



# Himachal Pradesh Reforestation Project -- CDM Forestry Experience

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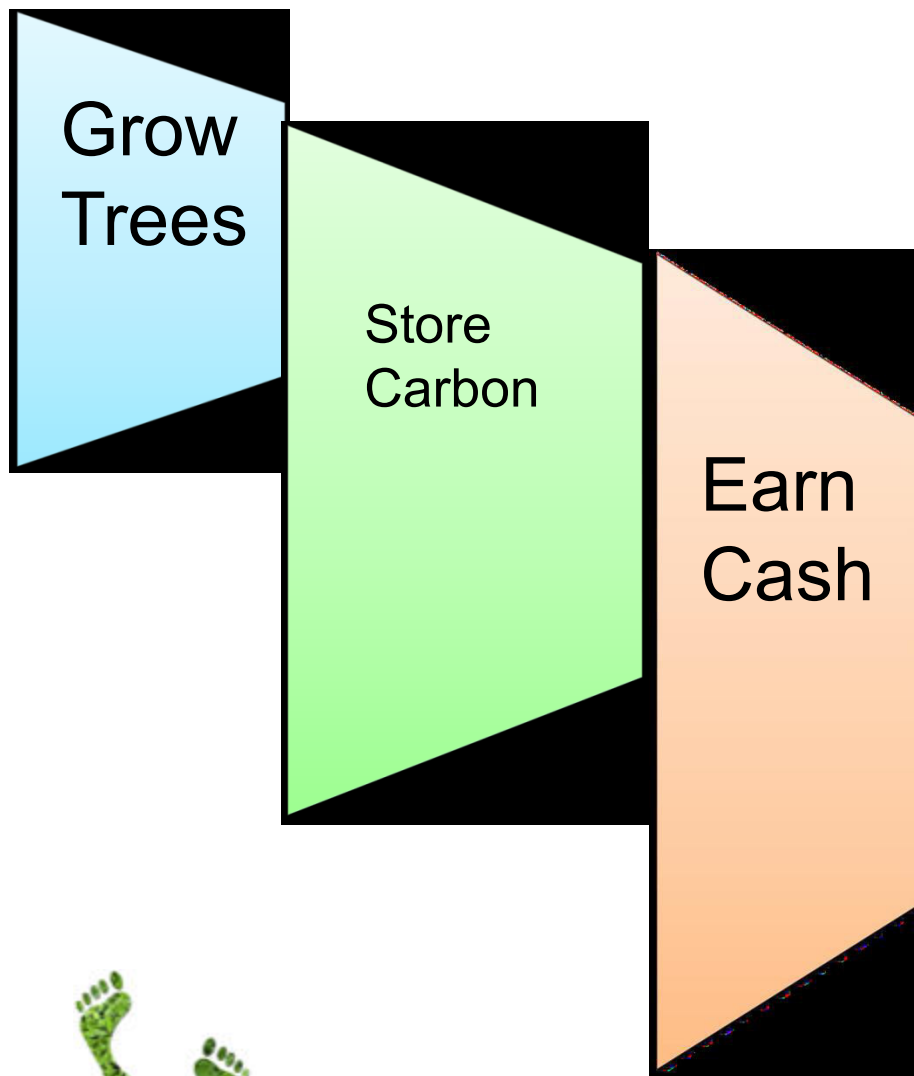
# Simple a Concept ! (?)

