisms and the REDD response measures.

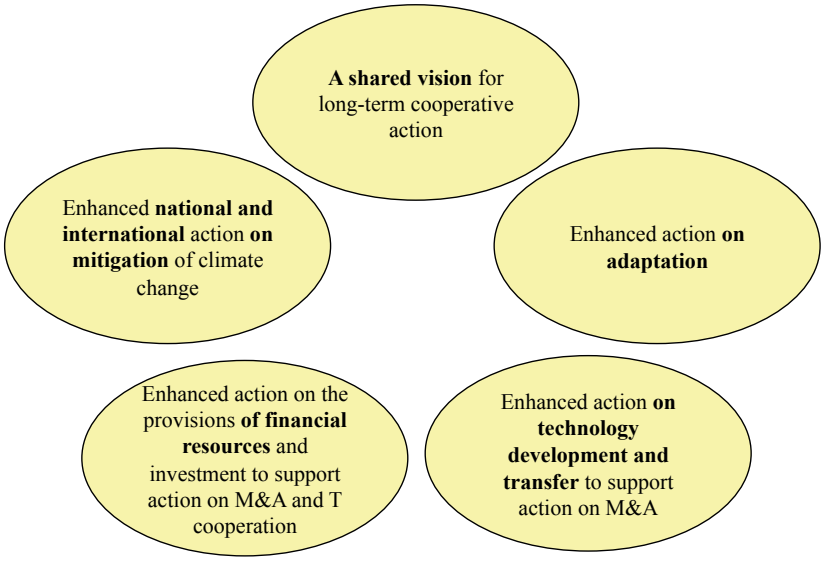
Main Presentation

Carbon Sequestration, Trade and Funding Mechanism

Symposium on Carbon Sequestration
SAARC Forestry Center

Namgay Heritage
27-29 November 2009

Bali Action Plan: 5 elements



Unsettling Context for COP15

- Time is short, no guarantee for success: Fully-fledged treaty put in question
- Chances to reach fully fledged Treaty in Copenhagen are minimal
- Consolidation yes, compromises no!
- US looks for exceptional treatment
- Strong G77 rhetoric on keeping Kyoto
- NGOs: 1.5 °C, 350 ppm
- Need to discuss holistically issues under the two tracks in Copenhagen
- Achieved limits under the Kyoto Protocol alone
- LCA text further consolidated but no real negotiations
- Ministerial part will be crucial at COP 15

Shared vision for Long Term Cooperative Action (LCA)

- Issues to be decided in Copenhagen:
  - Temperature level (1.5°C, 2°C?),
  - Global action by 2050 (-50% to -80%, from 1990?)
  - Developed country targets in 2020 (from 25% to at least 45%, vs 1990?) and 2050 (from 80% to at least 95%, vs 1990?)
  - Global peaking (by 2013, by 2020, next 10-20 years?)
  - How to review progress over time?

LCA - Finance

Focussed on three key questions that will go to Copenhagen:

★ New institutions and funds?
- EU does not defend the idea of a new fund, introduced text on High Level Forum/Body to overview all financial flows
- Fund proposals were consolidated, including US and new Japanese proposals.

★ Need for function to facilitate matching action and support?
- Australia, US and the EU worked together to consolidate views.
- Strong opposition from G77 who finds matching is irrelevant for the UNFCCC. Matching to be done in funds!

★ Who pays? Only developed countries or also developing countries?
- EU joined forces with Mexico, Singapore, Israel and the USA in calling for all parties except LDCs to contribute

LCA - New sectoral carbon market mechanisms

- Controversial subject! Support rather informal than public
- Concerns raised:
  - Choice of mechanism should be left to host country
  - Scope should not be limited to sectors, free choice
- For the EU it is key to establish new carbon market mechanisms with the following principles:
  - sector-based,
  - credits/units earned from threshold below policy baseline

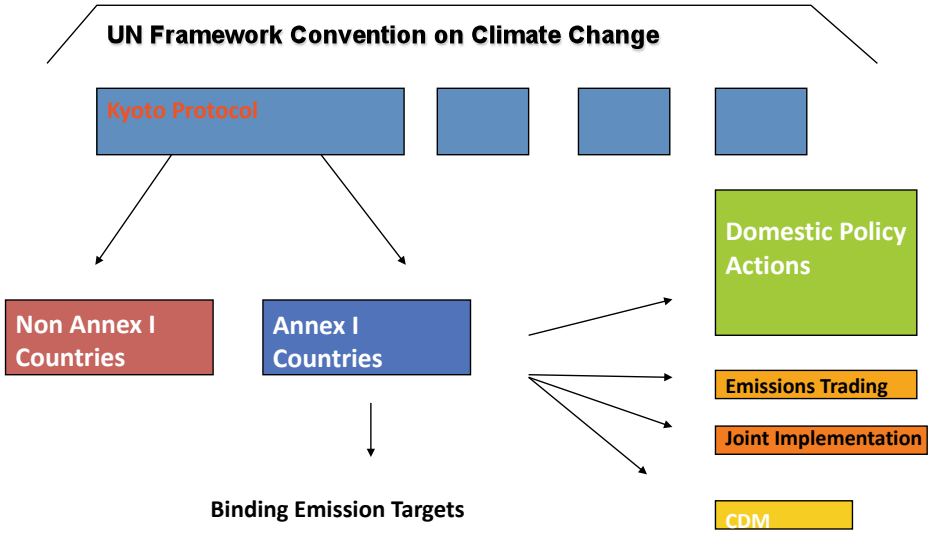
LCA – REDD response measures

- Reducing emission from deforestation and forest degradation during COP-11, by PNG and Costa Rica
- Cop-13(BAP) policy approaches and positive incentives on issues relating to reducing emission from deforestation and forest degradation in developing countries and the role of conservation, sustainable management of forest and enhancement of carbon stocks in developing countries (REDD+)
- Deforestation text (REDD) is streamlined, includes three stages
  - Readiness
  - Starting implementation
  - Introduce performance based mechanism
- Copenhagen needs to decide how this performance based mechanism should be funded and what its scope would be
- Potential adverse economic and social impacts of mitigation policies, mostly raised by OPEC countries. G77, mainly OPEC, wants a permanent institution to address this.
- Developed countries focus on the need for solid information and reporting of observed impacts.

Three main approaches

1. Carbon market offsets (direct)
   Allows emissions reductions from outside the capped country/sector
2. Market-linked systems
   Revenue from emissions permits forest protection
   Connected to market but not offsetting
3. Voluntary funding – foreign aid, voluntary offset purchases

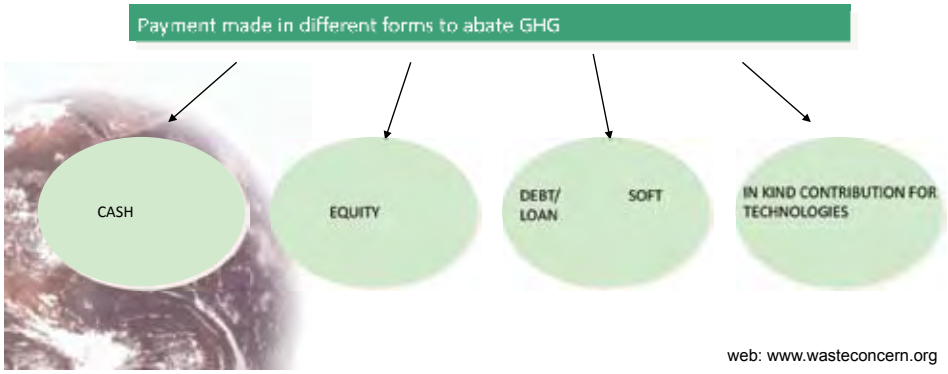
UNFCCC/KP CONTEXT



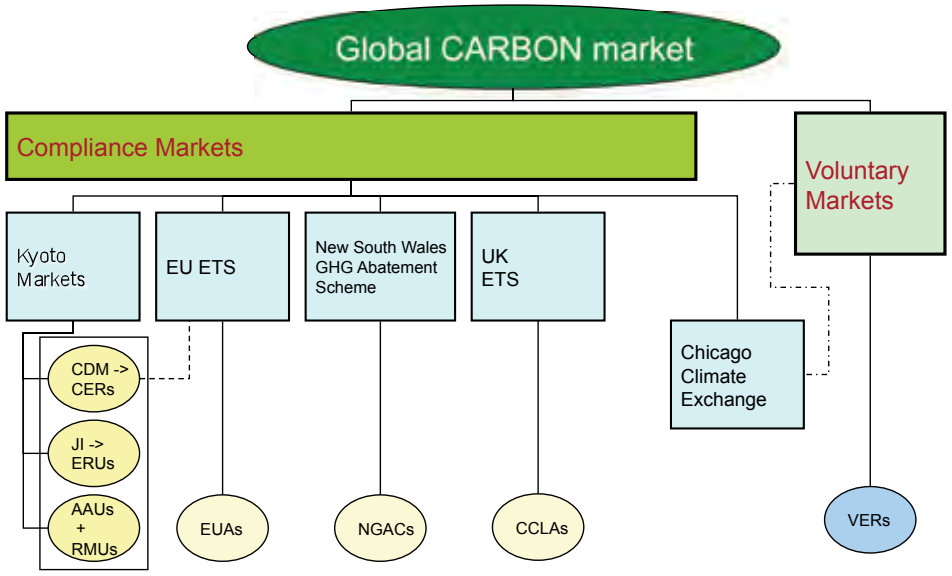
What is Carbon Financing?

- *Carbon financing* can be defined as *financial resources* provided to projects generating (or expected to generate) green house gas emission reductions in the form of the purchase of such emission reductions.

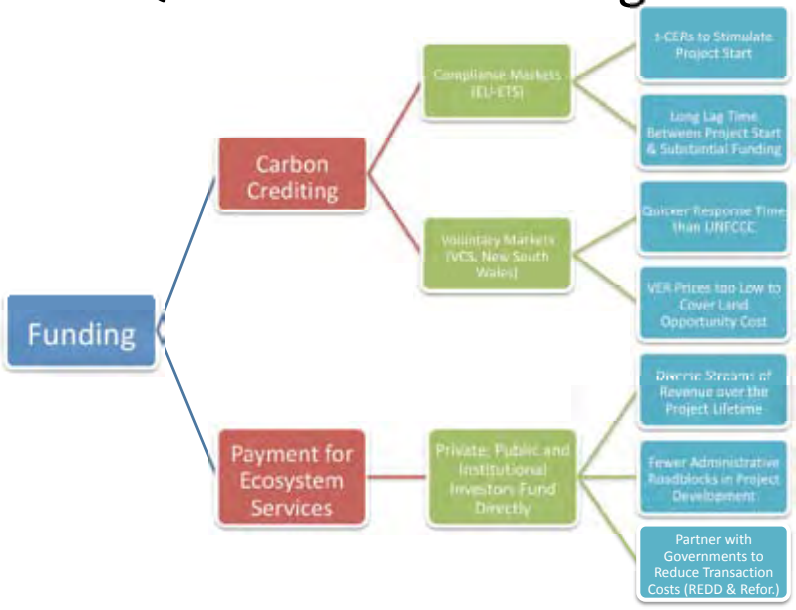
- In simple term, *carbon finance is a* purchase contracts whereby one party pays another party in exchange for a given quantity of Green House Gas (GHG) emission reductions.

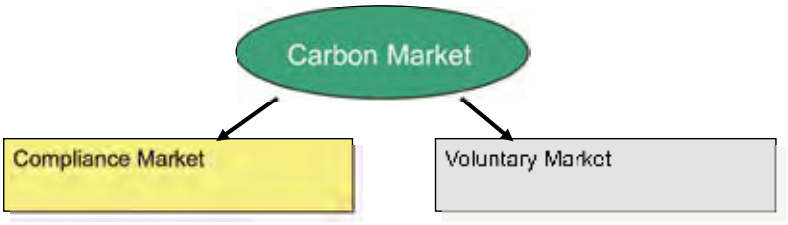


Structure of the Global Carbon Market



Quick Action Funding





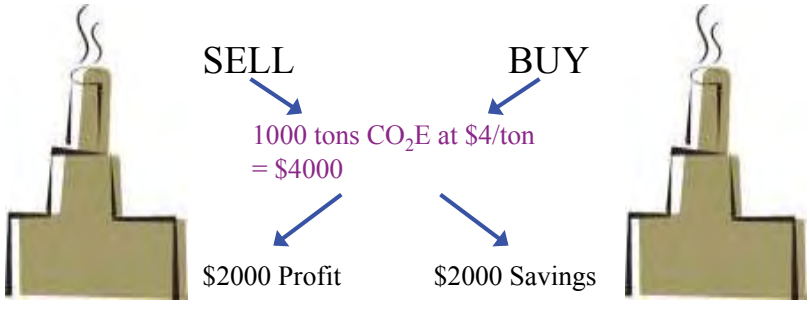
CER	VER
Compliance markets generate and trade green house gas emission reductions known as Certified Emission Reductions (CERs) that are regulated and directly initiated under the Kyoto Protocol's Clean Development Mechanism (**CDM).**	**Voluntary markets** generate and trade greenhouse gas emission reductions that are not regulated or directly initiated by the Kyoto Protocol and known as Verified Emission Reductions or (VERs).
Certified Emission Reduction (CERs): Green house gas reduction of any CDM project is measured according to internationally agreed methods and are quantified in standard units called Certified Emission Reductions (CERs). These are expressed in tons of carbon dioxide (CO2) equivalents.	**Verified Emission Reduction (VERs):** Green house gas reduction outside Kyoto Protocol is measured according to internationally agreed methods and are quantified in standard units called Verified Emission Reductions (VERs). These are also expressed in tons of carbon dioxide (CO2) equivalents.

What Is Emissions Trading?

What options are most cost-effective?

Company A can reduce 1000 tons CO_2E at \$2/ton = \$2000

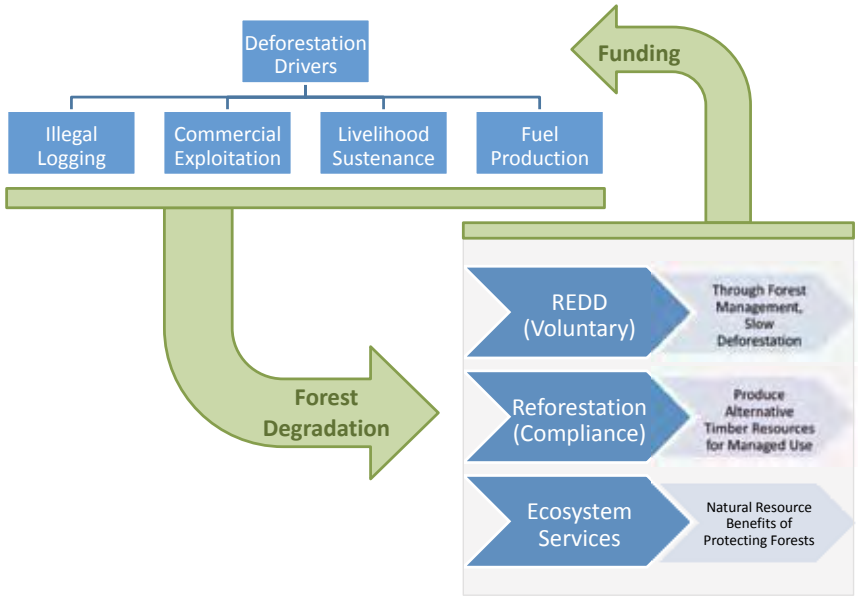
Company B can reduce 1000 tons CO_2E at \$6/ton = \$6000



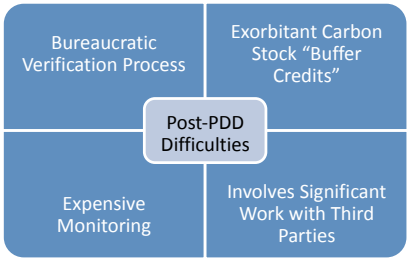
Company A - Seller

Company B - Buyer

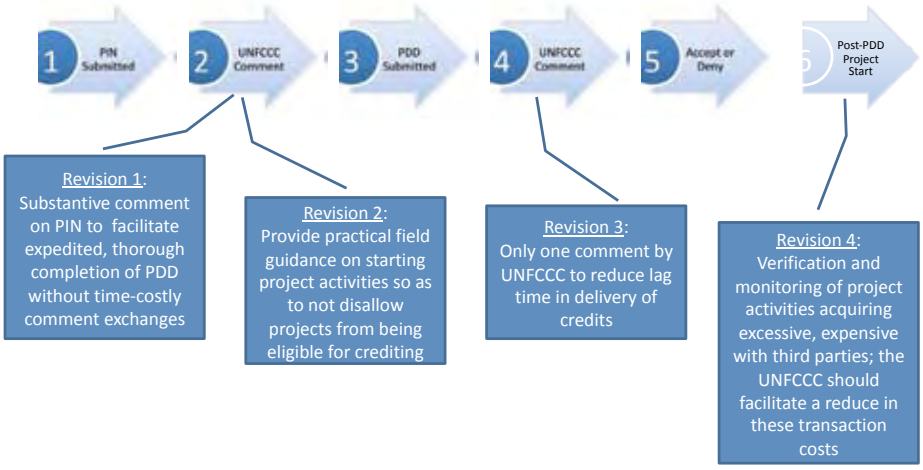
Forestry Intervention Strategies



CDM Approval Process

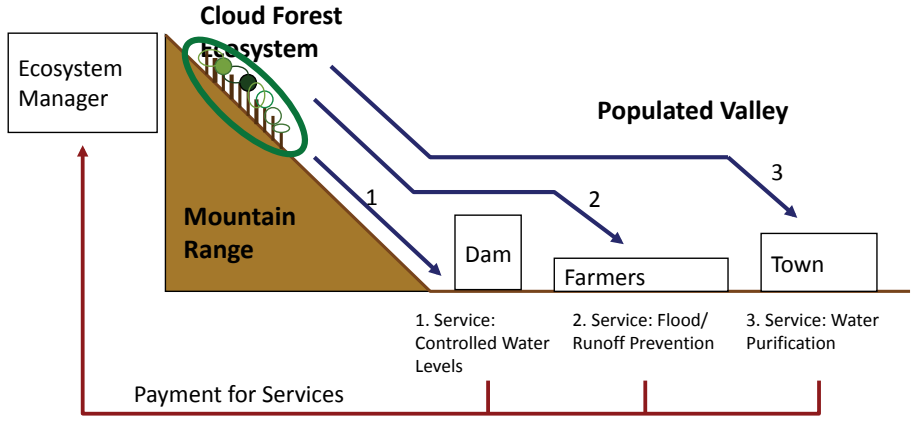


A Simple Model for Carbon Finance



Payment for Ecosystem Services

Payment for Ecosystem Services scheme: Illustrated below is a payment for watershed services set-up with 3 streams of revenue: i) dam owners; ii) farmers; and iii) municipalities.



Payment for Environmental Services (PES) schemes

- Area-based

(reducing deforestation, eco-tourism, watershed services)

- Use-restricting

(avoided deforestation)

- Public schemes

(taxes, subsidies, Integrated Conservation and Development Projects

- Product-based

(certification, gene trade)

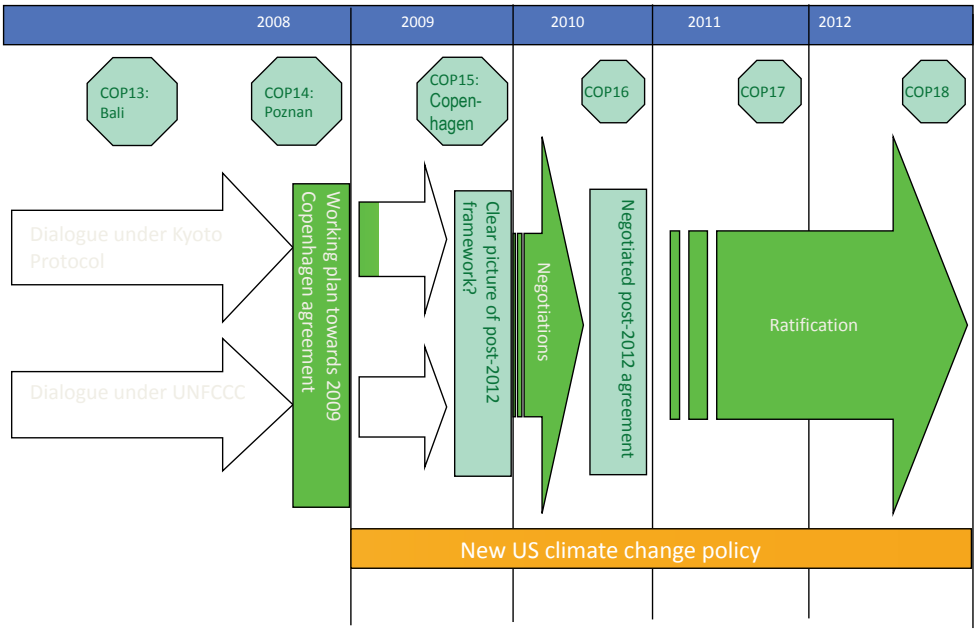
- Human-induced change

(reforestation)

- Private schemes

(market-based)

From Bali to Copenhagen and Beyond…



Presentation Number 4.

Hydropower CDM projects Bhutan

Presenter : Mr. Tashi Dorji, Bhutan.

Abstract.

The Kingdom of Bhutan, by virtue of its geographical location is blessed by nature with enormous hydropower potential of 30,000 mega watt (MW) and 120,000 GWh mean annual energy generation capacity. As per the updated Power System Master Plan, 23,760 MW has been identified so far and assessed to be technically feasible. Most of the schemes identified are run off the river types with minimal socio-environmental impacts. Only about 5% of this potential has been harnessed so far. The hydro power sector contributes about 60 of the government revenue and about 22% to the GDP. In view of this, the Government has recognized the hydro power sector as the back bone of the bhutanese economy. The Royal Government has now embarked on an ambitious plan of developing a minimum of 10,000 MW of hydro power generation by the year 2020.

Recognizing the clean and renewable form of hydropower energy with egligible socio-environmental effects, the hydro power projects is also being promoted under the Clean Development Mechanism (CDM) of the Kyoto Protocol of the United Nations Framework Convention on CLimate Chnage (UNFCCC) to accrue the additional benefits through carbon credits. Towards this, the Department of Energy (DoE), Ministry of Economic Affairs (MoEA) is promoting hydropower projects under the CDM.

Some of the hydropower projects being promoted under the CDM are as follows :

- The 70 kW Chendebji micro hydro power project located in Trongsa District is the first CDM project registered under the UNFCCC in May 2005. The total Certified Emission Reductions (CERs) generation per year from this project is about 474 t. CO2e. the local baseline has been used to come out with thte emission factor for the project.
- The CDM registration process with the UNFCCC for the 114 MW Dagachhu Hydropower Project located in Dagana District is currently underway. This project if registered as CDM project would yield annual CERs of about 0.502 million t. CO2e. the baseline used for this project is the regional electricity grid system consisting of Bhutanese grid and Eastern Regional grid of India.
- The CDM validation process for the 1020 MW Tala Hydroelectric Project is also in advance stage. This project has been fully commissioned in 2007. The total annual CERs potential for this project has been estimated at aboout 3.3 million t CO2e. the baseline uased for this project is the northern Electricity gri dog India.
- The 1200 MW Punatshangchhu project which is currently under construction is also being promoted as CDM project. The CDM consultant has been recruited to carry out CDM documentation. The estimated annual CERs potential fron the project is about 3.53 million t CO2e.

The additional benefits through the sale of CERs from the CDM hydropower projects would have enormous economic benefits to the nation as a whole.

Main Presentation

Contents

- ✓ Status of Hydropower Development in Bhutan
- ✓ Hydropower Development Target by 2020
- ✓ Policy Intervention for CDM
- ✓ Current Hydropower CDM Projects
- ✓ Future Prospects

2

Status of Hydropower Development

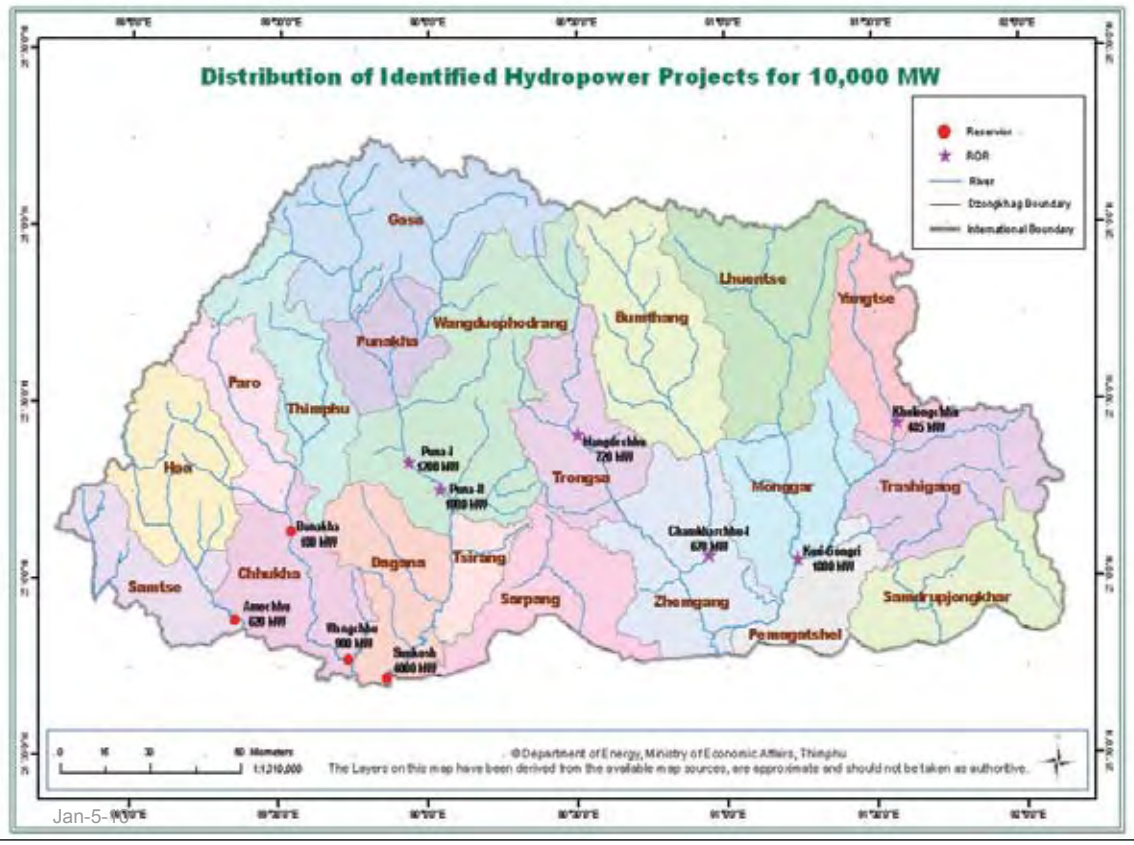
- Total hydropower potential = 30,000 MW (120,000 GWh)
- As per the Updated PSMP (2003-04) prepared under NORAD TA, techno-economically feasible > 10 MW, 76 sites = 23,760 MW (≈100,000 GWh), 6 reservoir and 70 RoR
- ≥ 60 MW developed so far = 1480 MW (7416 GWh)
- Mini/micro hydels developed so far = 23 nos, 8.168 MW
- Total hydropower developed = 1488.168 MW (5% of potential)
- Solar PV installed – 0.045 MWp
- Diesel Power installed capacity – 17.164 MW
- Total installed capacity – 1505.377 MW

3

Hydropower Projects Identified for Development by 2020

Sl. #	Project Name	Installed Capacity (MW)	Annual Generation (MU)	Construction Period Plan
1	Punatsangchhu-I	1200	5234	2008-2015
2	Dagachhu	114	500	2008-2012
3	Mangdechhu	720	2931	2010-2016
4	Punatsangchhu-II	990	4667	2010-2016
5	Chamkharchhu – I	670	3208	2012-2019
6	Kholongchhu	486	2209	2012-2018
7	Kuri-Gongri	1800	8459	2012-2020
8	Sankosh Res.	4060	6918	2011-2020
9	Wangchu Res.	900	2288	2012-2019
10	Bunakha Res.	180	893	2012-2018
11	Amochhu Res.	620	3375	2012-2019
	TOTAL:	**11,740 MW**	**40,682 MU**	

4



Policy Intervention

Umbrella Agreement of July 2006 between RGoB and GoI concerning cooperation in Hydropower development

- The two countries shall cooperate in the development of renewable energy and both countries shall support each other to develop projects under CDM of the Kyoto Protocol, using India's carbon emission baseline, and any other international mechanisms that may come into force to encourage renewable energy.
- GoI agreed to a minimum import of 10,000 MW of electricity from Bhutan by 2020.

Current Hydropower CDM Projects

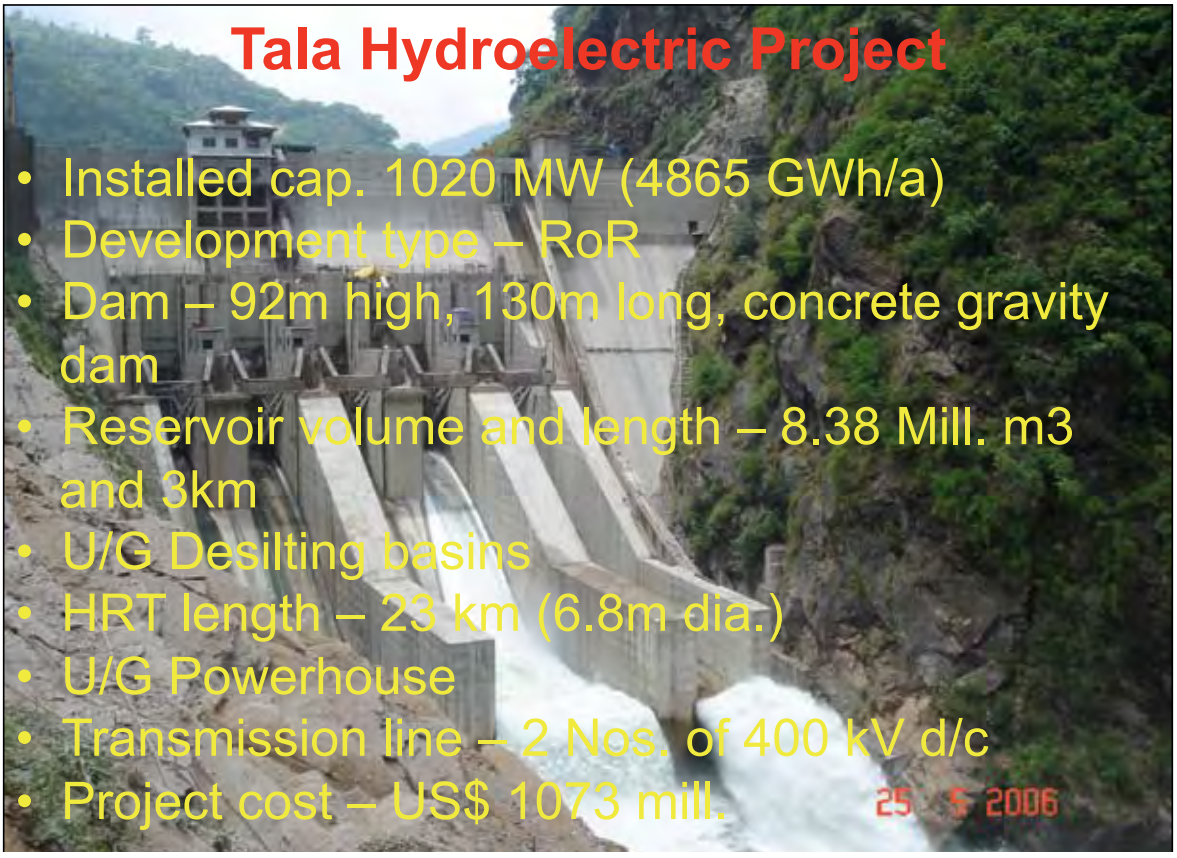
1. Chendebji Micro Hydropower Project (70 kW/ 0.58 MU/a)
2. Tala Hydroelectric Project (1020 MW/4865 MU/a)
3. Punatsangchhu-I Hydroelectric Project (1200 MW/5234 MU/a)
4. Dagachhu Hydroelectric Project (114 MW/500 MU/a)

Chendebji Micro Hydro Project

CDM Status

1. Project registered as CDM Project on 23rd May 2005
2. Total CER generation per year about 474 t. CO2e
3. Crediting period – 7 years x 3 (starting Aug. 19, 2005)
4. CERs issued for period from Aug. 2005 till Nov. 2006 ~ 474 t. CO2e
5. As per the agreement between RGoB and E7 Fund, 50% of CERs will belong to E7 Fund and rest with RGoB
6. For sale of 50% RGoB's share, Kansai Electric Power Co. Inc. has indicated interest at a price of Euro 12 per CER.
7. Presently, ERPA for sale of CERs to Kansai Electric is under review and consideration
8. Total CERs committed as per ERPA is about 237 CERs per annum
9. Validity of ERPA – till 2012

9



Tala Hydroelectric Project

Current Status of CDM Development and commitment

- CDM Project participants – THPA (62%), Powerlinks (22%) and PGCIL (16%)
- CDM Consultant – M/s Ernst & Young, India
- Mean annual energy generation – 4865 GWh/a
- Energy for export – 4135 GWh/a
- CERs generation – 3.28 million t.CO2e/a (Northern India baseline 0.793)
- THPA Share of CERs about 2.0 million t.CO2e
- Crediting period – 10 years

12

Tala Hydroelectric Project

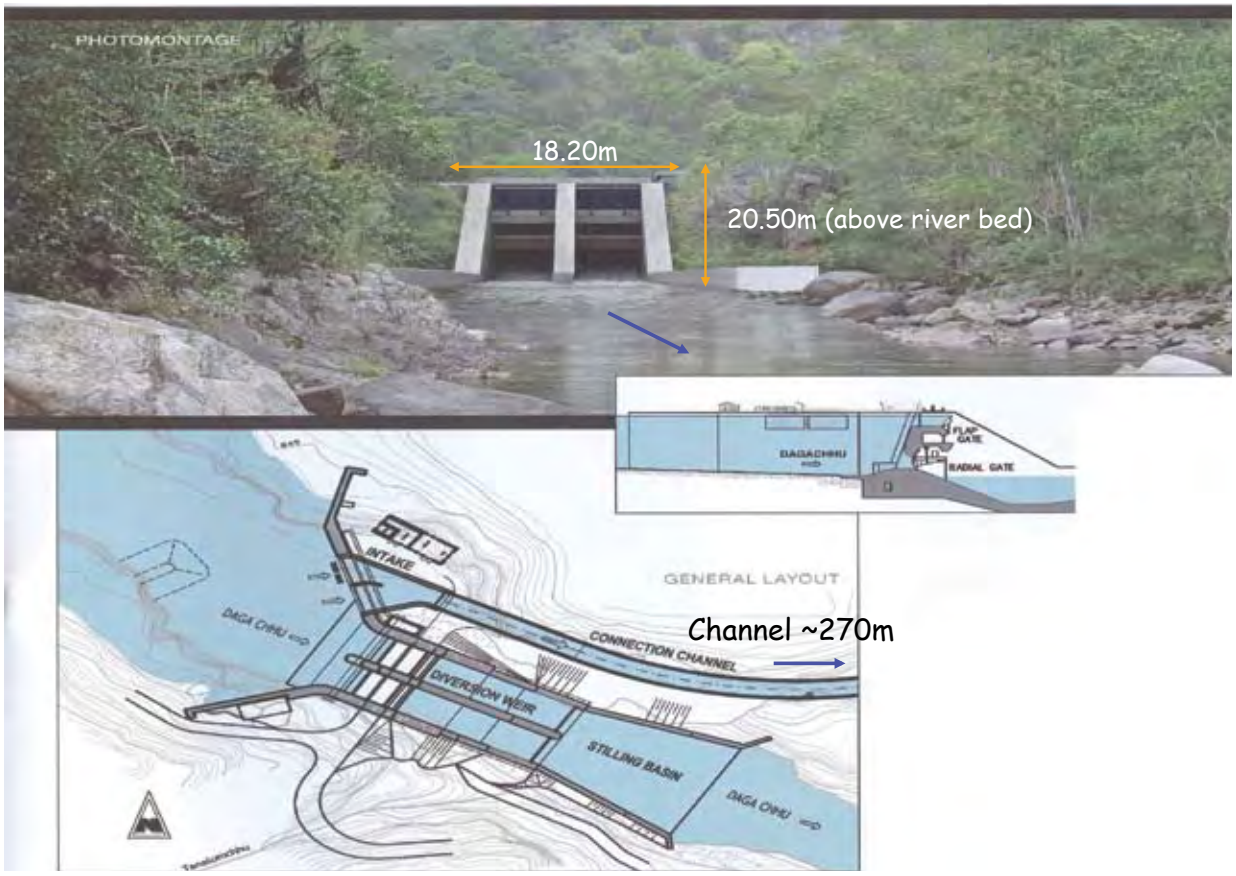
Status of CDM Development and Commitment