Grow  
Trees

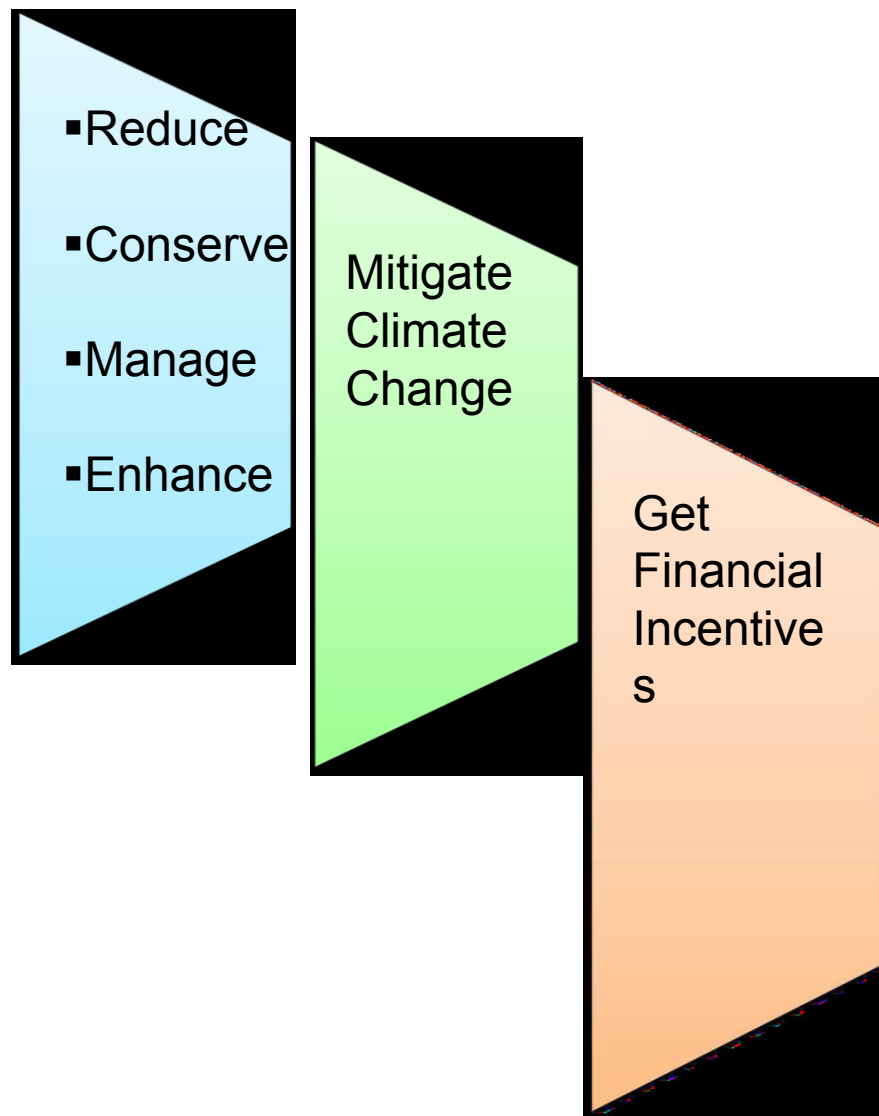
Store  
Carbon

Get  
Cash

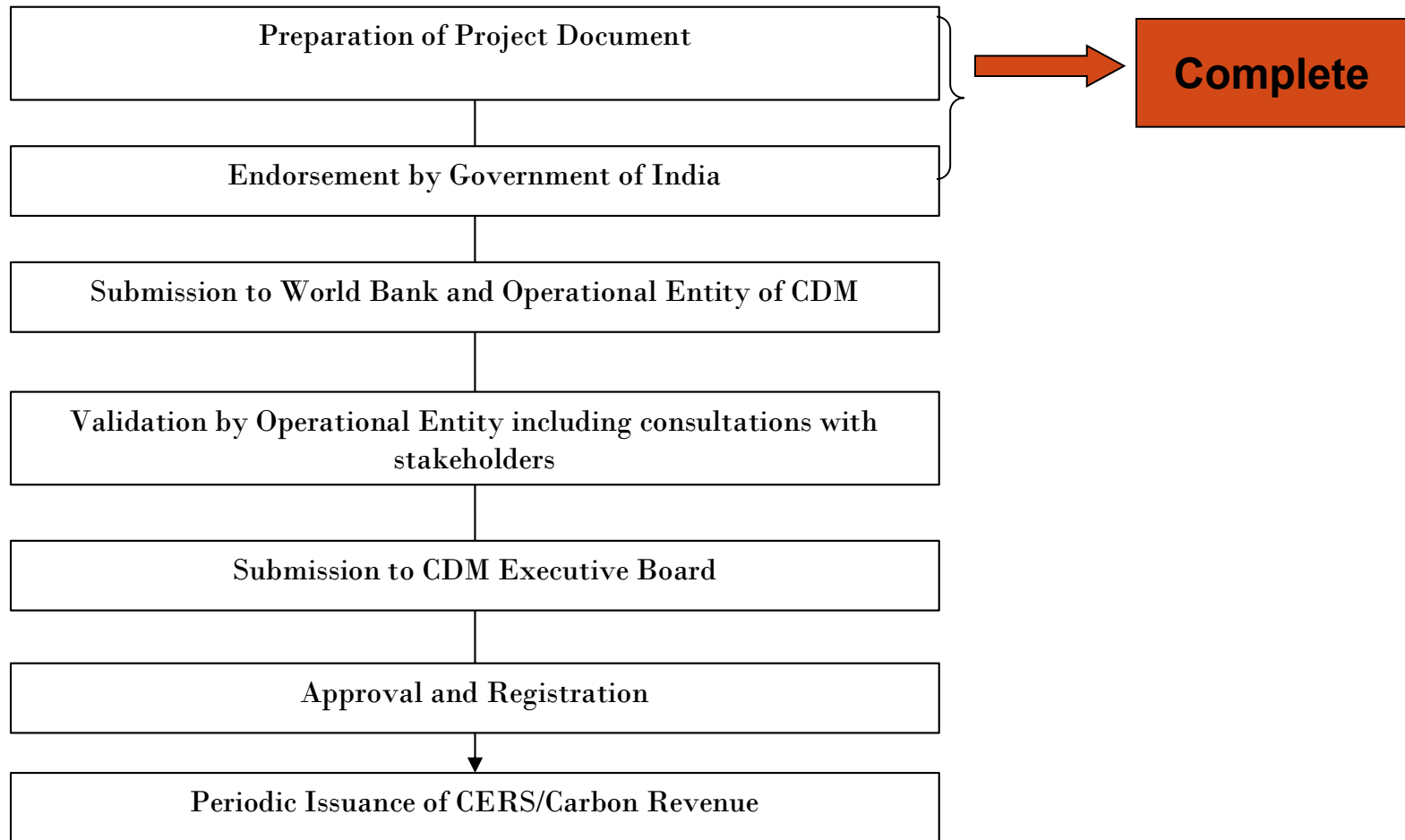
## CDM A/R



## REDD+



# Steps to Carbon Crediting



# STEPS

1. Selection of region or project area
2. Selection of approved A&R methodology
3. Preparation of PDD, approval
4. Validation, Registration
5. ERPA
6. Implementation
7. Periodic Verification
8. Issuance of CERs by UNFCCC EB



# HIMACHAL PRADESH



States a

(T)

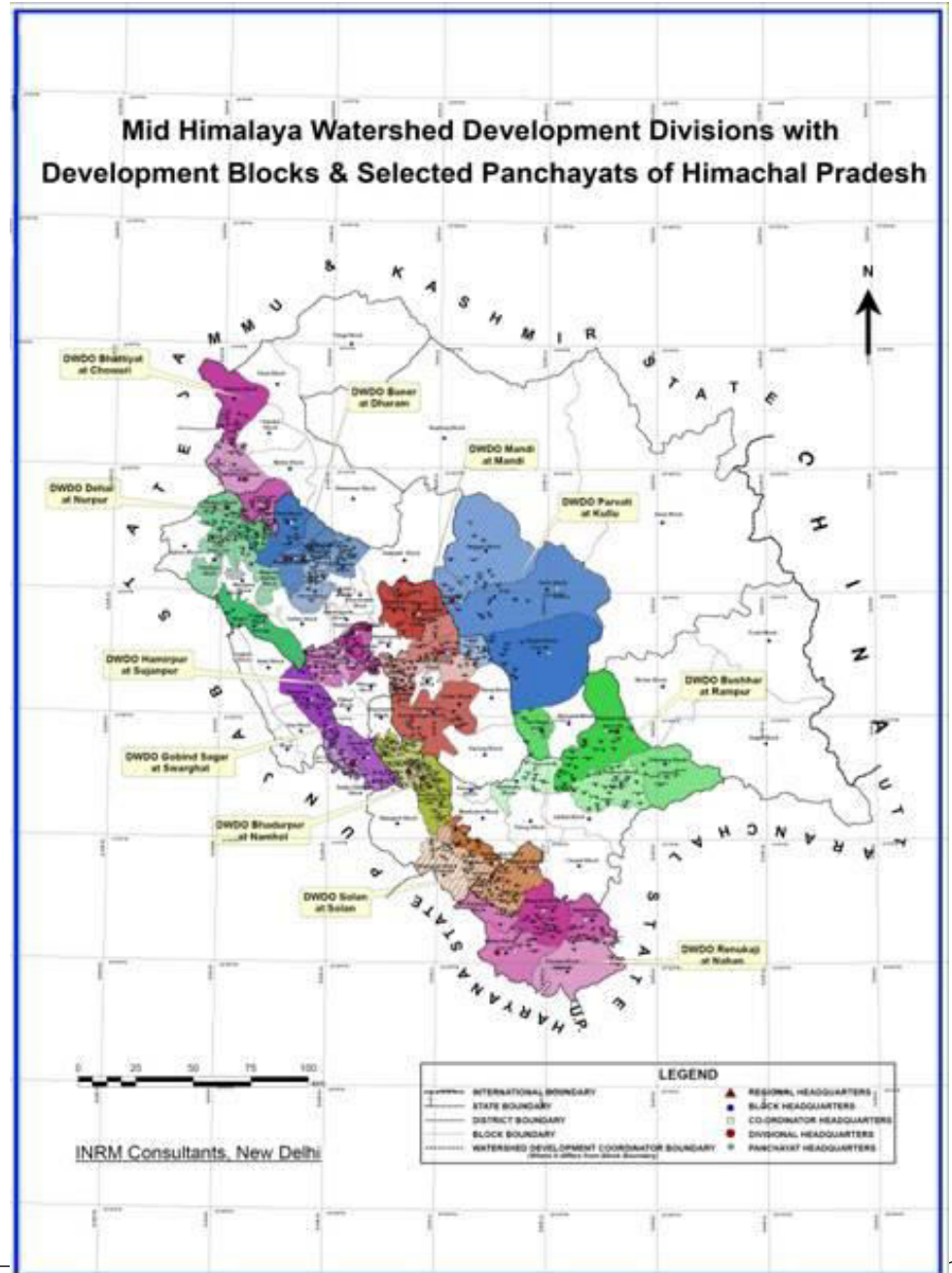
PAKISTAN

NEPAL

ARABIAN SEA

ANDAMAN & NICOBAR ISLANDS

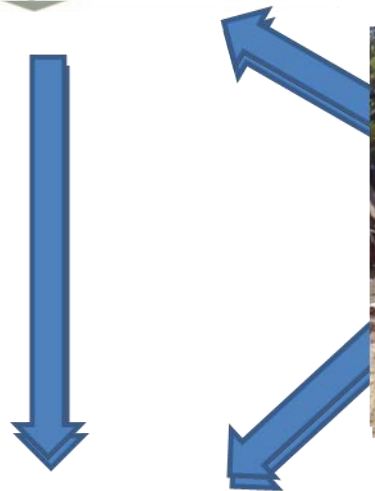
# Location Map



# HP- Best Practices- CDM Bio Carbon Project



**Plantations Important for Watershed Protection**



**CDM Money**

**Fuelwood**

**Forest Produce**

**Fodder**



**Communities Protect Plantations & watersheds For..**





# Highlights

- First in India in Govt. Sector involving govt. lands (forest / community) as well as private land Integrating Watershed development and livelihood
- First Pilot to test community benefit sharing mechanism through Carbon Markets involving govt. agencies and local institutions
- Second Large A/R CDM Project in India
- Has 4 times higher ER than the highest in A/R Sector (Maldova -179,242) – HP –Expected ER 828,016

# Salient Points

- **Title- “India: Himachal Pradesh Reforestation Project-  
Improving Livelihoods and Watersheds”**
- **Reforestation Project**
- **Expected Operational Life time : 60 Years**
- **Crediting period : 20 years (Renewable twice)**
- **Project proponent : Government of HP**
- **Project Partners : Govt. of H.P; World Bank;**

# Milestones



- Sept 2006 : PIN Approved
- May 2008 : PDD Approved
- 2008-2010 : Validation completed
- June 2011 : Registration  
( Effective date March 2011)
- May 2011 : ERPA signed
- July 2012 : Carbon Stock Sample
- Dec 2012 : Carbon Stock Estimate
- October 2013 : Verification
- August 2015 : 19 million received

**Area : 4003 ha**

**❖ GPs : 177**

**❖ Parcels : 419**

**❖ Size of parcels : 1 to 150 ha**

**❖ Land status: degraded forest /community land/private land**

**❖ Methodology : AR-ACM-001 (Version .03)**

**❖ Carbon Pool Selected: 3 (AGB+BGB+SOC)**

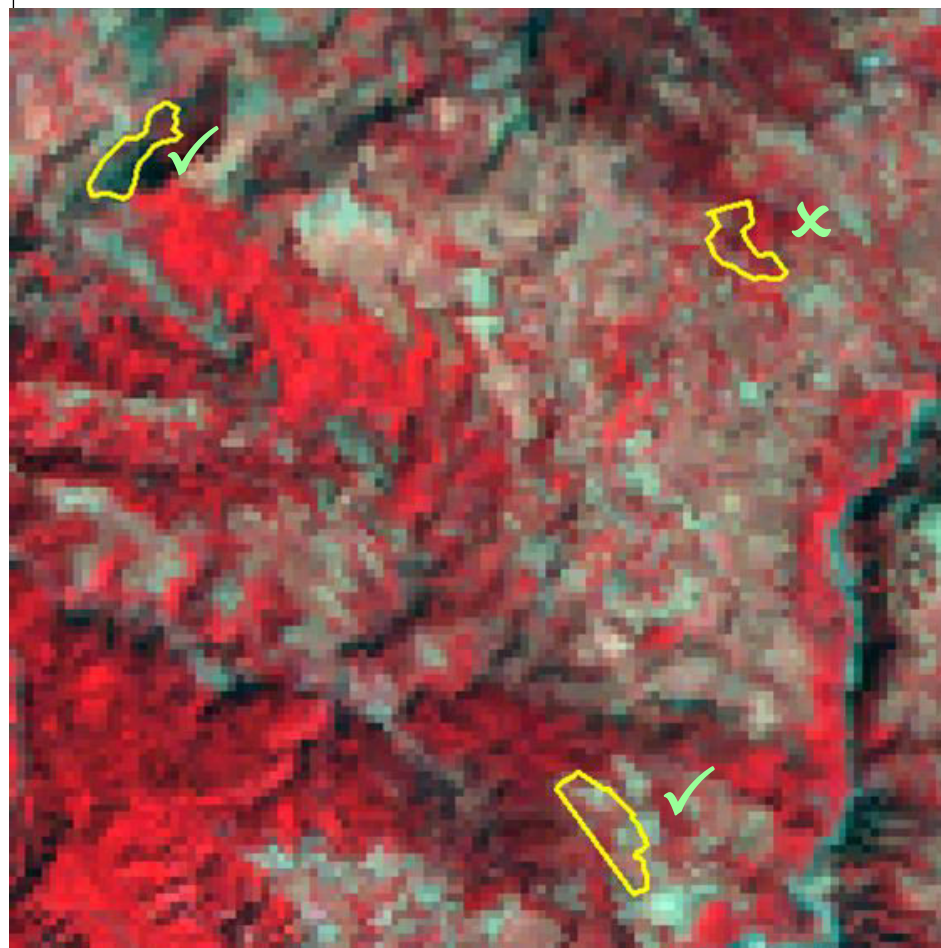
**❖ Estimated ex-ante GHG removals by sinks ~ 828**