- Feb. 2008 – Presentation made to Indian and Bhutanese DNAs
- Feb. 2008 – Site visit by Validator (DNV)
- March 2008 – Draft validation report submitted to THPA
- April 2008 – Meeting in Delhi to submit the clarifications on draft validation report
- Validation is underway

Punatsangchhu-I Hydroelectric Project

Current Status of Project Development and CDM

1. Project financed by Govt. of India through 60% loan at 10% interest and 40% as grant
2. Project Authority formed in November 2007 for construction and O&M of the Project
3. Main Civil Works awarded to Contractors in March 2009 and the work is in full swing
4. Project is scheduled for commissioning by 2015
5. As per the Bilateral agreement signed between RGoB and GoI, Project will be developed under CDM to generate carbon credits and would be shared by the two Govts.
6. Consultant recruited for development of PIN/PDD
7. UNFCCC informed of the project's intention of CDM development
8. PIN development underway
9. Total estimated CER from the Project ~ 3.53 Million per annum 15



Dagachhu Hydroelectric Project

Current Status of Project Development

- ❖Project Authority formed in Aug. 2007 for construction and O&M of the Project
- ❖Main Civil Works awarded to Contractor as Turnkey package on July 2009 at contract sum of Nu. 3,875 million.
- ❖EME package also awarded to Austrian suppliers in July 2009 at contract price of Euro 54.999 million
- ❖Project financed with 40% equity and 60% debt
- ❖Project is scheduled for commissioning by early 2013

18

Dagachhu Hydroelectric Project

CDM Status

- CDM Documents (PDD) prepared by Poyry Energy of Austria (Contract signed in 2005)
- Validation of the PDD done by DNV, Norway
- LoA received from Bhutanese and Indian DNAs
- Approved consolidated baseline and monitoring methodology ACM0002/Version 07 (EB36), Sectoral Scope 01 used
- Baseline used: Regional grid consisting of Bhutan and the Eastern Indian grid system
- Quantum of CERs per year ~502,000 t.CO2e
- Crediting period: 3 x 7 years

19

Application of Baseline and Monitoring Methodology

- ACM0002 (Version 07): "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"
- ACM0002 (Version 07): "Consolidated monitoring methodology for grid-connected electricity generation from renewable sources"
- Project boundary
  - Project site and all power plants connected physically to the (regional) electricity system that the CDM power plant is connected to
  - CDM Executive Board Decision of Dec 2006: "regional", in the context of "regional electricity system" used in ACM0002 can be interpreted as extending across several countries, i.e. transnational electricity systems are eligible
    - Free flow of electricity among Bhutan and the member states of the Eastern region through the Eastern Regional Load Dispatch Center (ERLDC)
    - Long-term Agreement between India and Bhutan to increase imports from Bhutanese hydro power plants to India

⇒**The Eastern regional grid and Bhutan is a single regional market for estimation of baseline**

Grid definition consisting of Bhutan and Eastern Regional Grid of India

- Since December 2006, trans-national electricity systems are eligible under the CDM methodology ACM0002. A common grid emission factor shall be estimated.•ACM0002 defines a project electricity system in which power plants can be dispatched without significant transmission constraints.
- The CO2 database is published by the Indian Central Electricity Authority.
- Definition of regional grid consisting of Bhutan and Eastern Region–Agreement for bilateral cooperation in hydro power (India agrees on minimum import of 10,000 MW from Bhutan in 2020, maximum utilization of the Bhutanese hydro power plants in India)–Bhutanese power plants exporting to India are dispatched by the dispatch center of the Eastern Indian grid.
- Annual electricity production of 500 GWh with expected emission reductions of 502,000 t CO2

Dagachhu Hydroelectric Project

- Request for registration submitted to UNFCCC.
- Project under ref. 2746 has been put up for review in the UNFCCC website from 10th October 2009 till 1700 hours of 6th December 2009
- If there is no major comments, the project will stand registered

Future Prospects for CDM Hydropower Project

1. 11 Hydropower projects to be developed by 2020 totaling about 11,740 MW (~40,682 GWh/year)
2. Construction of 2 projects underway totaling 1314 MW/5734 GWh, while construction of 2 other projects (1710 MW/7598 GWh) to start by 2010 to be commissioned by 2016.
3. Preparation/updation of DPRs of 7 other hydropower projects in currently underway and construction is scheduled to commence by 2011/2012 to achieve the target by 2020.

   As part of the TORs for DPR studies of 7 projects, the Consultants will study and incorporate elements relating to declaring the project to be promoted as a CDM in order to avail benefits through carbon credits

23

Sl. #	Project Name	Operational	Annual Generation (MU)	Estimated Emission Reduction (Mill. t.CO_2e/ year)
1	Mangdechhu (720)	2016	2931	2.943
2	Punatsangchhu-II (990)	2016	4667	4.686
3	Chamkharchhu–I (670)	2019	3208	3.221
4	Kholongchhu (486)	2018	2209	2.218
5	Kuri-Gongri (1800)	2020	8459	8.493
6	Sankosh Res. (4060)	2020	6918	6.946
7	Wangchu Res. (900)	2019	2288	2.297
8	Bunakha Res. (180)	2018	893	0.897
9	Amochhu Res. (620)	2019	3375	3.389
	TOTAL:		**34,948**	**35.088**

Assumed baseline emission factor of 1.004 t.CO_2e/MWh for regional grid consisting of Bhutan and Eastern Indian Grid

24

Day 2 (28th Nov. 2009)

Theme I (continued)

Presentation Number 5.

Hurdles with carbon trading affecting developing countries especially SAARC region and the way forward

Presenter : Ms. Thevaky Markandu, Sri Lanka.

Abstract

Annex I countries function as buyers as compliance towards their targets and sustainable development while Non - Annex I countries function as a sellers to improve their financial returns, contribute to sustainable development and facilitate technology transfer (appropriate).

Lack of a strategic approach to evaluate the CDM potential of various sectors including marginal abatement costs of carbon reduction and clear understanding of the size of CDM market of various sectors for making macro level policy decisions is a major hurdle in the carbon trading.

Constraints for carbon trading are mainly:

- Institutional constraints
- Information constraints
- Inadequate technical capacity
- Investment risk
- Financing constraints.

In order to avoid costly, reactive and unplanned adaptation actions in the future, it is important for policy makers to proactively mainstream adaptation concerns into development planning, and to seek and mobilize resources for investment in existing development interventions. It is clear that without international cooperation financing adaptation actions among SAARC member states are not efficient.

Main presentation

CDM Projects Of SAARC Countries

COUNTRY	PROJECTS REGISTERED
AFGHANISTAN. (NOT ACCRETED KYOTO PROTOCOL).	
BANGLADESH.	2
BHUTAN.	1
INDIA.	467
NEPAL.	2
PAKISTAN.	3
SRI LANKA.	6
MALDIVES.	0
(AS ON 10TH NOVEMBER 2009)	

KEY CARBON TRADING DRIVERS

Annex I countries function as a buyers

- **Compliance their targets**
- **Sustainable development**

While ;

Non - Annex I countries function as a sellers

- **Improve their financial returns**
- **Contribute to sustainable development**
- **Facilitate technology transfer (appropriate).**

CARBON TRADE COMPONENTS

CARBON TRADE

Compliance

Compliance markets generate and trade greenhouse gas emission reductions known as Certified Emission Reductions **(CERs).**that are regulated and directly initiated under the Kyoto Protocol's Clean Development Mechanism **(CDM).**

CERs: Green house gas reduction of any CDM project is measured according to internationally agreed methods and are quantified in standard units called **CERs**. These are expressed in tons of CO_2 equivalents.

Voluntary

Voluntary markets generate and trade greenhouse gas emission reductions that are not regulated or directly initiated by the Kyoto Protocol and known as Verified Emission Reductions or (**VERs**).

VERs: Greenhouse gas reduction outside Kyoto Protocol is measured according to internationally agreed methods and are quantified in standard units called **VERs**. These are also expressed in tons of CO_2 equivalents.

POSSIBLE CHALLENGES

- OVER ESTIMATING THE CDM POTENTIAL
- OVER ESTIMATING THE CDM REVENUE
- LACK OF KNOWLEDGE
- LACK OF EXPERTISE
- NO EASY ACCESS TO NEW INFORMATION
- FEAR OF ADOPTING NEW TECHNOLOGIES
- NO PROPER FINANCIAL MECHANISMS.

INADEQUATE CLARITY OF CDM

- WHAT IT DELIVERS ?
- WHAT ARE THE ELIGIBLE PROJECTS ?
- HOW TO INITIATE THE CDM PROJECT ?
- HOW DIFFICULT IS THE PROJECT DEVELOPMENT ?
- WHAT IS THE DEVELOPMENT COST ?
- HOW MUCH CAN BE EARNED FROM CDM ?
- WHETHER IT CONTRIBUTES TO THE CAPITAL COST OF THE PROJECT ?
- WHO ARE THE INTERNATIONAL BUYERS ?
- WHAT ARE THE TANGIBLE BENEFITS TO THE COUNTRY ?
- IS IT POLITICAL SENSITIVE PROCESS ?

POSSIBLE RISKS

- COUNTRY RISK
- TRADE RISK
- COUNTERPARTY RISK
- NON-PERMANENCE RISK
- REPLACEMENT RISK
- CONSTRUCTION RISK
- PERFORMANCE RISK
- REGULATORY RISK
- RESOURCE RISK
- TECHNOLOGY RISK
- FINANCIAL RISK

LACK OF A STRATEGIC APPROACH

- TO EVALUATE THE CDM POTENTIAL OF VARIOUS SECTORS INCLUDING MARGINAL ABATEMENT COSTS OF CARBON REDUCTION AND CLEAR UNDERSTANDING OF THE SIZE OF CDM MARKET OF VARIOUS SECTORS FOR MAKING MACRO LEVEL POLICY DECISIONS.

WEAK INSTITUTIONAL STRUCTURES

- PUBLIC SECTOR
- PRIVATE SECTOR
- RESEARCH AND TECHNICAL INSTITUTIONS
- NGOS
- AGENCIES OR INSTITUTIONS
  (CDM PROJECT DEVELOPMENT CYCLE REQUIRE PARTICIPATION OF MULTI-STAKEHOLDERS INCLUDING ENABLING LEGAL ENVIRONMENT)
- GUIDELINES
- CDM POLICY – DRAFT STATE.

INADEQUATE TECHNICAL CAPACITY

- UPDATED NATIONAL TECHNICAL CAPACITY FOR THE CDM PROJECT DEVELOPMENT.
- INSUFFICIENT HUMAN RESOURCES.

LACK OF CDM MARKETING STRATEGY

- PUBLIC SECTOR
- PRIVATE SECTOR

FOR EFFECTIVE PARTICIPATION OF INTERNATIONAL MARKET .

INADEQUATE FUNDING

- NO PUBLIC SECTOR CDM FINANCING MECHANISMS
- INADEQUATE PRIVATE SECTOR FINANCING.

POSSIBLE BARRIERS

- INADEQUATE AWARENESS ON THE CDM CONCEPT
- WEAK OR NO ACCESS TO THE MARKET
- WHEN MARKET ACCESS IS THERE THE PROJECTS ARE SMALL AND NOT MARKETABLE
- HIGH TRANSACTION COSTS
- BANKS DO NOT PROMOTE ACTIVELY
- DNA AND THE GOVERNMENT DO NOT PLAY PROACTIVE ROLE
- CHAMBERS OF INDUSTRIES DO NOT PLAY ADEQUATE ROLE
- MEDIA DO NOT PLAY A EFFECTIVE ROLE
- CDM HAS BECOME A DONOR PROJECT DRIVEN ISSUE
- THERE IS NO SUSTAINABLE FINANCING FOR CDM PROMOTION
- CAPACITY ISSUES AT ALL LEVELS
- ABSENCE OF CMD DEVELOPMENT STRATEGY

CONSTRAINTS FOR CARBON TRADING

- INSTITUTIONAL CONSTRAINTS
- INFORMATION CONSTRAINTS
- INADEQUATE TECHNICAL CAPACITY
- INVESTMENT RISK
- FINANCING CONSTRAINTS.

WAY FORWARD

- IN ORDER TO AVOID COSTLY, REACTIVE AND UNPLANNED ADAPTATION ACTIONS IN THE FUTURE, IT IS IMPORTANT FOR POLICY MAKERS TO PROACTIVELY MAINSTREAM ADAPTATION CONCERNS INTO DEVELOPMENT PLANNING, AND TO SEEK AND MOBILIZE RESOURCES FOR INVESTMENT IN EXISTING DEVELOPMENT INTERVENTIONS.

- IT IS CLEAR THAT WITHOUT INTERNATIONAL COOPERATION FINANCING ADAPTATION ACTIONS AMONG SAARC MEMBER STATES ARE NOT EFFICIENT.

Theme II. Carbon Sequestration Technologies

Presentation Number 6.

National Forest Inventory and Assessment of Forest Biomass Carbon Stock of India's Forests

Presenter : Mr. Rajesh Kumar, India.

Abstract

India's estimation of Forest Biomass Carbon Stock is based on four information components viz, Forest cover maps, Forest types maps, National Forest Inventory and estimates of missing components of forest biomass. Data requirement, sampling designs and methodologies for each of above components were provided in detail. Integration of the above four components provides the estimates of the above ground biomass carbon, carbon stock in dead wood, carbon stock in litter and Soil organic carbon stock in the forest of India. About 22,000 NFI sample plots which are distributed over different physiographic zones are redistributed into different strata (density & forest type)- post stratification- and analyzed to estimate growing stock of trees per ha of each strata. These volumes are then converted into biomass. By adding the missing components of tree biomass as per new biomass study, the per ha biomass of trees of NFI is expanded.

The biomass of herb, shrub, litter, deadwood are then added to the expanded biomass per ha of each strata which are then converted into carbon by using conversion factors. The data of soil carbon estimated from NFI plots are redistributed like growing stock data into different strata- post sampling stratification- and analysed to estimate carbon per ha of each strata.

The Above steps are repeated for the forest cover strata 1994 and 2004 separately to get spatial distribution of forest carbon grid by grid and then total carbon forest stock for each period is estimated. The superimposition of 1994 forest carbon grids over the 2004 forest carbon grids provides the change in carbon stock over a period of time.

Main Presentation

National Forest Inventory and Assessment of Forest Biomass Carbon Stock of India's Forests

SAARC Symposium on "Carbon Sequestration"
Thimphu, 27-29 November, 2009

Rajesh Kumar
Forest Survey of India, Dehradun
(Ministry of Environment & Forests)

Assessment of Forest Biomass Carbon Stock of India's Forests- various components

- Forest cover maps,
- Forest types maps,
- National Forest Inventory,
- Estimation of missing components of forest biomass, and
- Integrating the above four components to estimate the forest carbon and change

FOREST COVER ASSESSMENT OF THE COUNTRY ON A TWO YEAR CYCLE USING WALL TO WALL APPROACH

Forest Cover and change Assessment

INPUTS

- Satellite data of the entire country from National Remote Sensing Centre (NRSC) IRS ID/IRS-P6 (23.5m spatial resolution)
- SOI Topographic sheets - 1: 50,000

METHODOLOGY

- Digital Interpretation/visual
- Ground Verification
- Minimum map able area is I ha

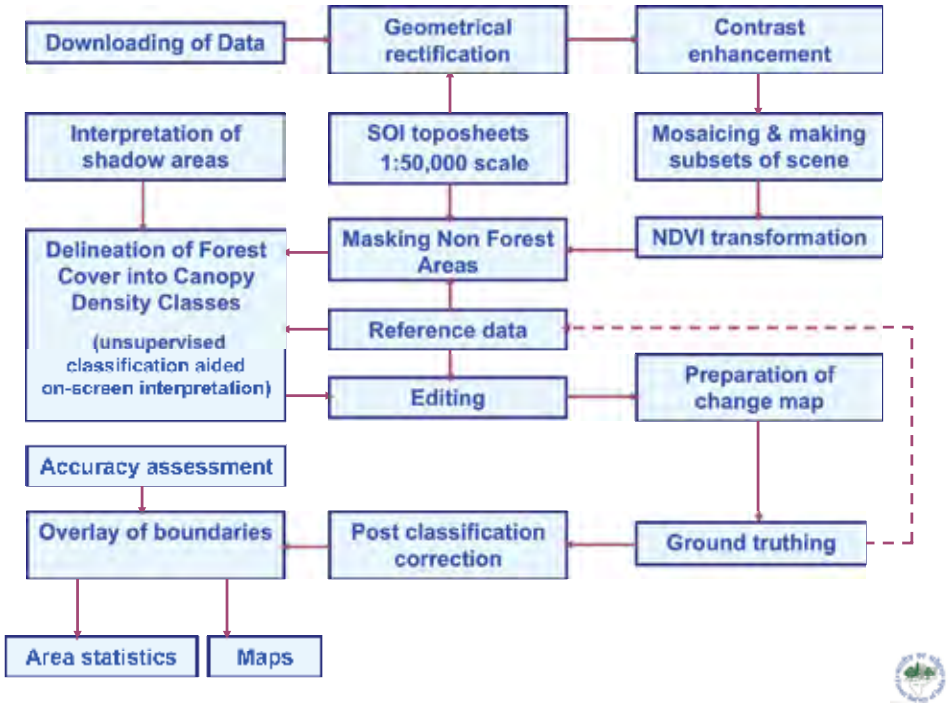
OUTPUTS

Forest cover maps on 1:50,000 scale in digital or hard copy form showing following forest cover classes:

CATEGORY	CANOPY DENSITY
Very Dense Forest	More than 70% canopy
Moderately Dense Forest	40-70%
Open Forest	10-40%
Scrub	Less than 10% in forest lands
Mangroves	

It takes almost two years to complete the assessment process after procureme
satellite imagery

Flow Chart : Forest Cover Mapping



Two decades of Forest Cover Assessment in India

Cycle	Year of Assessment	Satellite & Sensor	Resolution	Scale
I	1987	LANDSAT MSS	80m x 80m	1:1million
II	1989	LANDSAT TM	30m x 30m	1:250,000
III	1991			
IV	1993			
V	1995	IRS-1B LISS-II	36m x 36m	
VI	1997			
VII	1999	IRS-1C LISS-III	23m x 23m	
VIII	2001	IRS-1C/1D LISS-III	23m x 23m	1:50,000
IX	2003	IRS-1D, LISS-III	23m x 23m	1:50,000
X	2005	IRS-P6, LISS-III	23m x 23m	1:50,000

Forest Cover of the Country - 2005

Class	Area (km²)	% of Geo. Area
Forest Cover		
a) Very Dense Forest (more than 70% density)	54,569	1.66
b) Moderately Dense Forest (40% to 70% density)	332,647	10.12
c) Open Forest (10% to 40 % density)	289,872	8.82
Total Forest Cover	677,088	20.60
Non-forest Area		
Scrub	38,475	1.17
Non-forest	2,571,700	78.23
Total Geographic Area	3,287,263	100.00

Mapping of Forest Types of India
(based on Champion & Seth Classification, 1968)

Forest Type-

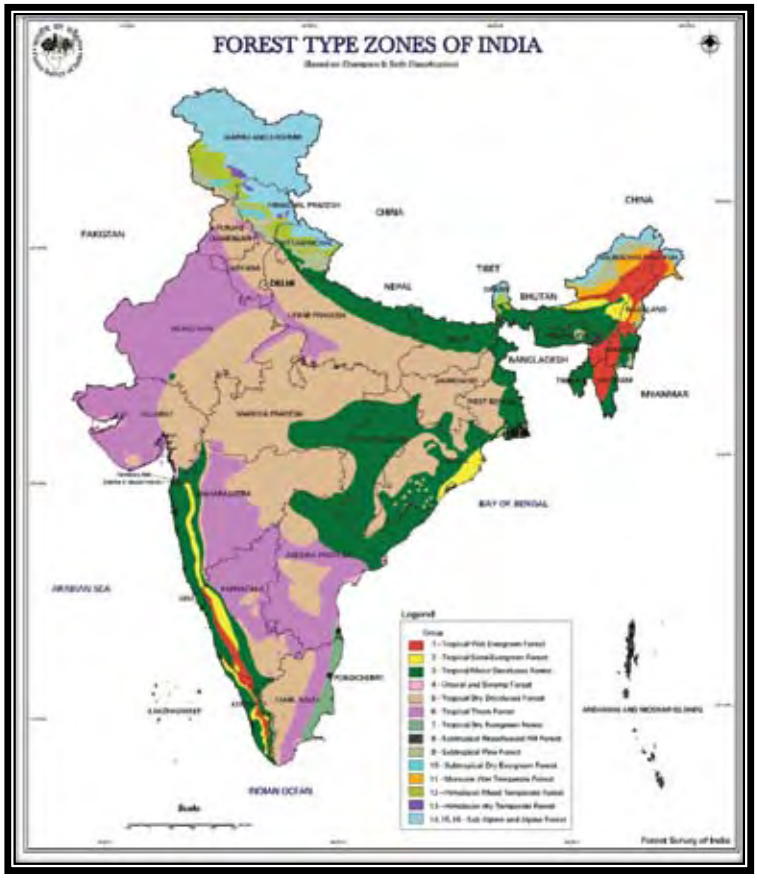
'A unit of vegetation that possesses broad characteristics in physiognomy and structure sufficiently pronounced to permit its differentiation from other such units'

Diverse Conditions

- tropical to temperate
- desert to wettest point on the earth
- vast coast line
- highest mountain peaks
- among largest extent of mangrove forests
- vast alluvial plains
- diverse island ecosystems and marine life

Forest Type Classification by Champion & Seth (1968)

- Most widely used classification system for India's forests
- A revision of 1936 classification given by Champion
- Forests are classified into 6 major groups based on climatic factors
- Major groups divided into 16 type groups based on temperature and moisture conditions
- Type groups have been classified into 200 forest types based on location specific climate and edaphic conditions



Forest Types of India*

MAJOR GROUPS	TYPE GROUPS
Moist Tropical Forests	Group 1-Tropical Wet Evergreen Forests Group 2-Tropical Semi-Evergreen Forests Group 3-Tropical Moist Deciduous Forests Group 4-Littoral And Swamp Forests
Dry Tropical Forests	Group 5-Tropical Dry Deciduous Forests Group 6-Tropical thorn Forests Group 7-Tropical Dry Evergreen Forests
Montane Temperate Forests	Group 8-Southern Subtropical Broadleaved Hill Forests Group 9-Subtropical Pine Forests
Montane Subtropical Forests	Group 10- Subtropical Dry Evergreen Forests Group 11-Montane Wet Temperate Forests Group 12-Himalayan Moist Temperate Forests
Sub Alpine Forests	Group 13-Himalayan Dry Temperate Forests Group 14-Sub Alpine Forests
Alpine Scrub	Group 15-Moist Alpine Scrub Group 16- Dry Alpine Scrub

SUB-GROUPS

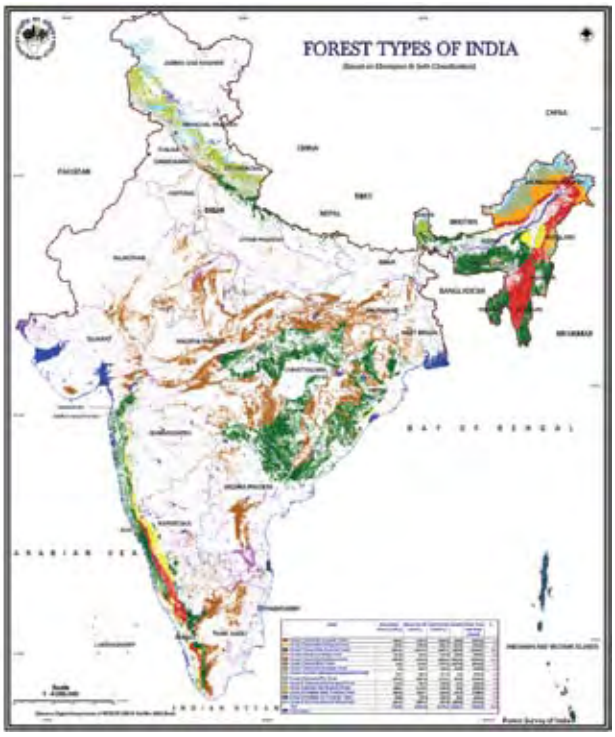
Sub-group- 22 Nos.

TYPES

Types - 200 Nos.

*As per Champion and Seth classification(1968)

Forest Cover of India in Different Forest Type Groups



Group	%
Group 1-Tropical Wet Evergreen Forest	8.75
Group 2-Tropical Semi-Evergreen Forest	3.35
Group 3-Tropical Moist Deciduous Forest	33.83
Group 4-Littoral And Swamp Forest	0.36
Group 5-Tropical Dry Deciduous Forest	30.17
Group 6-Tropical thorn Forest	5.1
Group 7-Tropical Dry Evergreen Forest	0.29
Group 8-Southern Subtropical Broadleaved Hill Forest	0.36
Group 9-Subtropical Pine Forest	5.89
Group 10- Subtropical Dry Evergreen Forest	0.36
Group 11-Montane Wet Temperate Forest	3.45
Group 12-Himalayan Moist Temperate Forest	3.79
Group 13-Himalayan Dry Temperate Forest	0.26
Group 14, 15,16-Sub Alpine and Alpine Forest	3.79
Total	100.00
Water bodies	

National Forest Inventory on a two year cycle using systematic sampling

National Forest Inventory- methodology

- The basic goal is to estimate growing stock of forests and TOF on a two year basis and improve the estimate in subsequent cycles. However,all the districts of the entire country will be covered in 20 years.
- The country has been stratified into 14 physiographic zones
- Ten percent (60) districts are covered in every two year cycle.
- The districts are selected randomly within each zone with probability proportion to size.
- Along with the Forest inventory, vegetation survey of herbs and shrubs is also carried out.
- Measurement of soil and litter carbon is also carried.

15

National Forest Inventory-Methodology --contd

- Topographic sheets of 1:50,000 scale forms the base map for the inventory.
- Firstly, the topographic is divided into grids of 2 ½′ × 2 ½ ′
- Within each such grid, four sub grids of size 1 ¼ ′ × 1 ¼ ′ are laid.
- Two sub grid are then randomly selected.
- Sample plots are then laid in each sub-grid at the intersection of the diagonals.

16

National Forest Inventory-Methodology

Physiographic Zone Map of India

17

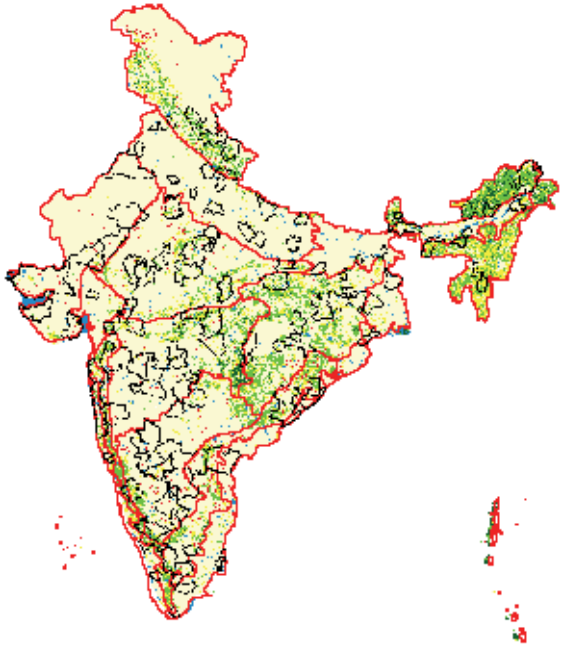
National Forest Inventory- Methodology --contd

Physiographic Zones on Forest Cover

18

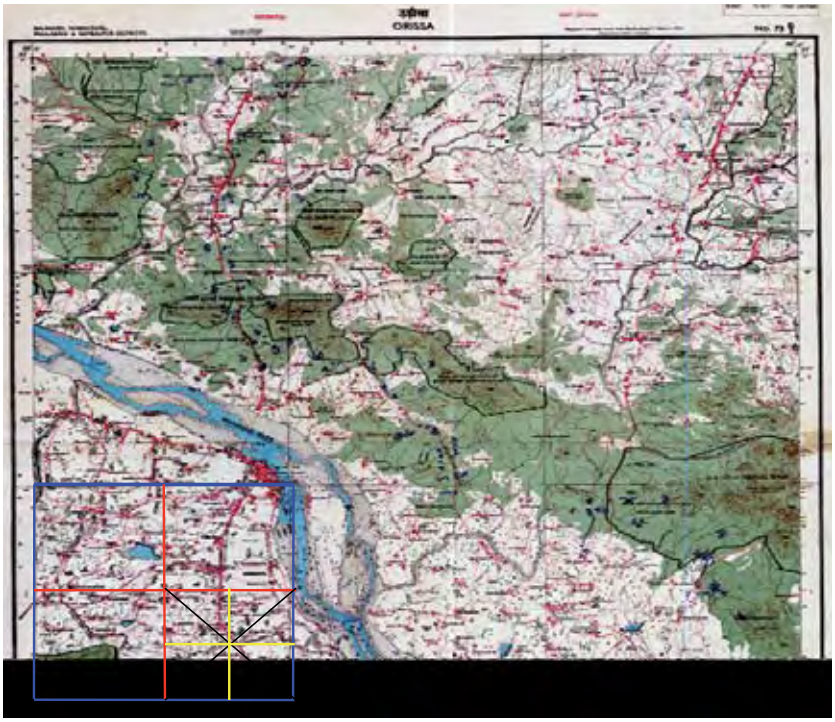
National Forest Inventory – Methodology --contd

Randomly Selected 60 districts



19

Topographic sheets on scale 1:50,000 (15'×15' Grid)
(Base map for starting the field inventory)

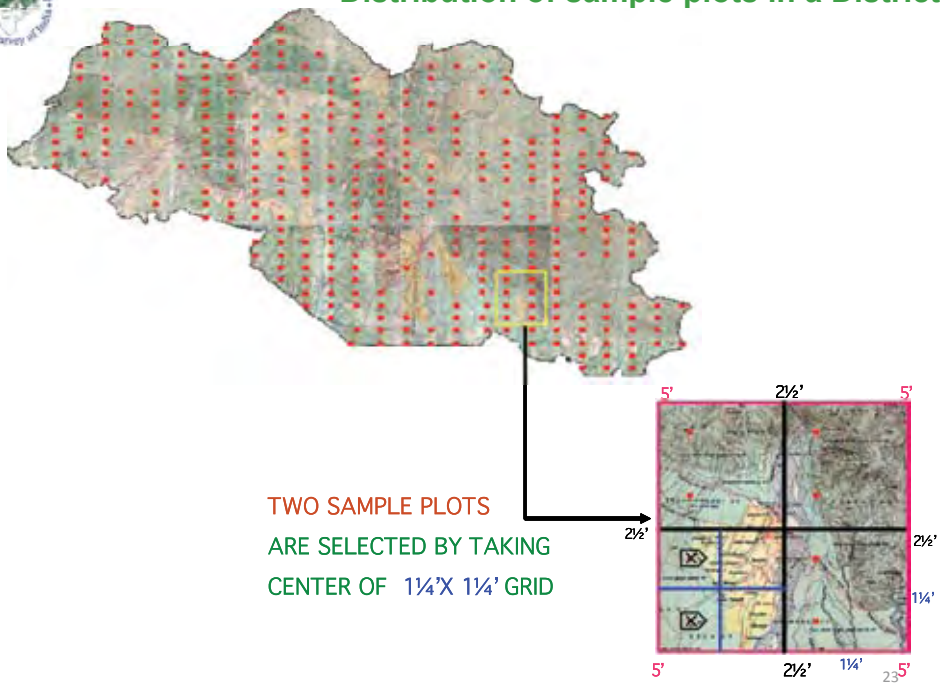


21

Marking of Plots

Out of four Sub-Grids of **1¼'X 1¼'** made from **2½' X 2½'** Grid only **TWO SUB-GRIDS** are randomly selected

Distribution of sample plots in a District

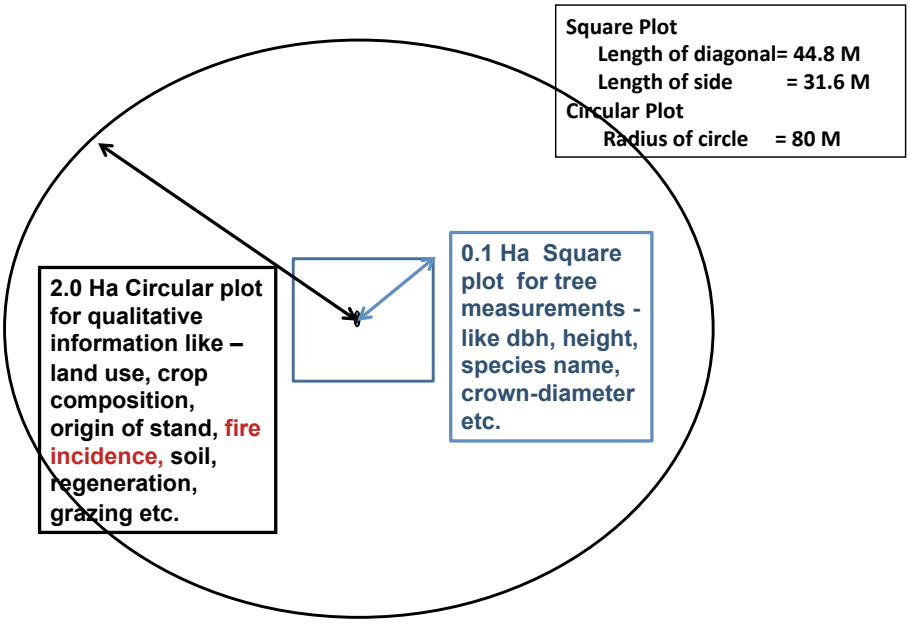


TWO SAMPLE PLOTS
ARE SELECTED BY TAKING
CENTER OF 1¼'X 1¼' GRID

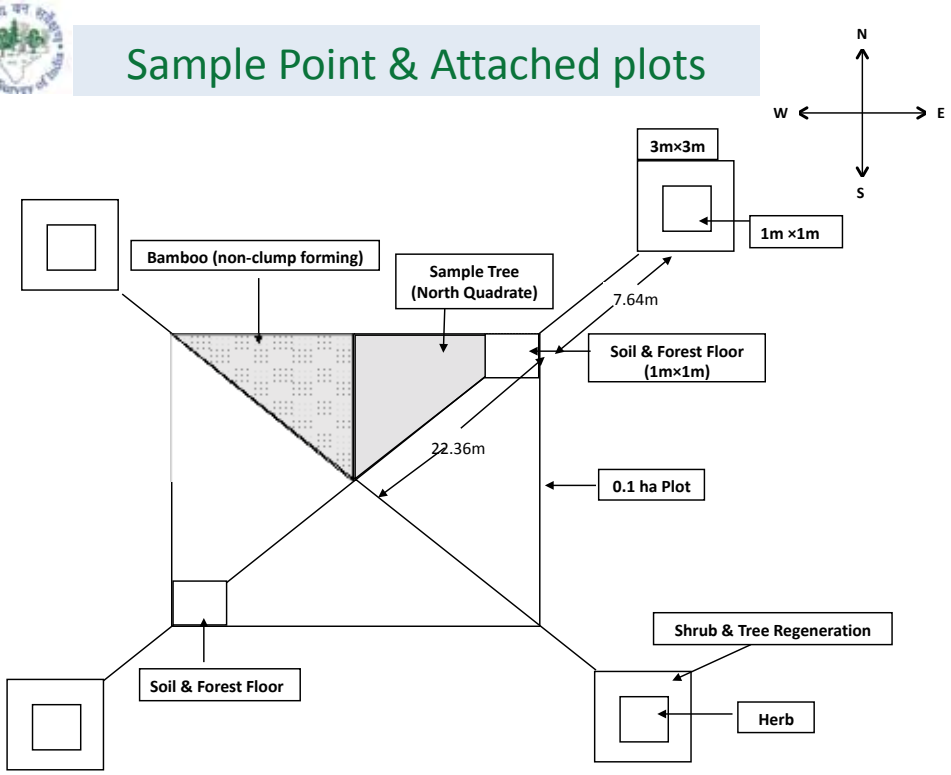
National Forest Inventory- Methodology - contd

- At grid centre a square plot of 0.1 ha is laid out
- Measurement of various parameters like dbh, species name, crown-diameter etc.for all trees above 10 cm dbh are carried out.
- For litter and humus and soil carbon, two sub plots of 1 sq. m are laid out on opposite corners of the inventory plot (0.1 ha).
- Samples of litter and humus and soil are then collected from all the sub-plots.