# Guiding Principles

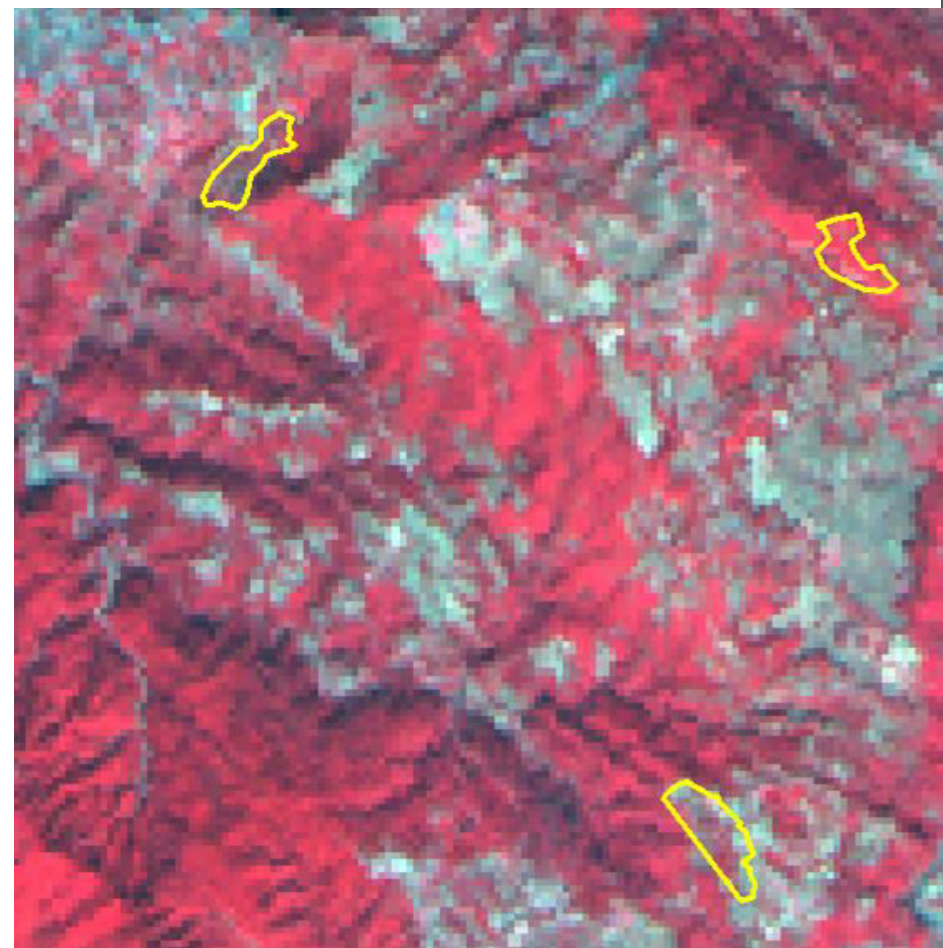
- Identify Native and local Species.
- Involve Communities in reforestation efforts.
- Value addition to ongoing watershed interventions.
- Technical and financial support for reforestation by MHWDP (including capacity building).
- Carbon Revenue to go to communities as incentive to protect Forests/ Watersheds.

# Project Boundary and Land Eligibility

- ✓ Remote Sensing Data - GPs with significant quantities of eligible lands shortlisted (FSI data/Survey maps).
- ✓ Communities sensitized, PRA conducted to identify Spare-able/agreed land parcels likely to qualify.
- ✓ GPS Survey - Generate Boundaries/polygons, measure area.
- ✓ FSI analysis for eligibility using Satellite Data- 1990 (TM) and current (LIS-III).
- ✓ Generated output on maps.
- ✓ Scrutiny by Validation Team – Onsite Visit / Satellite



1989  
LANDSAT TM



2004  
IRS P6 LISS III

# SPREAD OF PARCELS – DISTRICT.



86 km

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Image © 2009 DigitalGlobe  
Image © 2009 TerraMetrics  
© 2009 Cnes/Spot Image