Data Collection



Sample Point & Attached plots



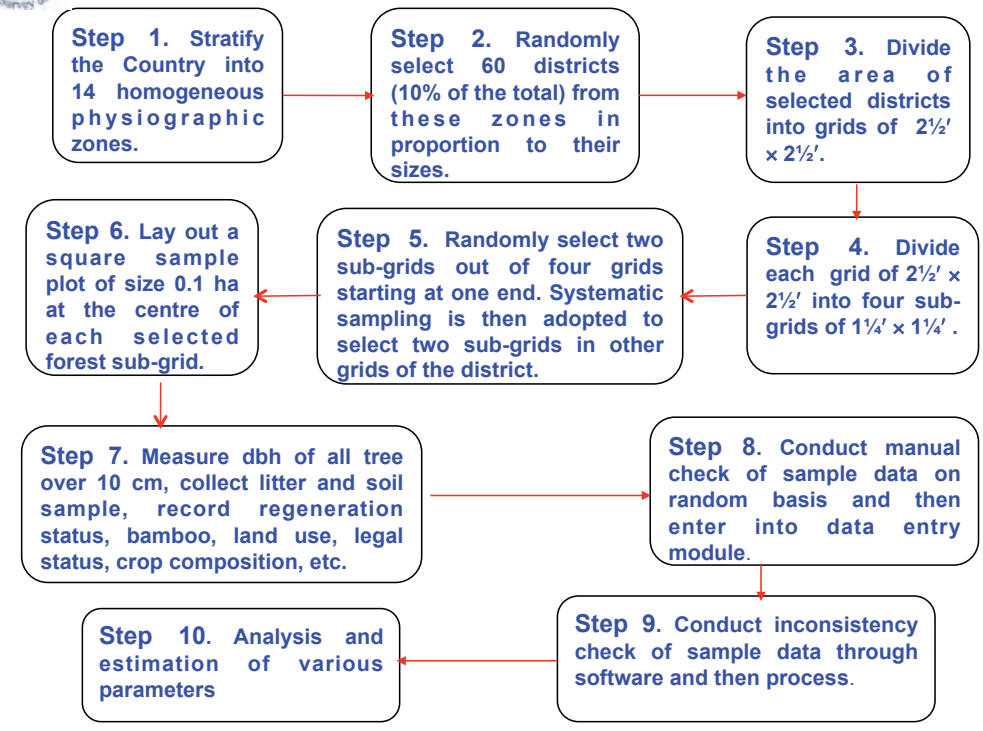
Methodology of NFI -- contd

- Data collection, data entry and data checking is done by the four zonal offices.
- Partial data checking, data processing, analysis and output production is done in the headquarters at Dehradun
- Use of the suitable volume equation is most critical for accurately estimating the volume (biomass) of the tress.
- More than 250 volume equations have been developed by FSI of tree species growing in different physiographic zones are used for estimating growing stock.
- In FSI these volume equations V = f (D, H, F)

  are based on measurement of trees above 10 cm dbh and excludes volume of main stem below 10 cm and branch wood below 5 cm diameter.

27

Schematic diagram of the National Forest Inventory (NFI) in India



Missing components of forest biomass from NFI for REDD and NATCOM II

Missing Components of Forest Biomass

The following biomass components have not been measured till now under NFI

- Volume of stem below 10 cm dia, branches below 5 cm, foliage etc of NFI trees
- Volume of all tress below 10 cm dbh,
- Shrubs, herbs, climbers etc.
- Dead wood
- Litter (branches only)
- Below ground root volume
- Tree bark

New Biomass Study

- FSI launched a new biomass study in August 2008 to measure missing components of forest biomass (not measured by NFI) as per REDD requirement and needed for NATCOM II
- The study has followed two approaches
- (a) measure biomass of herb, shrub, climber, dead wood and litter by laying out sample plots (about 100 plots in each physiographic zone thus in all 1,400 sample plots)
- (b) select 20 to 30 number of trees for each species in different zones cut and measure their biomass to generate biomass equations for:
  - i) Dbh of NFI trees Vs. biomass of branch for trees above 10 cm dbh.
  - ii) dbh/collar dia Vs. total biomass of trees below 10 cm dbh.

Methodology of new Biomass Study

Steps for measuring biomass of herbs, shrubs, dead wood and litter (branch)

- One district is selected from each physiographic zone.
- While selecting districts (already inventoried under NFI) due care is taken so that all major forest types (species) and canopy densities are properly represented.
- About 100 sample which has already been inventoried are revisited in each district. In a stratum based on type and density, analysis of existing volume data shows that about 15 sample plots gives a permissible error of 30%.

Methodology of new Biomass Study

- **Steps for measuring biomass of herbs, shrubs, dead wood and litter (branch)**
  - **At the given geo-coordinates a cluster of two points having three concentric plots at a distance of 30m away from the centre of point are laid out**
  - **The three concentric plots have sizes**
    5mx5m for dead wood,
    3mx3m for shrubs, climbers & litter and
    1mx1m for herbs

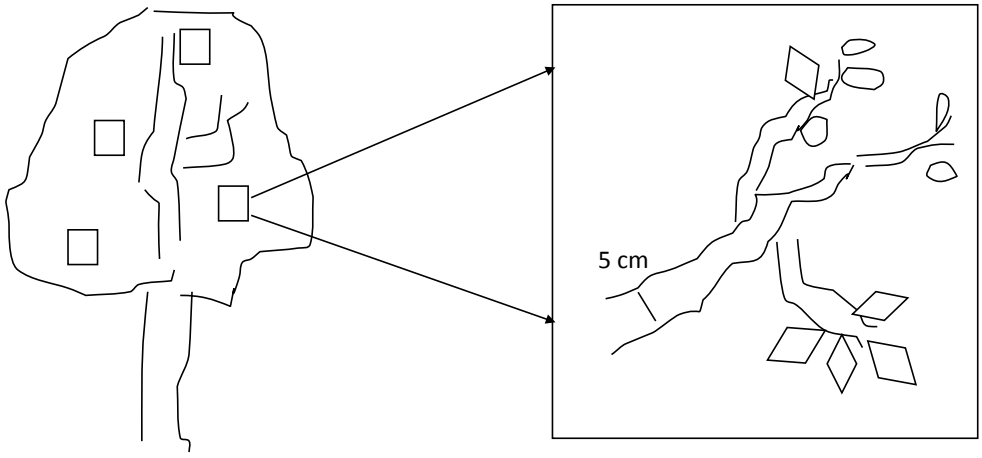
Methodology for new Biomass Study

- **Steps for measuring biomass of stems, branches, foliage, of trees above 10 cm dbh**
  - **a. This exercise is independent of plots and is being carried out while approaching for laying concentric plots.**
  - **b. Only about 20 important tree species in each physiographic zone are covered in this exercise.**
  - **c. In each dia-class 3 normal trees are selected for measurement.**

Methodology for new Biomass Study

- **Steps for biomass of branches of trees above 10 cm dbh**
  - d. Dbh, crown width, crown length and shape of the crown of the selected trees are recorded.
  - e. 4 windows of 1mx1m dimension are opened in all the four directions.
  - f. All materials is felled up to 5 cm dia of branches
  - g. Weights of twigs, leaves, fruits, flowers are separately recorded.
  - h. On the basis of surface area and biomass of 4 sq. meter, biomass of branches of the trees is estimated.

Methodology for new Biomass Study



4 Windows of 1mx1m for measuring biomass of branches

Methodology of new Biomass Study

- **Steps for biomass of trees below 10cm dbh:**
  - **This information is also collected for same 20 important tree species.**
  - **For each dbh/collar diameter class, three normal seedlings/saplings/poles are selected and felled.**
  - **Weights of wood, twigs, leaves, flowers and fruits are recorded separately.**
  - **From this, the total biomass of each trees is calculated**

Estimation of forest carbon of India's forests by integrating, forest cover, forest type maps, national forest inventory data and missing components of forest biomass data.

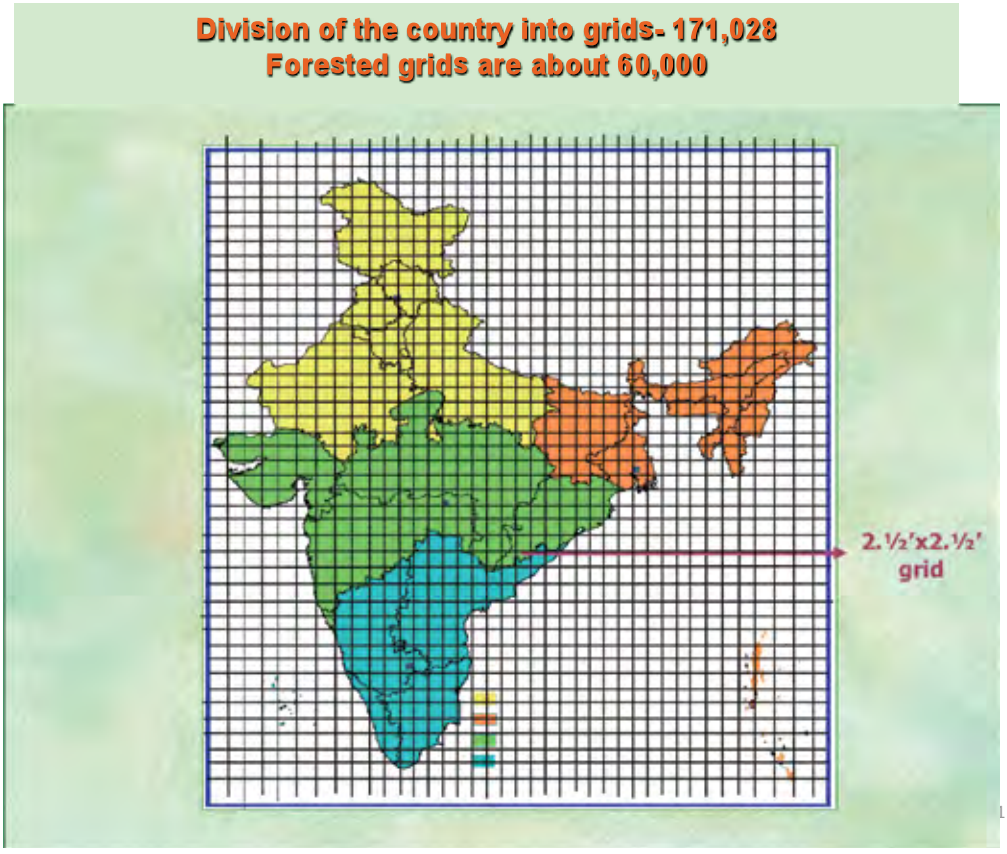
Estimation of Carbon stock change in India's Forests

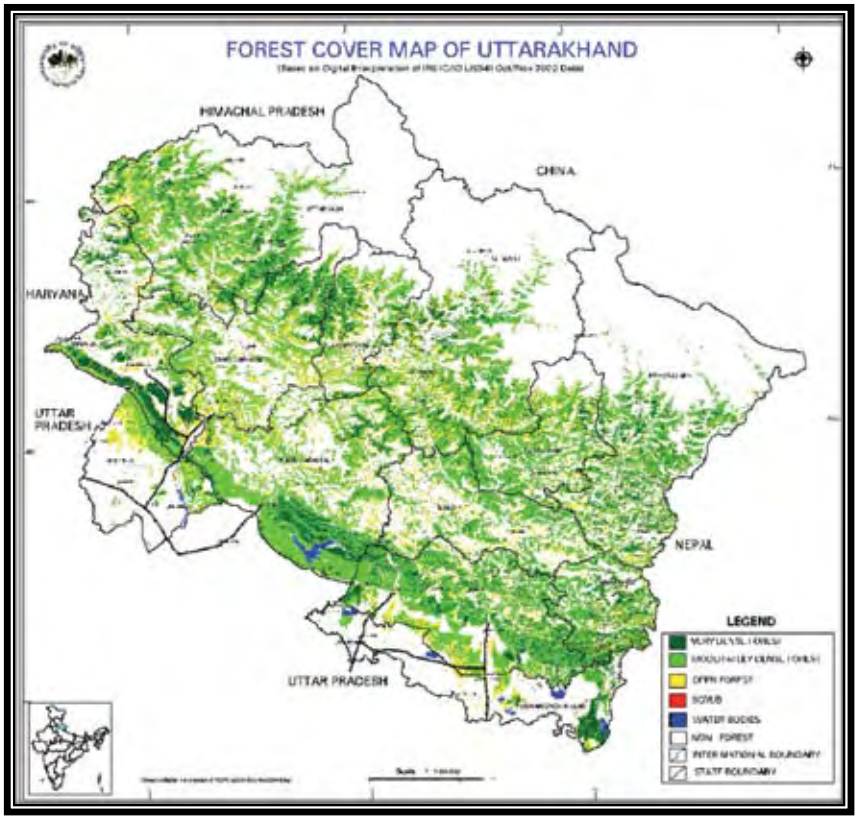
FSI is estimating following Carbon pools in India's forest

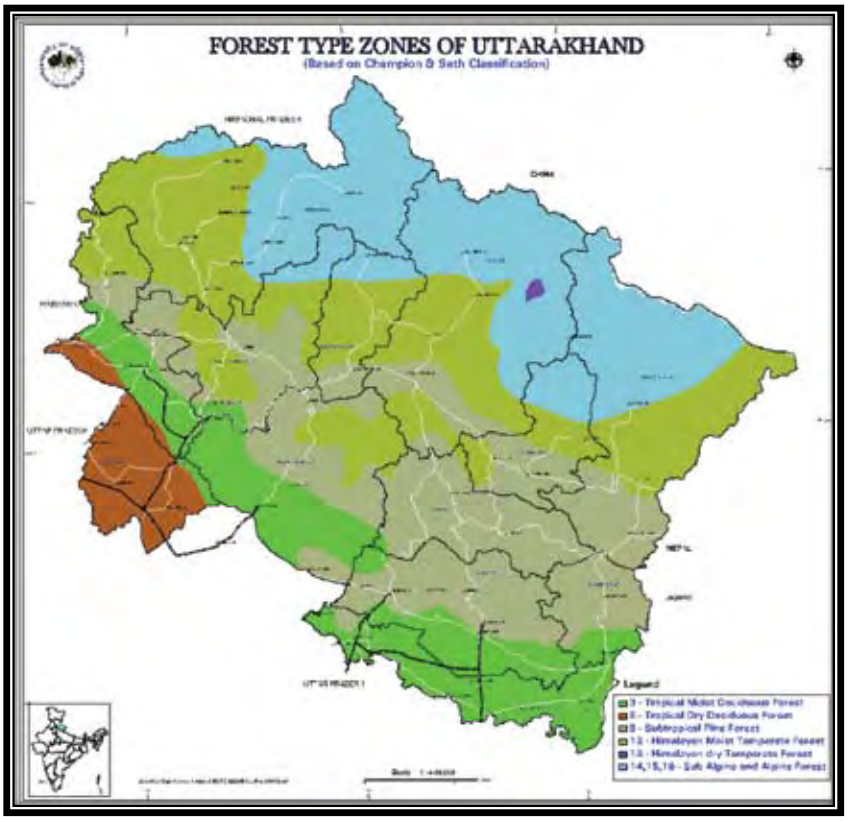
- Above ground biomass (complete)
- Deadwood
- Litter
- Soil organic carbon

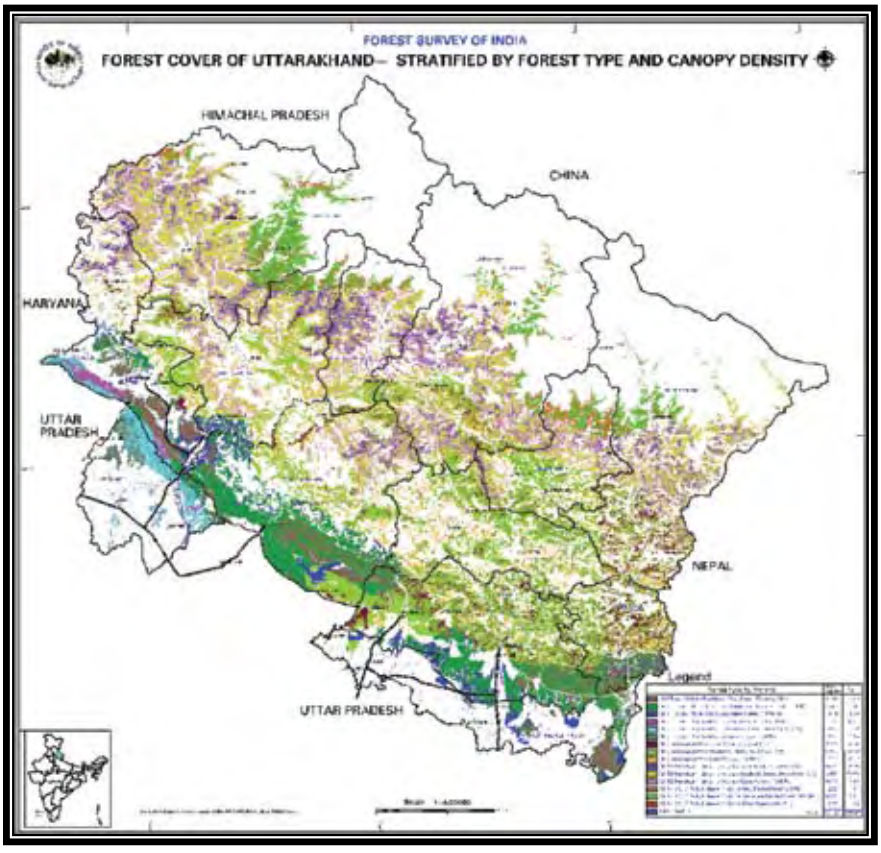
Estimation of Carbon stock change in India's Forests

- Forest type maps are overlaid on the existing forest cover maps of the country classified into 3 canopy density classes in digital form for 1994 and 2004 separately
- Overlay stratifies the forests into canopy density and forest type strata (about 30 in all) and provides the area under each strata.
- Then country wide spatial data base of about 60, 000 grids of size 2½' x 2½' in GIS is overlaid and given unique identification.
- Attach each forested polygon within grid with its attributes density, forest type, location, soil and climatic details.