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# NM 060-P1

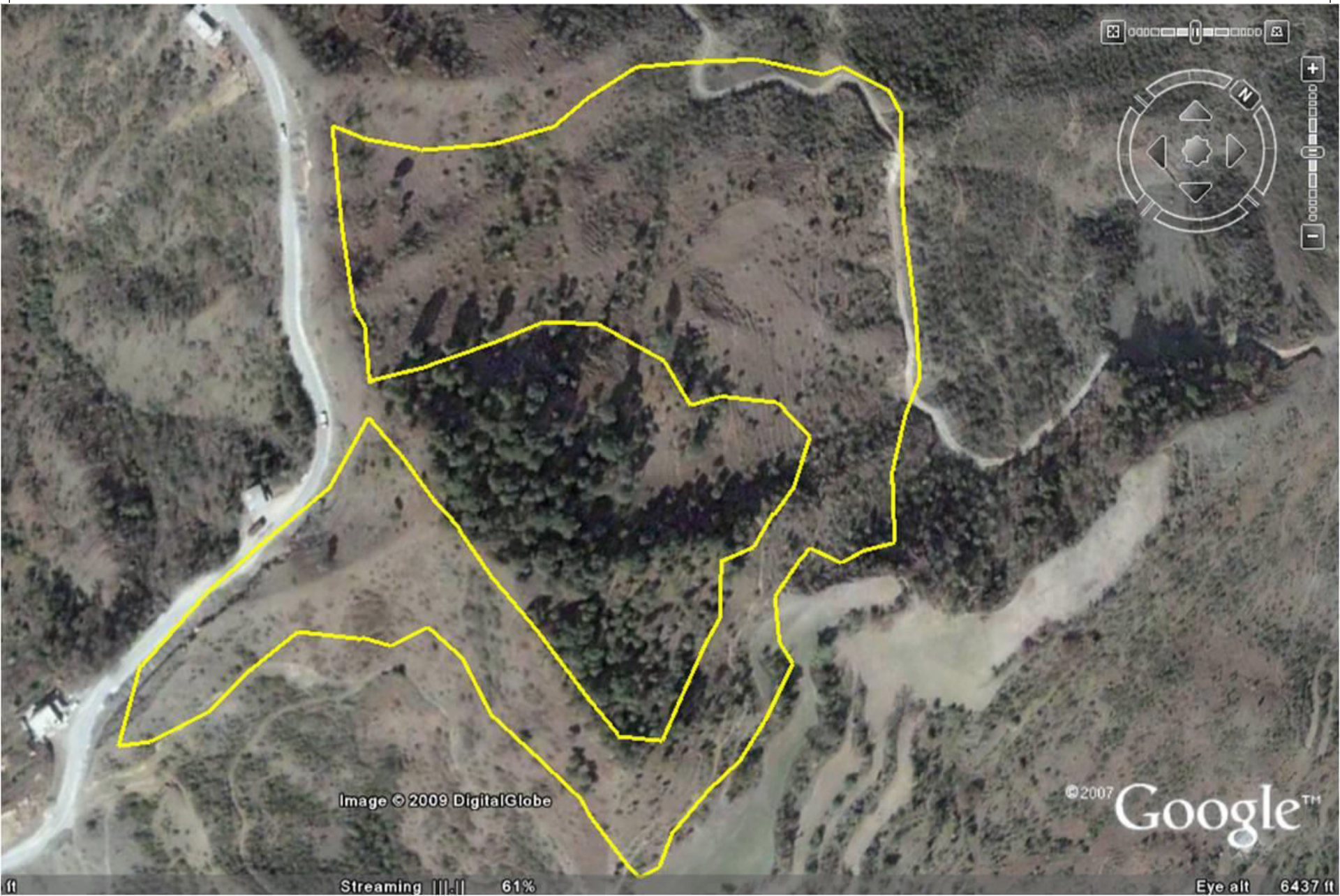


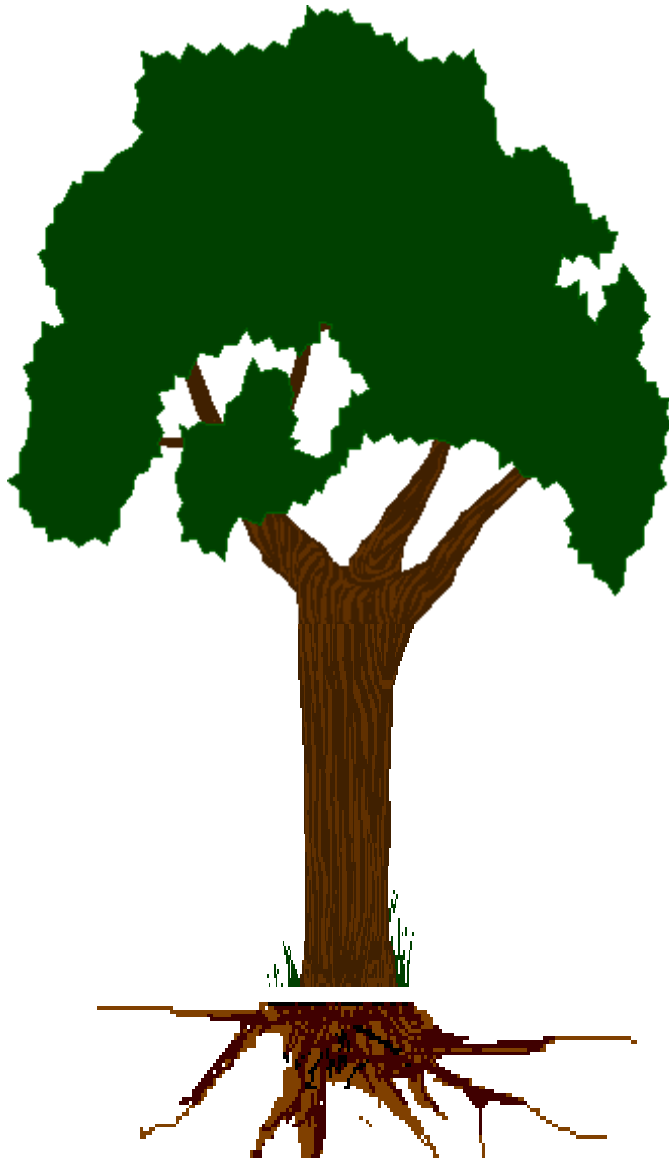
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Streaming 61%

Eye alt 6437 ft

# Key Variables



$BEF_j$  = Biomass  
Expansion Factor

$D_j$  = Wood Density

$V_{j,t}$  = Trunk volume

$R_j$  = Root to Shoot Ratio

Above-Ground Biomass (AGB) =  $V \cdot BEF \cdot D$   
Below-ground Biomass =  $AGB \cdot R$   
About half of the biomass is Carbon

$j$  = Species dependent  
 $t$  = Time dependent

# Calculation of Carbon Stocks

(A) Cumulative Area under each Strata (stand)

(B) Av. MAI [t/ha] (Literature): Fast Growing-  
Slow Growing-

(C) Av. BEF (IPCC default) : 1.2

(D) Total AGB :  $(A) \times (B) \times (C)$

(E) Total AG\_Carbon :  $(D) \times 0.5$

(F) Total BG\_Carbon:  $(E) \times 0.22$

(G) Total Carbon:  $AG\_C + BG\_C + SoC$  (0.5t/ha)

(H) Total CO2 Eq:  $(G) \times 3.66$

## Values Used for C stock Estimation

BEF : Literature Value of 17 Sp. Taken

Av. Value 1.98 (1.49 – 2.90)

Conservative Value - 1.2 (IPCC GPG 2003) used

Root : Shoot Ratio- Literature Value of 13 Sp

Av. Value 0.22 (0.17 – 0.39) used

IPCC Default 0.26- (Higher)

Carbon Fraction -0.5

SoC – 0.5 tC/Ha/Yr (Methodology)