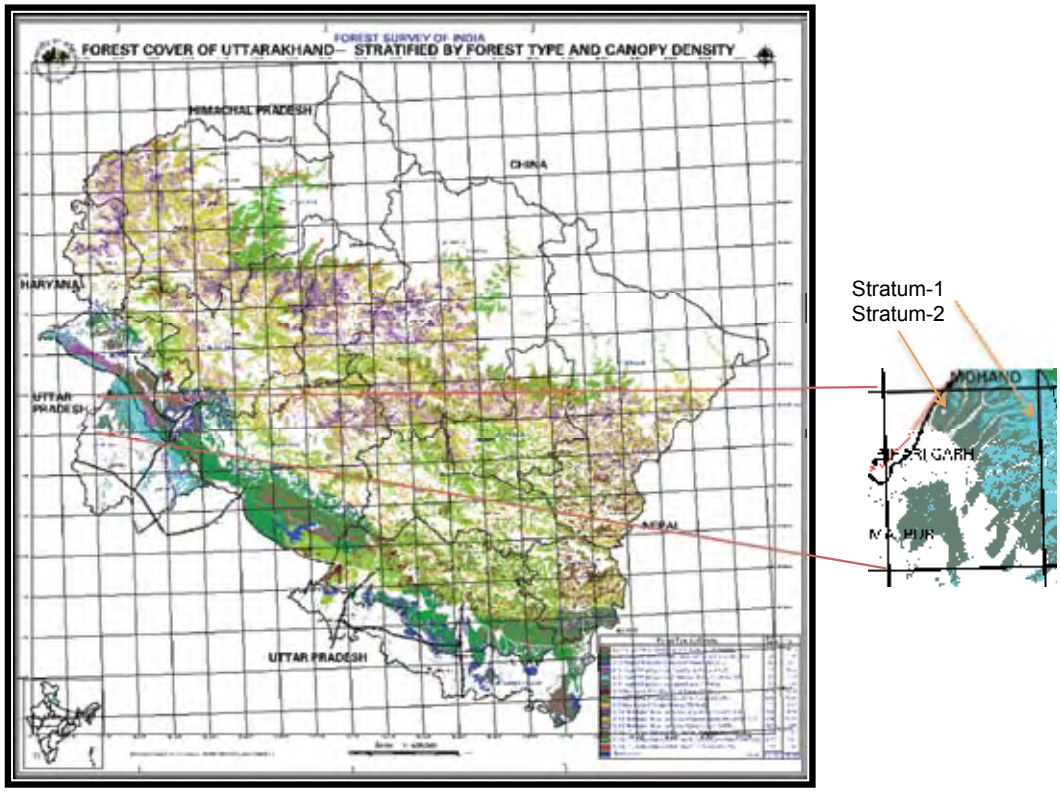

Division of the country into grids- 171,028
Forested grids are about 60,000
2.½'x2.½' grid


FOREST COVER MAP OF UTTARAKHAND
HIMACHAL PRADESH
CHINA
HARYANA
UTTAR PRADESH
NEPAL
UTTAR PRADESH
LEGEND


FOREST TYPE ZONES OF UTTARAKHAND
(Based on Champion & Seth Classification)
CHINA
NEPAL
Legend


FOREST SURVEY OF INDIA
FOREST COVER OF UTTARAKHAND– STRATIFIED BY FOREST TYPE AND CANOPY DENSITY
HIMACHAL PRADESH
CHINA
HARYANA
UTTAR PRADESH
NEPAL
UTTAR PRADESH
Legend

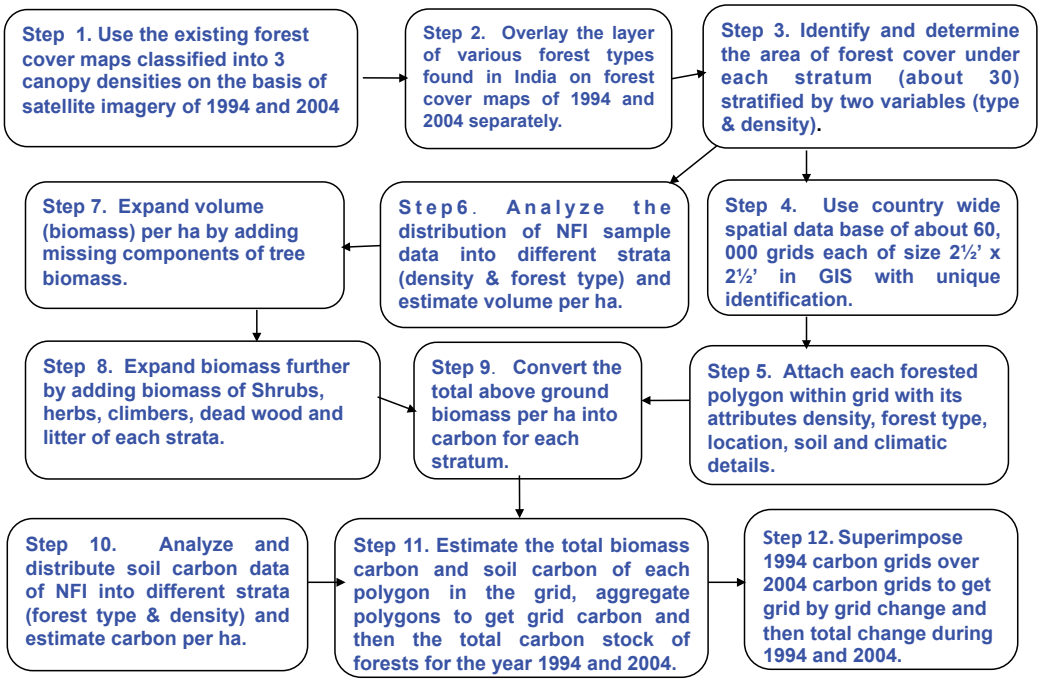
Forest Type by Density	Area (Sqkm)	%
Gr3 Tropical Moist Deciduous Very Dense Forest (>70%)	1141	4.67
Gr 3 Tropical Moist Deciduous Moderate Dense Forest (40-70%)	2520	10.31
Gr 3 Tropical Moist Deciduous Open Forest (10-40%)	914	3.74
Gr 5 Tropical Dry Deciduous Very Dense Forest (>70%)	133	0.54
Gr 5 Tropical Dry Deciduous Moderate Dense Forest (40-70%)	387	1.58
Gr 5 Tropical Dry Deciduous Open Forest (10-40%)	278	1.14
Gr 9 Subtropical Pine Very Dense Forest (>70%)	1160	4.75
Gr 9 Subtropical Pine Moderate Dense Forest (40-70%)	5757	23.55
Gr 9 Subtropical Pine Open Forest (10-40%)	2118	8.67
Gr 12 Himalayan Moist Temperate Very Dense Forest (>70%)	1489	6.09
Gr 12 Himalayan Moist Temperate Moderate Dense Forest (40-70%)	4949	20.25
Gr 12 Himalayan Moist Temperate Open Forest (10-40%)	1810	7.41
Gr 14,15,16 Sub Alpine and Alpine Very Dense Forest (>70%)	255	1.04
Gr 14,15,16 Sub Alpine and Alpine Moderate Dense Forest (40-70%)	1257	5.14
Gr 14,15,16 Sub Alpine and Alpine Open Forest (10-40%)	275	1.12
Water bodies Total	24442	100.00



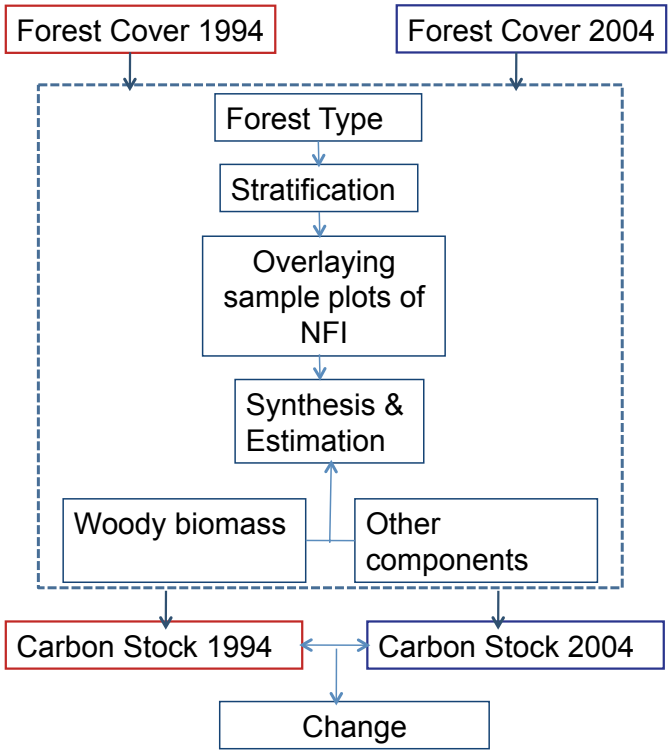
Estimation of Carbon stock change in India's Forests

- About 22, 000 NFI sample plots distributed over different physiographic zones are redistributed into different strata (density & forest type)- post sampling stratification- and analyzed to estimate growing stock of trees per ha of each strata.
- These volumes are then converted into biomass
- By adding missing components of tree biomass as per new biomass study the per ha biomass of trees of NFI is expanded.
- The biomass of herb, shrub, litter, deadwood are then added to expanded to the biomass per ha of each strata which are then converted into carbon by using conversion factors.
- The data of soil carbon estimated from NFI plots are redistributed like growing stock data into different strata- post sampling stratification- and analysed to estimate carbon per ha of each strata.
- The Above steps are repeated for the forest cover strata 1994 and 2004 separately to get spatial distribution of forest carbon grid by grid and then total carbon forest stock for each period is estimated.
- Superimposition of 1994 over 2004 forest carbon grids provides the change.

Schematic diagram of Estimation of Carbon stock change in India's Forests



Approach



Preliminary estimates of Biomass and Carbon stock in India's Forests Components

Components		Biomass (million tonnes)	Carbon (million tonnes)
A.	**Above Ground**		
	Woody biomass of trees above 10 cm dbh	3076	1507
	biomass of small wood of trees above 10 cm dbh	872	410
	biomass of foliage of trees above 10 cm dbh	53	24
	biomass of small wood of trees below 10 cm dbh	132	61
	biomass of foliage of trees below 10 cm dbh	6	2
	Biomass of shrubs	27	12
	Biomass of climbers	14	6
	Biomass of herbs	3	1
Total Above Ground		**4182**	**2023**
B.	**Below ground**	**1319**	**638**
	total live biomass	**5501**	**2661**
C.	**Deadwood**	**56**	**26**
D.	**Litter**	**-**	**80**
E.	**Soil Organic Carbon**	**-**	**3972**
	Total		**6740**

Presentation Number 7.

Concept of carbon sequestration technologies, various, carbon sequestration technologies available within the SAARC region

Presentr : Ms. Thevaky Markandu, Sri Lanka.

Abstract

Carbon sequestration is a way to reduce greenhouse gas emissions. It complements two other major approaches for greenhouse gas reduction, namely, improving energy efficiency and increasing use of non-carbon energy sources.

Carbon sequestration technology development is to develop technologies to capture, separate, and store carbon dioxide (CO_2) in order to reduce green-house gas emissions without adversely influencing energy use or hindering economic growth.

Climate change considerations should be incorporated into project design and implementation, specifically by working to decrease emissions. The direction of technology transfer should be based on

- Technologies that reduce GHGs or enhance sink.
- Technologies that adapt to climate change impact.

Main Presentation

What Is Carbon Sequestration?

- Carbon sequestration is a way to reduce greenhouse gas emissions

It complements two other major approaches for greenhouse gas reduction, namely improving energy efficiency and increasing use of non-carbon energy sources.

Carbon Sequestration Options

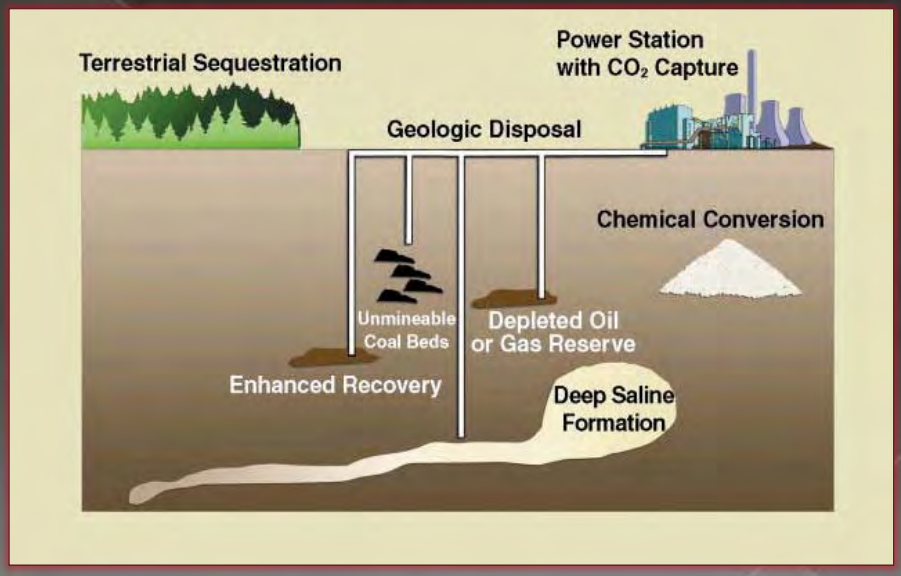


Image source:
http://anneminard.com/wp/wp-content/uploads/2009/05/carbon-sequestration.jpg

The Mitigation Of Carbon Footprints

- The mitigation of carbon footprints through the development of alternative projects, such as solar or wind energy or reforestation, represents one way of reducing a carbon footprint.

Carbon Sequestration Technology Development

- Develop technologies to capture, separate, and store carbon dioxide (CO_2) in order to reduce green-house gas emissions without adversely influencing energy use or hindering economic growth.

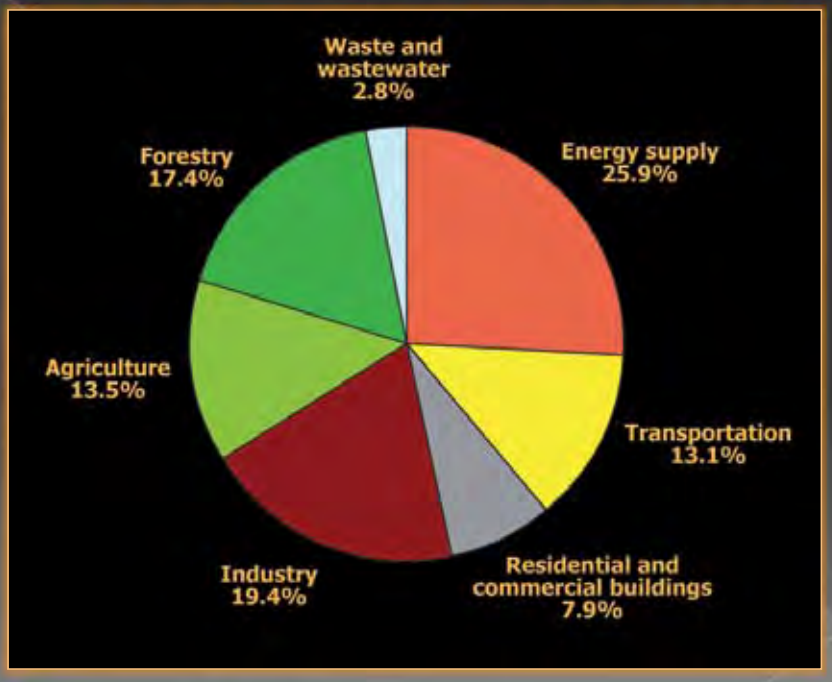
The recommended UNFCCC Framework For Technology Transfer

- Technology needs and needs assessment
- Technology information
- Enabling environments
- Capacity building
- Mechanisms for technology transfer.