Region

### Dharamshala Region

Watershed divisions: Kullu, Mandi, Chowari, Nahan and Dharamshala

### Bilaspur Region

Watershed divisions: Sujanpur, Swarghat, Nurpur, Solan and Namhol

Land category

Degraded forest land

Degraded community land

Degraded and abandoned private land

Degraded forest land

Degraded community land

Degraded and abandoned private land

Model

Restoration model

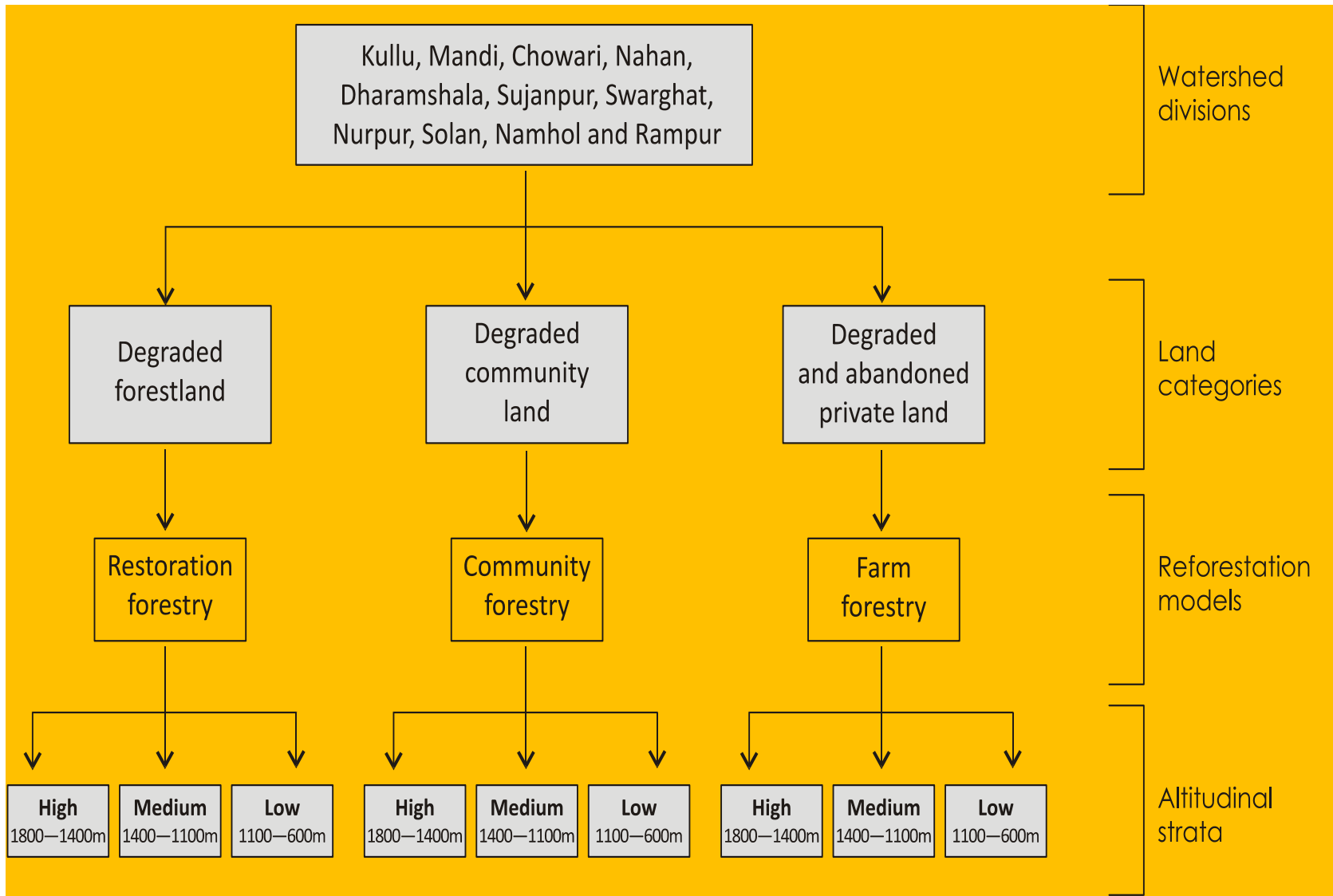
Community forestry model

Agro-forestry model

Restoration model

Community forestry model

Agro-forestry model



Demonstration of Additionality (Combined Tool)  
Alternative Scenarios Forest & Community Lands can't be put to other use except Afforestation; Pvt. Lands Degraded (Unfit for Agriculture)

Barrier

Financial – F & C –Currently Low budget allocation ; P- No State budget available nor Financial access from Capital markets

Ecological- Degraded Lands require Higher & Continuous Caring, Tending & After-Care of Plantations

Common Practice Analysis –Incentive of Carbon Revenue for Continuous Caring & Tending of Plantations; Improved Silviculture Practices

# Estimation of Net GHG Removals (Ex ante)

- ❑ TARAM model of WB used
- ❑ Compilation of Rep. Growth Rate of a Age Class for Stand Model – as input to TARAM has been a challenge
- ❑ Species – 45
- ❑ Strata – 9
- ❑ Age Classes 4 (<5y; 5 -10y; 11-20y; >20y)
- ❑ Growth Rates -2 (Fast ; Slow)
- ❑ Large No of Literature Values of CAI/MAI
- ❑ Lack of Complete/Sufficient Rep Regional Data



# Wood Density

S.No.	Scientific Name	Standard Specific Gravity	Reference
1.	<i>Acacia catechu</i>	0.875	Suitability Indices of Indian Timbers for Industrial and Uses by A.C.Shekhar & A.S.Gulati.IFR Vol.2, No.1 (1972)
2.	<i>Acer pictum</i>	0.557	Physical and mechanical propeties of <i>Acer caesium and A. Pictum</i> from Jubbal Forset Division,H.P. published in van Vigyan,29 (1):40-50.
3.	<i>Aegle marmelos</i>	0.754	Suitability Indices of Indian Timbers for Industrial and Uses by A.C.Shekhar & A.S.Gulati.IFR Vol.2, No.1 (1972)
4.	<i>Aesculus indica</i>	0.428	A note on physical and mechanical properties of <i>Aesculus indica</i> ( Horse chestnut) from River Range, Chakarata. Indian Forester,96(3) (1970).
5.	<i>Ailanthus altissima/A.excelsa</i>	0.356	Specific gravity of Indian timbers.Published in J.Timb.Dev.Assoc.()31(3):12-42(1985)
6.	<i>Albizzia procera</i> (Safed siris)	0.579	Suitability Indices of Indian Timbers for Industrial and Uses by A.C.Shekhar & A.S.Gulati.IFR Vol.2, No.1 (1972)
7.	<i>Albizzia lebbek</i> ( <i>A.odoratissima</i> ) Kala siris	0.632	Suitability Indices of Indian Timbers for Industrial and Uses by A.C.Shekhar & A.S.Gulati.IFR Vol.2, No.1 (1972)
8.	<i>Albizzia stipulata</i> ( <i>A.chinensis</i> )	0.676	Phy. & Mech. Properties of <i>Albezzia chinensis</i> from Dehradun.Published in T.D.A.,July-Oct.2002 ,Vol. 48, No. 3&4.
9.	<i>Alnus nepalensis / A.nitida</i>	0.319	Suitability Indices of Indian Timbers for Industrial and Uses by A.C.Shekhar & A.S.Gulati.IFR Vol.2, No.1 (1972)

# Baseline

Land Category	ABG Non-Tree Biomass Dry/t/ha/Yr	Tree Biomass t/ha (SE -0.5 – 1.15)	Soil Organic Carbon (tC/ha) (SE- 1.14 – 3.01)	
Forest	1.7	1.92	26.98	
Community	1.3	1.85	30.21	
Private	2.0	2.18	27.74	

Degraded Lands have Negligible or Zero other Carbon Pools (Litter, Dead Wood, Non Tree Biomass)

MAI = 0.004 t/Ha/Yr

Av. Growing Stock = 3.27 t/Ha (Insignificant, Not Included)

# Year wise Planted Area



Year of Planting	Area (Ha)
2006 - 07	135.3558
2007 - 08	207.4375
2008 - 09	556.4892
2009-10	704.0873
2010-11	1332.3253
2011-12	264.99
2012-13	30.00
<b>Total</b>	<b>3230.6851</b>

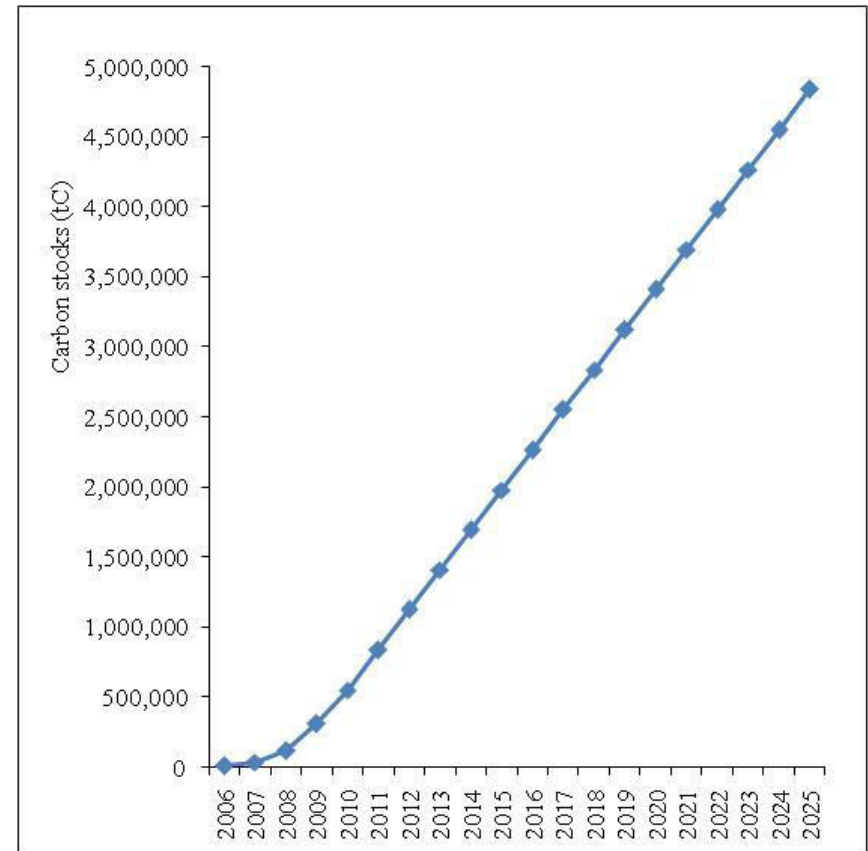
S. No.	Scientific Name	S. No.	Scientific Name	S. No.	Scientific Name
1	<i>Acacia catechu</i>	16	<i>Gravellia robusta</i>	31	<i>Terminalia arjuna</i>
2	<i>Aegle marmelos</i>	17	<i>Grewia optiva/G. oppositifolia</i>	32	<i>Terminalia chebula</i>
3	<i>Aesculus indica</i>	18	<i>Juglans regia</i>	33	<i>Artocarpus lakoocha</i>
4	<i>Ailanthus altissima/A. excelsa</i>	19	<i>Mangifera indica</i>	34	<i>Hicoria carya</i>
5	<i>Albizzia procera</i>	20	<i>Melia azadirchta</i>	35	<i>Dendrocalamus spp</i>
6	<i>Albizzia lebbek</i>	21	<i>Morus alba</i>	36	<i>Tectona grandis</i>
7	<i>Albizzia stipulata</i>	22	<i>Pinus roxburghii</i>	37	<i>Terminalia tomentosa</i>
8	<i>Alnus nepalensis/A. nitida</i>	23	<i>Pongamia pinnata</i>	38	<i>Prunus armeniaca</i>
9	<i>Azadirachta indica</i>	24	<i>Populus ciliata/P. Alba/P. deltoids</i>	39	<i>Ulmus laevigata/u. wallichiana.</i>
10	<i>Bauhinia variegata</i>	25	<i>Quercus leucotrichophora</i>	40	<i>Prunus cornuta/P. Cerassoides/P.padus</i>
11	<i>Bombax ceiba</i>	26	<i>Robinia pseudoacacia</i>	41	<i>Olea glandulifera</i>
12	<i>Toona ciliata</i>	27	<i>Salix alba</i>	42	<i>Pinus wallichiana</i>
13	<i>Cedrus deodara</i>	28	<i>Sapindus mukorossii</i>	43	<i>Cassia seamia</i>
14	<i>Dalbergia sissoo</i>	29	<i>Syzygium cuminii</i>	44	<i>Acacia nilotica</i>
15	<i>Embllica officinalis</i>	30	<i>Terminalia bellerica</i>	45	<i>Butea monosperma</i>