Direction of Technology Transfer In Sri Lanka

- Technologies that reduce GHGs or enhance sink
- Technologies that adapt to climate change impact.

GLOBAL ANTHROPOGENIC GAS EMISSIONS



Source:
IPCC Fourth Assessment Report.

SEQUESTERING CARBON IN AGRICULTURE SECTOR

- Promoting conservation of Agriculture
- Rehabilitation and restoration of degraded grasslands and cultivated organic soil
- Sustainable forest management, reforestation and afforestation.

REDUCING EMISSIONS
Reducing Agricultural and forestry emissions of CO_2
Reducing Agricultural emissions of CH_4 and NO_2

Technology for Energy Sector for Greenhouse Gas Emission Reduction in Sri Lanka

TECHNOLOGIES AVAILABLE:

- Alternative Energy Options
- Bio Refinery.

Transport Infrastructure

- Climate change considerations will be incorporated into project design and implementation, specifically by working to decrease emissions during construction and make travel more efficient.

Advanced Technology

- Better utilization of raw materials
- Higher productivity resulting in lower cost of production
- Quality improvement of product
- Quality improvement service
- Upgrading of technical skills
- Improving competitiveness.

Presentation Number 8.

Enhancing the technology to increase the rate of carbon sequestration relevant for SAARC region

Presenter : Ms. Thevaky Markandu, Sri Lanka.

Abstract

Either high or rising emissions in South Asia mean there are vast opportunities to invest in emissions-reduction measures which would include in energy efficiency, fuel switching, renewable energy, industrial processes, waste-management systems, and land restoration. These measures offer cost-effective abatement options attractive for carbon financing.

There are two main types of sequestration namely:

- Direct sequestration, where CO_2 is removed from energy systems (such as power plants and oil refineries) and is permanently stored or converted to value added products, and
- Indirect sequestration, where CO_2 is removed from the atmosphere by enhanced natural processes.

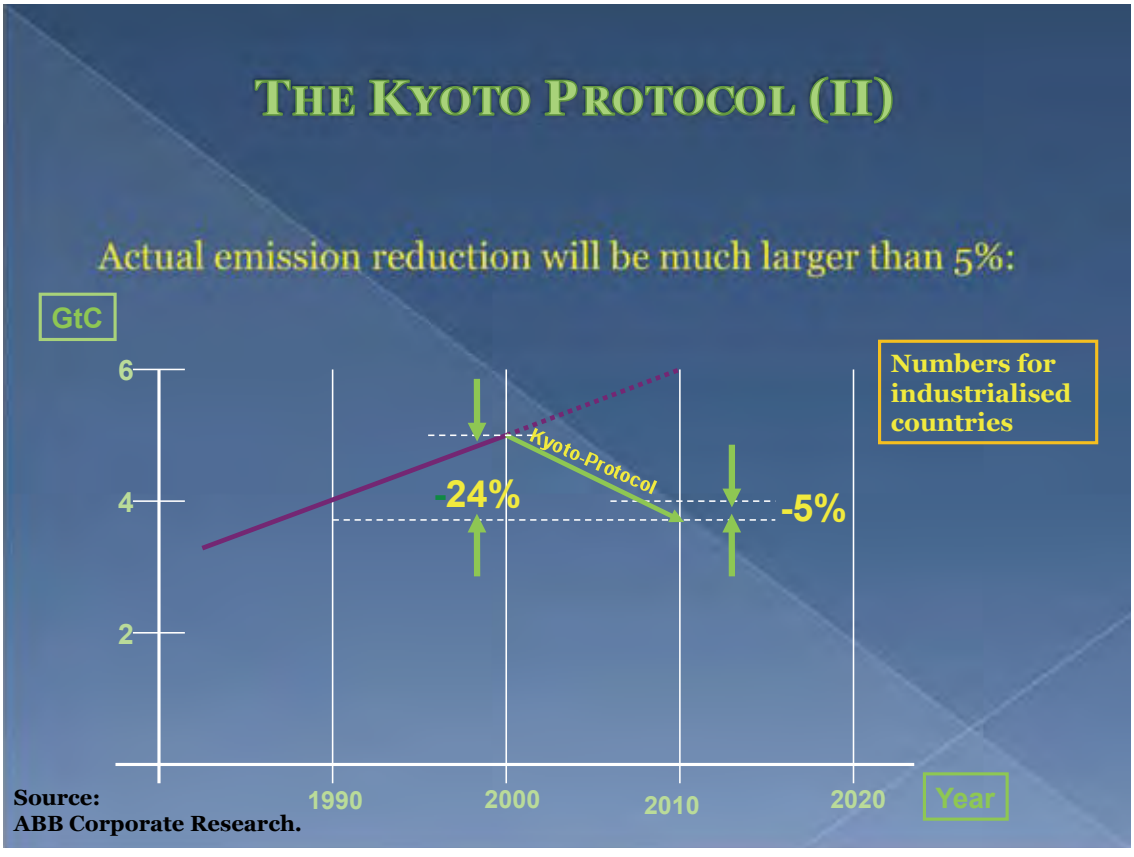
Technology mitigation is deemed necessary to enhancing the technology to increase the rate of carbon sequestration relevant for SAARC region. Therefore its necessary to :

- Review technology options and resources that are applicable to GHG mitigation in the sectors identified.
- To help choose the technologies, set clear criteria such as ability to mitigate GHG emissions, ability to contribute to development goals, market potential, access / availability of technologies etc.
- Using expert judgment develop a refined list of sectors that offer strategic mitigation potential. Technologies with cross - sectoral application need to be noted.

Each and every technology for reducing emissions of GHGs faces some form of constraint to its widespread adoption and needs to be tackled on a case by case basis.

To be successful, the techniques and practices to sequester carbon must meet the following requirements to be effective and cost-competitive, provide stable, long-term storage, and be environmentally benign.

Main Presentation



Types Of Sequestration

- There are two main types of sequestration:
  - Direct sequestration, where CO_2 is removed from energy systems (such as power plants and oil refineries) and is permanently stored or converted to value added products, and
  - Indirect sequestration, where CO_2 is removed from the atmosphere by enhanced natural processes.

Carbon Trade Development

- High and rising emissions in South Asia mean there are vast opportunities to invest in emissions-reduction measures
- Including in energy efficiency, fuel switching, renewable energy, industrial processes, waste-management systems, and land restoration.
- These measures offer cost-effective abatement options attractive for carbon financing.

PROMOTING LOW-CARBON GROWTH MITIGATION

- Projects focusing on improved energy efficiency and clean energy, transport (including non-fuel aspects such as better urban planning), improved waste management systems, and land restoration, offer cost-effective opportunities.

PROMOTING LOW-CARBON GROWTH

- Collaboration with the private sector will enable further development, acquisition, deployment, and diffusion of technologies.

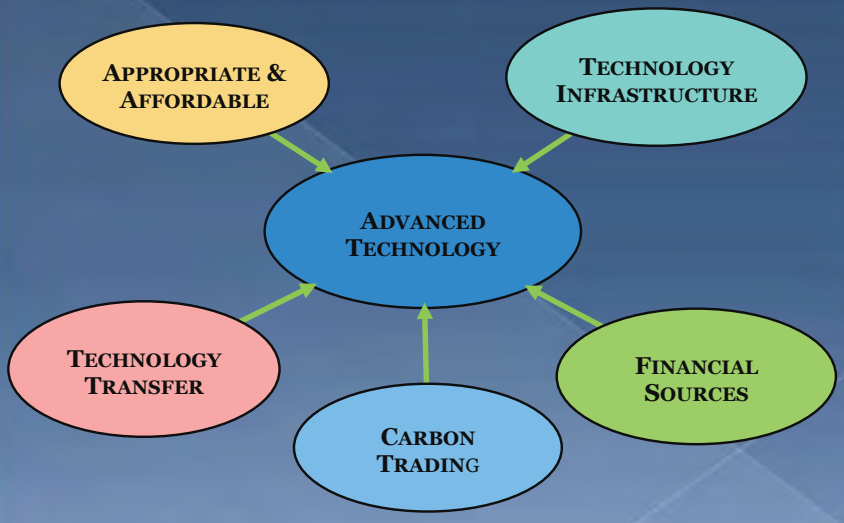
TECHNOLOGY MITIGATION

- Review technology options and resources that are applicable to GHG mitigation in the sectors identified.
- To help choose the technologies, set clear criteria such as ability to mitigate GHG emissions, ability to contribute to development goals, market potential, access /availability of technologies etc.
- Using expert judgment develop a refined list of sectors that offer strategic mitigation potential. Technologies with cross - sectoral application need to be noted.

CONSTRAINT

- Every technology for reducing emissions of GHGs faces some form of constraint to its widespread adoption and needs to be tackled on a case by case basis.

ENHANCING THE TECHNOLOGY



TECHNOLOGY NEED - SRI LANKA

- Agriculture Sector
- Land Use, Land Use Change and Forestry (LULUCF) Sector
- Water Resources Sector
- Energy Sector
- Transport Sector
- Industry Sector
- Waste Management Sector.

Prioritize Sectors and Select Key Technologies

- Prioritization should be based on:

  - The extent to which GHG emissions can be reduced (mitigation) and the extent to which resilience can be enhanced (adaptation)
  - The extent to which the technologies desired are available, ease of transfer, scope for partnerships, extent to which technological capabilities can be built through the transfer, resources available, extent to which institutional capacity can be built etc.
  - The extent to which institutional infrastructure and policy support are available or can easily be introduced to develop, transfer, and utilize the technology.

SUCCESSFUL TECHNIQUES

- To be successful, the techniques and practices to sequester carbon must meet the following requirements:

  - be effective and cost-competitive
  - provide stable, long-term storage, and
  - be environmentally benign.

Public-Private Partnership

- Instead of trying to find common ground and exploiting their different strengths, public and private organizations involved in grass root-level delivery of information and technologies, tend to ignore each other and competitively push their own interests.

Presentation Number 9.

Sampling Design for Forest Inventory in Inaccessible Areas using Remote Sensing and GIS

Presenter : Mr. Rajesh Kumar, India.

Abstract

Sampling of forest areas in very difficult or inaccessible areas is crucial to calculate the growing stock of forests which is then useful to calculate Forest Biomass Carbon Stock or carbon sequestration potential the participants took interest to know the techniques for Forest Inventory in Inaccessible Areas using Remote Sensing and GIS and the sampling designs used for such activities. The participants were explained on the technicalities on the above topic.

Due to specific geographic conditions, heavy forested area, difficult hilly terrain, lack of proper road network and inaccessibility of many sample points forest inventory becomes time consuming and costly and in such situation the proposed methodology can be used without compromising the precision. Satellite data are used to classify the forest cover of the area of interest into three category, 'very dense forest', 'moderately dense forest' and 'open forest'. Using GIS, digital elevation model is created at an interval of 300 m. Using this DEM three elevation classes are then created viz 0-900m, 900-2400m and 2400m and above. Using these two criteria 9 strata are formed. Road network is degitised and two buffers are created along the road one at 700m and other at 2000m. The area between 700 to 2000m is used for sample points selection as it represents the whole area. One cluster is of 5 sample plots of 0.1 hectare, 1 at centre and 4 in all directions at 200 meter from the centre of plot is created. 30 clusters (150 points) are proportionately distributed in 9 different strata. Data is collected, entered and analysed to obtain growing stock. Comparing with earlier results, the precision is found better.

Mountainous country like Bhutan can use this methodology for estimation of growing stock and in turn biomass carbon.

Main Presentation

Sampling Design for Forest Inventory in Inaccessible Areas using Remote Sensing and GIS

Special sampling design for EH

- Due to specific geographic conditions
- Heavy forested area
- Difficult hilly terrain
- Lack of proper road network
- inaccessibility of many sample points
- Stratified sampling permits different sampling design in different strata

Peculiarity of Eastern Himalaya

- Generally districts in EH has 300 such sample points.
- Takes on an average 3 days to reach sample points.
- Difficult to do within prescribed time.
- Remote Sensing & GIS employed.

Objectives:-

- ***Reduction in time to carry out Forest Inventory.***

  Achievement of desired level of precision.

  Easy accessibility of sample points.

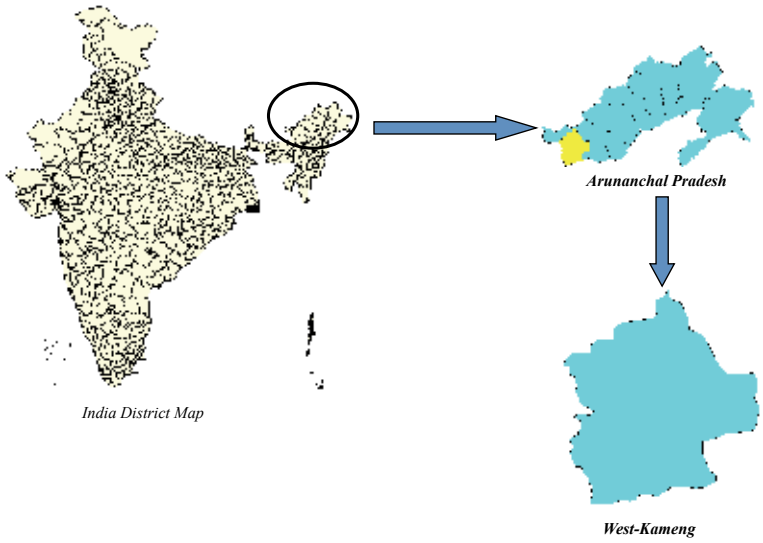
Data Used

- IRS 1D\LISS-III Satellite Imagery.
- SOI Toposheets (Scale 1:50,000)
- Contour Map of District at an interval of 300m
- Road network Map of District

Software Used

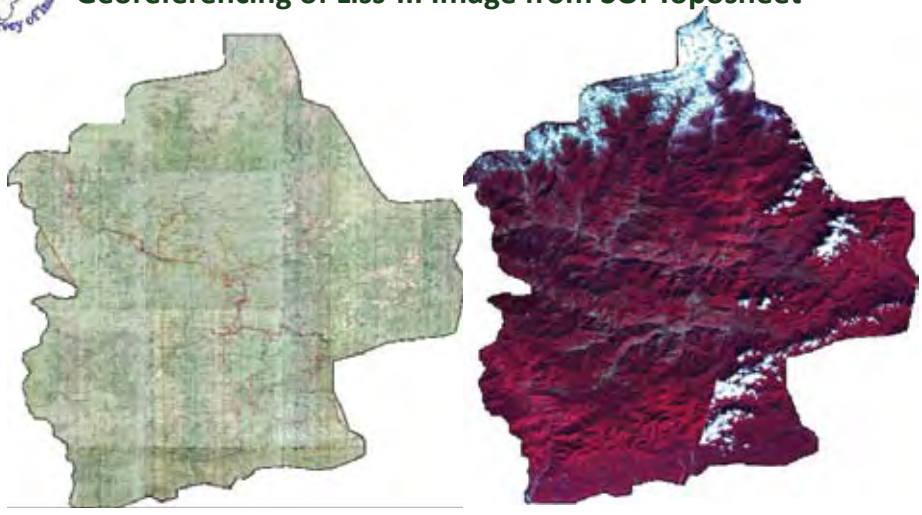
- Erdas Imagine 8.6 for DIP.
- Arc GIS for Analysis.
- Windows XP

Selection of District from India Map



India District Map

Georeferencing of Liss-III Image from SOI Toposheet



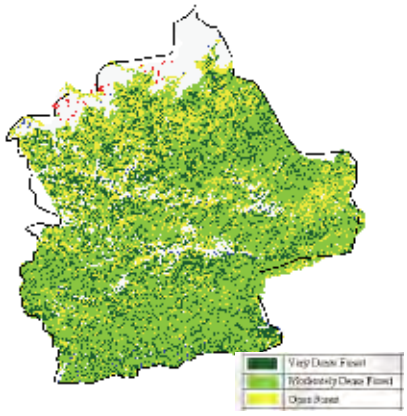
Mosaic and subsetted Toposheets of West Kameng

IRS 1D/ LISS-III Satellite Imagery

Preparation of Thematic Map by classifying Liss-III image into three forest density classes.

1. Closed Forest (70% above)
2. Moderate Forest (40%-70%)
3. Open Forest (Below 40%)

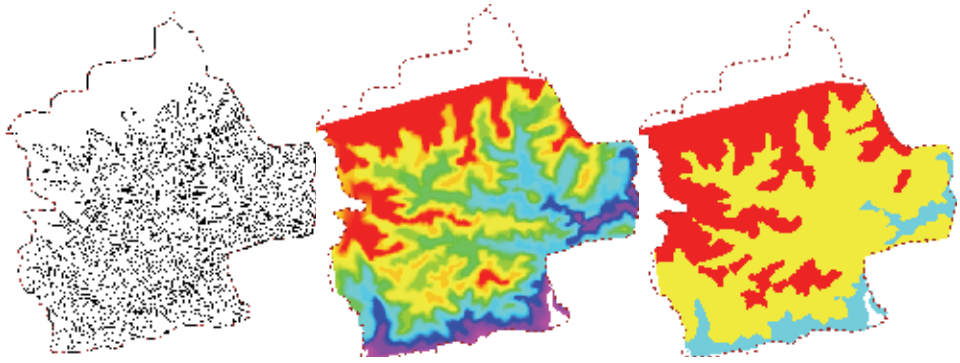
IRS 1D/ LISS-III Satellite Imagery



Classified Map of West-Kameng

Creation of Digital Elevation Model on the basis of contours at a distance of 300m from Survey of India Toposheet.

Distribution of three altitudinal zones by recoding Digital Elevation Model.

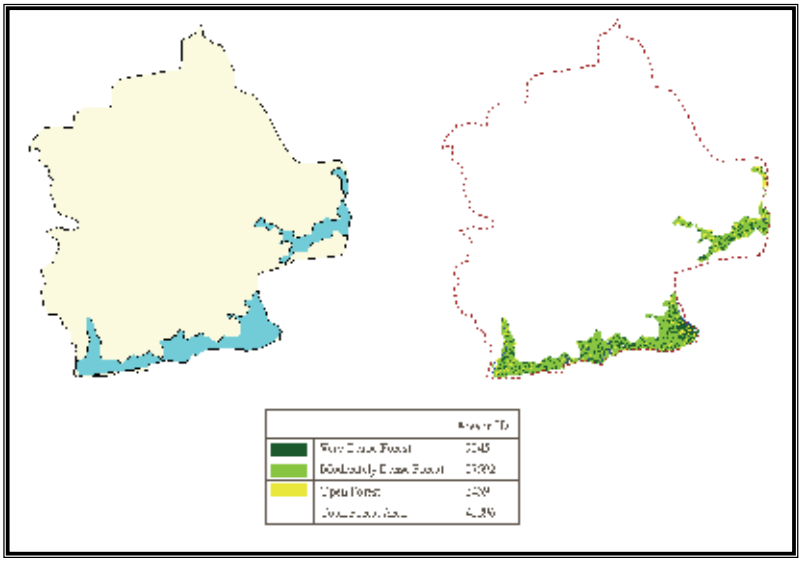


Contour Map of West Kameng with contour interval of 300m.

Digital Elevation Map of West Kameng

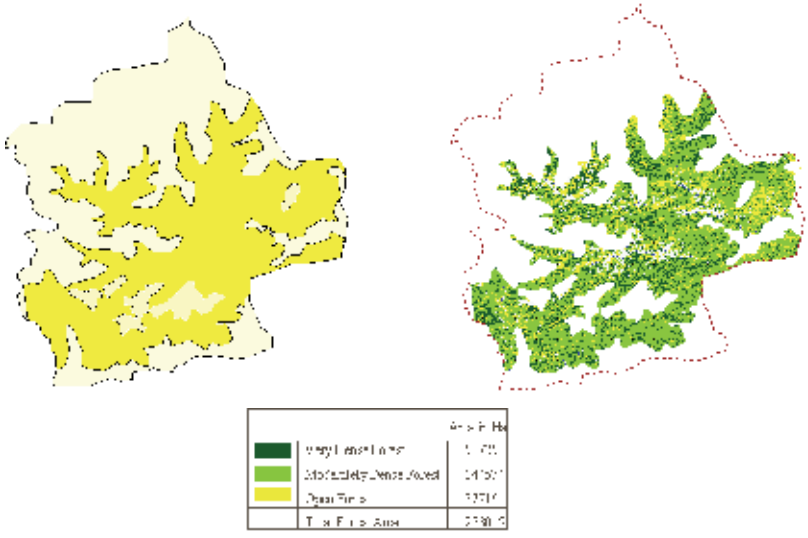
Total area falling in 0-900m altitude zone is 40896 hectares.

Out of which 9845 ha. falls in Very Dense Forest, 27592 ha. in Moderately Dense Forest and 3459 ha. in Open Forest.



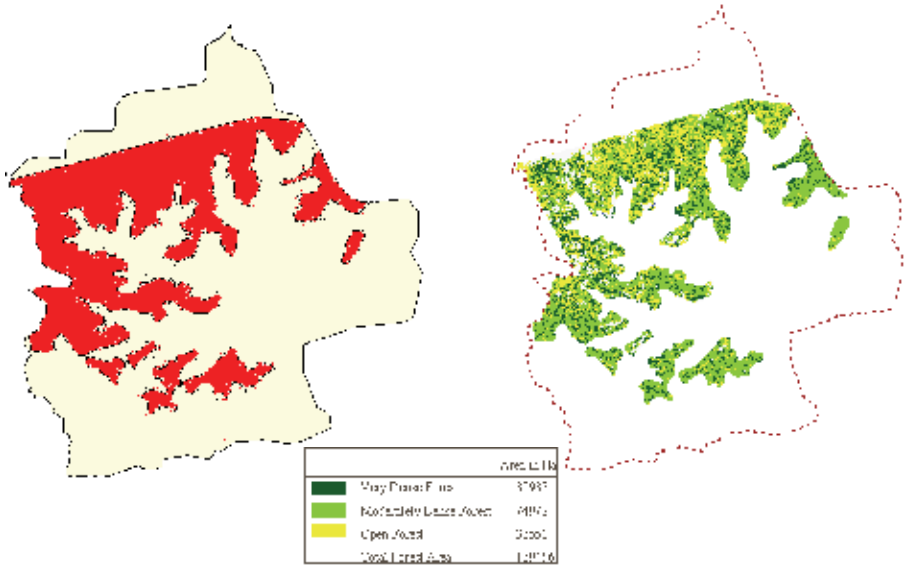
Total area falling in 900m-2400m altitude zone is 233015 hectares.

Out of which 50725 ha. falls in Very Dense Forest, 144574 ha. in Moderately Dense Forest and 37716 ha. in Open Forest.

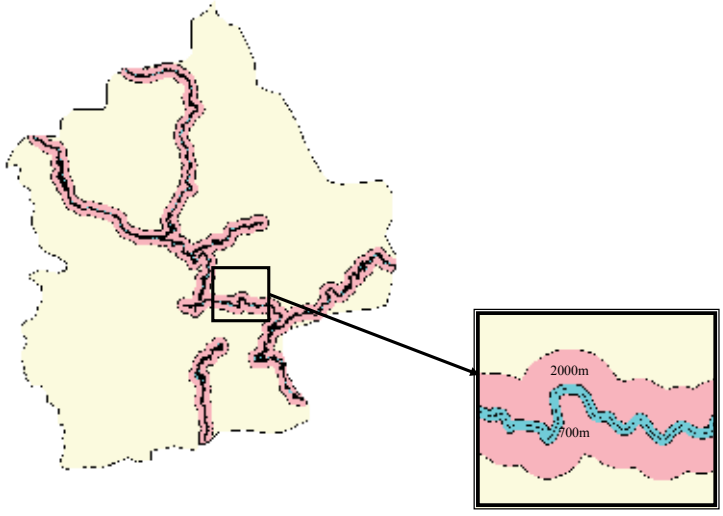


Total area falling above 2400m altitude zone is 139456 hectares.

Out of which 30933 ha. falls in Very Dense Forest, 74972 ha. in Moderately Dense Forest and 33551 ha. in Open Forest.

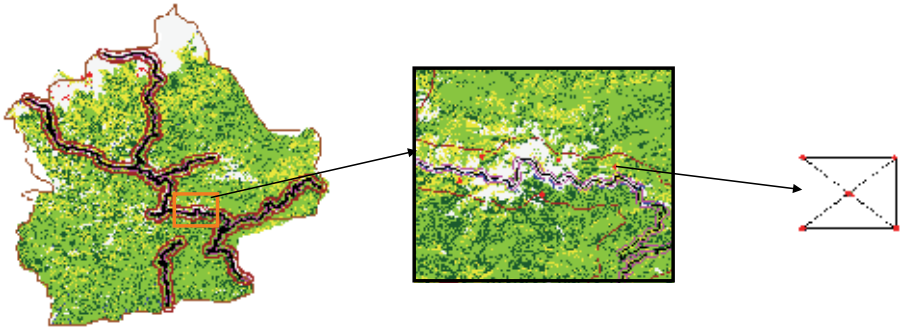


Road Network Map of West Kameng with two buffer Zones of 700m and 2000m.



Generation of Sample cluster points

- Road Network Map of West Kameng with two buffer Zones of 700m and 2000m was generated from SOI toposheet
- Based on area of forest cover (VDF, MDF & OF) in each altitudinal strata cluster samples between 700-2000m from the centre of the road were generated
- One cluster is of 5 sample plots of 0.1 hectare land, 1 at centre and 4 in all directions at 200meter from the centre of plot was created.
- 30 clusters (150 points) proportionately distributed in 9 different strata.
- Data collected, entered and analysed to obtain growing stock.

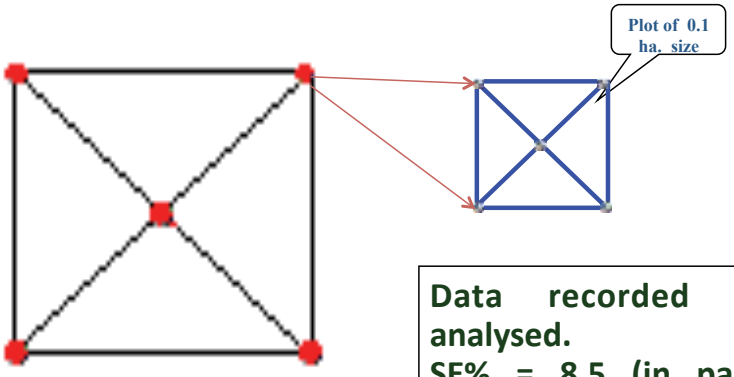


Peculiarity of Eastern Himalaya

- Cluster of 5 plots 1 at centre and 4 in all directions at 200 meter from the centre of plot was created.
- Study of past data suggest, 150 points would suffice.
- 30 clusters (150 points) proportionately distributed in different strata.

Marking of Plots

One cluster of 5 sample plots of 0.1 hectare land 1 at centre and 4 in all directions at 200meter from the centre of plot was created.



Data recorded & analysed.
SE% = 8.5 (in past study it was 13.2)

Growing stock: At A Glance

	Vol. (billion. m^3)
• Total Growing stock	6.22
• Forests	4.60
• TOF	1.62

Top Five Species in Forests

	Total Vol(%)
Shorea robusta	8.04
Tectona grandis	4.33
Terminalia crenulata	2.82
Pinus roxburghii	2.71
Anogeissus latifolia	2.44

Top Five Species in TOF

	Total Vol(%)
Mangifera indica	11.18
Cocus nucifera	4.94
Syzygium cumini	4.20
Azadiracta indica	3.91
Madhuca latifolia	3.72

Theme III - Assessing Carbon Funds

Presentation Number 10.

Develop standard format for writing proposals for accessing carbon fund

Presenter : Ms. Thevaky Markandu, Sri Lanka.

Abstract

In order to seek financial assistance for the CDM Projects, the way forward is to adopt common format for SAARC region which would firstly strengthen the regional cooperation among member states and secondly the Member States will have a readymade format for use.

Out of the key participants/proponents of the CDM project process, CDM Project Investor / Developer and Designated National Authority (DNA) may play a major role in this regard.

For SAARC Countries the CDM Sectors are follows as:

1. Energy.
   - ➢ Renewable energy.
   - ➢ Energy efficiency/conservation and cogeneration.
2. Transportation.
   - ➢ Alternative fuel vehicles.
   - ➢ Mass transit systems, cleaner engines.
3. Agricultural and livestock practices.
4. Land, land use and forestry.
5. Industrial processes (cement, fertilizer, sugar, textile).
6. Waste management.
   - ➢ Landfill gas capture.
   - ➢ Recycling.

A common sample format and guide lines for writing proposals to access carbon fund for use by the SAARC Member States was developed by the symposium. The cover page of the proposal would contain the following headings:

1. Cover Letter/letter of request
2. Executive summary
3. Project name project location.
4. Project address.
5. Project type.
6. Brief project description (in brief)
7. Project proponent(s).

The main project proposal would contain the following headings. A guideline is also developed to explain each main heading. The guideline outlines what information are to be included under each main heading.

1. Project specifications
2. Site specifics and environmental conditions
3. System impacts and co-benefits
4. Replicability/Expandability
5. Scaling up potential
6. Stakeholder review (if any)
7. Project period
8. Planning, Monitoring and Evaluation
9. Budget estimated

Main Presentation

CDM PROJECT DEVELOPMENT PROCESS

- Project developer identifies a potential CDM project
- Identify project sector
- Decide whether small-scale CDM
- Inform DNA of the host country
- Prepare a Project Design Document
- Select baseline methodology (new or approved)
- Select/designed monitoring plan
- Decide project crediting period
- Collect data from relevant national authorities
- Calculate emission reductions and expected CERs
- EIA for the project
- Validate
- Register
- Verify CERs.

KEY PARTICIPANTS OF A CDM PROJECT PROCESS

- CDM Project Investor/Developer
- Designated National Authority (DNA)
- Designated Operational Entity (DOE)
- CDM Executive Board (EB)
- Conference Of Parties (COP)
- Meeting Of Parties (MOP).

DESIGNATED NATIONAL AUTHORITY

- A country level focal point for CDM, based in Ministry of Environment & Natural Resources etc
- Issue the letter of approval confirming CDM projects contributes to sustainable development in the host country
- Link between international CDM investors and potential projects in the country
- May involve in marketing of CDM project pipeline
- Establish national CDM regulations, strategy, and criteria for sustainability and approval
- Monitor CDM sector in the country.

CDM INVESTOR

- Prepare Project Designed Document
- Propose baseline methodology
- Ensure additionality criteria
- Calculate expected GHG reductions and CERs
- Obtain all permits and approval from DNA
- Secure financing.

FORMAT AND CONTENT OF PROPOSALS

FORMAT AND CONTENT OF PROPOSALS

- Standard cover letter
- One page executive summary.
  - Project Name Project Location
    - Project Address
    - Project Type
    - Brief Project description
    - Project owners.

PROPOSAL FORMAT

- Project Specifications
- Site Specifics, System Impacts
- Replicability, and Expandability
- Co-Benefits, Environmental Conditions, & Stakeholder Review
- Timeline
- Budget

PROJECT SPECIFICATIONS

- Description of the organization, & its history experience with similar projects.
- Description of the goals & objectives of the project.
- Description of the project site specifications.
- Description of the baseline conditions on site, including relevant site history, existing operations, and systems that sequester, collect or destroy GHG emissions if any.
- Description of the Project's mitigation, reduction, or sequestration procedures, processes, and technology.
- Description of how the project will create carbon reductions.

CONT / -

- Performance information and any relevant research and development studies related to the technology or practices. Provide any relevant data on the efficiency and or effects of the Project's process or technology.
- Information of the GHG emissions of the "business as usual" scenario (site without Project) and the GHG emissions after implementing this Project.
- Describe how you will ensure that increases in GHG emissions from Project activities are accounted for in the emissions reductions calculations as required in the relevant protocols. Examples include mobile emissions from transporting manure, vehicles used in planting and caring for trees in urban forestry projects, and other mobile combustion emission.
- Provide monitoring plan and other project performance metrics.

SITE SPECIFICS, SYSTEM IMPACTS, REPLICABILITY, & EXPANDABILITY

- Description of the Project site and confirmation that the site is under the bidder's legal control.
- Description present environmental conditions of the Project area.
- Provide a map showing the location of the Project.
- For Forest Projects, provide in electronic format a Geographical Information System (GIS) shape file of the Project property.
- Confirm current zoning for the Project site and any available information on development plans for the vicinity.
- Description of any possessory rights that must still be acquired or which are not yet secured for the proposed term of the Agreement. If none, so state.
- Describe the Project's replicability and expandability.

CO-BENEFITS, ENVIRONMENTAL CONDITIONS, & STAKEHOLDER REVIEW

- Description of the benefits the Project will generate other than carbon reductions
- Information about the uniqueness of the co-benefits
- Describe any prior "stakeholder" review and collaboration.

TIMELINE

- Project construction start date
- Projected carbon reductions per year
- Achievement of project objectives and other deliverables.

BUDGET

- Capital costs
- Labor costs
- Administrative costs
- Any and all funding streams
- Other financing possibilities.

Draft

Standard Format for seeking financial assistance for CDM Projects proposed by the symposium.

I. Cover Page

Cover letter/letter of request.

Executive summary (in brief).

Project name

Project address

Project type

Project description (in brief)

Project proponent(s)

Project location

II. Main Body of the Project Proposal

Proposal Format

1. Project specifications
2. Site specifics and environmental conditions
3. System impacts and co-benefits
4. Replicability/Expandability
5. Scaling up potential
6. Stakeholder review (if any)
7. Project period
8. Planning, Monitoring and Evaluation
9. Budget estimate

Guidelines for preparing detailed proposal under each main heading.

1. Project Specifications

a. Description of the organization, & its history experience with similar projects.

b. Description of the goals & objectives of the project.

c. Description of the project site specifications.

d. Description of the baseline conditions on site, including relevant site history, existing operations, and systems that sequester, collect or destroy GHG emissions if any.

e. Description of the Project's mitigation, reduction, or sequestration procedures, processes, and technology.

f. Description of how the project will create carbon reductions.

g. Performance information and any relevant research and development studies related to the technology or practices. Provide any relevant data on the efficiency and or effects of the Project's process or technology.

h. Information of the GHG emissions of the "business as usual" scenario (site without Project) and the GHG emissions after implementing this Project.

i. Describe how you will ensure that increases in GHG emissions from Project activities are accounted for in the emissions reductions calculations as required in the relevant protocols. Examples include mobile emissions from transporting manure, vehicles used in planting and caring for trees in urban forestry projects, and other mobile combustion emission.

j. Provide monitoring plan and other project performance metrics.

2. Site Specifics and Environmental Conditions

a. Description of the Project site and confirmation that the site is under the bidder's legal control.

b. Description present environmental conditions of the Project area.

c. Provide a map showing the location of the Project.

d. Confirm current zoning for the Project site and any available information on development plans for the vicinity.

e. Description of any possessory rights that must still be acquired or which are not yet secured for the proposed term of the Agreement. If none, so state.

3. System Impacts and Co-Benefits

a. Description of the benefits the Project will generate other than carbon reductions

b. Information about the uniqueness of the co-benefits

4. Replicability/Expandability (time extension)

a. Describe the Project's replicability/expandability/

5. Scaling up potential

a. Describe the Project's scaling up potential

6. Stakeholder Review (if any)

a. Describe any prior "stakeholder" review and collaboration.

7. Project Period

a. Project construction start date

b. Projected carbon reductions per year

8. Planning, Monitoring and Evaluation

b. State clearly achievement of project objectives and other deliverables.

c. Develop an effective mechanisms to monitor and evaluate the project deliverables preferably by a third party.

9. Budget Estimate

a. Capital costs (construction/infrastructure development, equipments and technology etc.)

b. Recurrent Costs (administrative cost, labour costs etc.) and

c. Other Costs.