# Plantation Survival (%) July 2014

<b>Sr. No.</b>	<b>Division</b>	<b>Area Planted</b>	<b>Area Sampled</b>	<b>Weighted Survival %</b>
<b>1</b>	<b>Mandi</b>	<b>344.11</b>	<b>29.3</b>	<b>65.54</b>
<b>2</b>	<b>Sujanpur</b>	<b>107.14</b>	<b>84.1</b>	<b>87.37</b>
<b>3</b>	<b>Dharmshala</b>	<b>61.60</b>	<b>19.94</b>	<b>67.73</b>
<b>4</b>	<b>Nurpur</b>	<b>67.85</b>	<b>22.26</b>	<b>76.45</b>
<b>5</b>	<b>Chowari</b>	<b>404.57</b>	<b>38.87</b>	<b>73.88</b>
<b>6</b>	<b>Solan</b>	<b>44.89</b>	<b>18.49</b>	<b>85.08</b>
<b>7</b>	<b>Nahan</b>	<b>72.99</b>	<b>22.14</b>	<b>24.06</b>
<b>8</b>	<b>Swarghat</b>	<b>750.16</b>	<b>64</b>	<b>87.61</b>
<b>9</b>	<b>Namhol</b>	<b>85.46</b>	<b>24.39</b>	<b>55.41</b>
<b>10</b>	<b>Kullu</b>	<b>554.76</b>	<b>67.15</b>	<b>69.26</b>
<b>11</b>	<b>Rampur</b>	<b>707.93</b>	<b>40.74</b>	<b>60.73</b>
	<b>Total</b>	<b>3201.46</b>	<b>431.38</b>	<b>72.75</b>

## Estimate of GHG removals by sinks according to project activities for the three plantation models in tCO<sub>2</sub>-e

Year	Restoration model	Community forestry model	Agro-forestry model	Total CO <sub>2</sub> -e
2006	11549	0	0	11549
2007	25664	0	0	25664
2008	75707	5897	0	81605
2009	152955	18281	20701	191937
2010	182083	18281	41403	241767
2011	213244	21685	50758	285687
2012	213244	21685	50758	285687
2013	213244	21685	50758	285687
2014	213244	21685	50758	285687
2015	213244	21685	50758	285687
2016	213244	21685	50758	285687
2017	213244	21685	50758	285687
2018	213244	21685	50758	285687
2019	213244	21685	50758	285687
2020	213244	21685	50758	285687
2021	213244	21685	50758	285687
2022	213244	21685	50758	285687
2023	213244	21685	50758	285687
2024	213244	21685	50758	285687
2025	213244	21685	50758	285687
<b>Total</b>	<b>3646620</b>	<b>367730</b>	<b>823469</b>	<b>4837819</b>
Per ha	514	474	387	484



# Projected Revenue from Sale of CERs

	<b>CERs (tCO<sub>2</sub>-e)</b>	<b>CERs/year (tCO<sub>2</sub>-e)</b>	<b>CER revenue (Rs./year) at US\$ 4.75/tCO<sub>2</sub></b>
<b>Total for the whole project area</b>	<b>8,28,016</b>	<b>41,979</b>	<b>198723840</b>
<b>Average per hectare</b>	<b>207</b>	<b>10.34</b>	<b>2481.6</b>
<b>Total Project Area (in ha)</b>		<b>No. of plantation patches</b>	
<b>4003</b>		<b>419</b>	

# CARBON REVENUE

MHWDP/ FOREST DEPARTMENT

PRIVATE LAND

FOREST LAND

COMMUNITY LAND

90 % of carbon revenue

20 % of remaining carbon revenue

80 % of remaining carbon revenue

20 % of carbon revenue

**Gram Panchayats' GP FUND**  
(undertaking works as approved in GPWDP)

**Gram Panchayats' GP FUND**  
(undertaking works as approved in GPWDP)

80 % of carbon revenue

Owner or Attorney

**USER GROUP/VFDS**  
(members responsible for protection of land parcel)

**USER GROUPS/ VFDS**  
(members responsible for protection of land parcel depending upon their share /rights in land parcel)



# MONITORING



- Process
- Reporting
- Compilation, Analysis, Calculation
- Way Forward

# Monitoring Process

- Monitoring By PP as per Monitoring Plan
- Periodic Verification of Carbon Stocks by Third Party Verifiers (3-5 Yr)
- Parameters
- Formats
- Team & Mechanism
- Quality Checks
- Recording
- Results
- Archiving

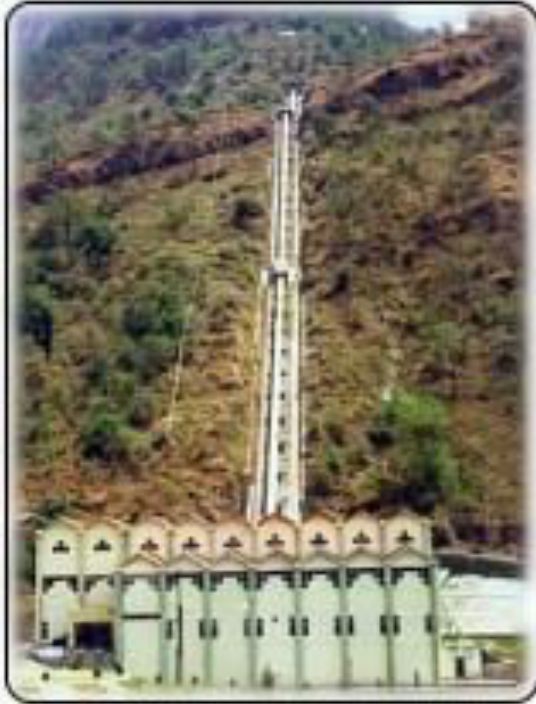
# Reporting for Monitoring

- Land Stratification and Category Details
- Parcel Details: Area , Latitude, Longitude, Altitude
- Species Details: Composition, No.( stratum and category wise)
- Growth Data: DBH, Height ,
- Survival
- Undergrowth Data

# Trade Off

Reducing Poverty

Reducing Emissions



**hydroelectricity**



**Horticulture:  
apples**



**tourism**



**cement**



**tea**



# Land

- Availability
- Eligibility
- Suitability
- Discreet Parcels
- Approachability
- Strata
- Baseline
- Additionality
- Leakage

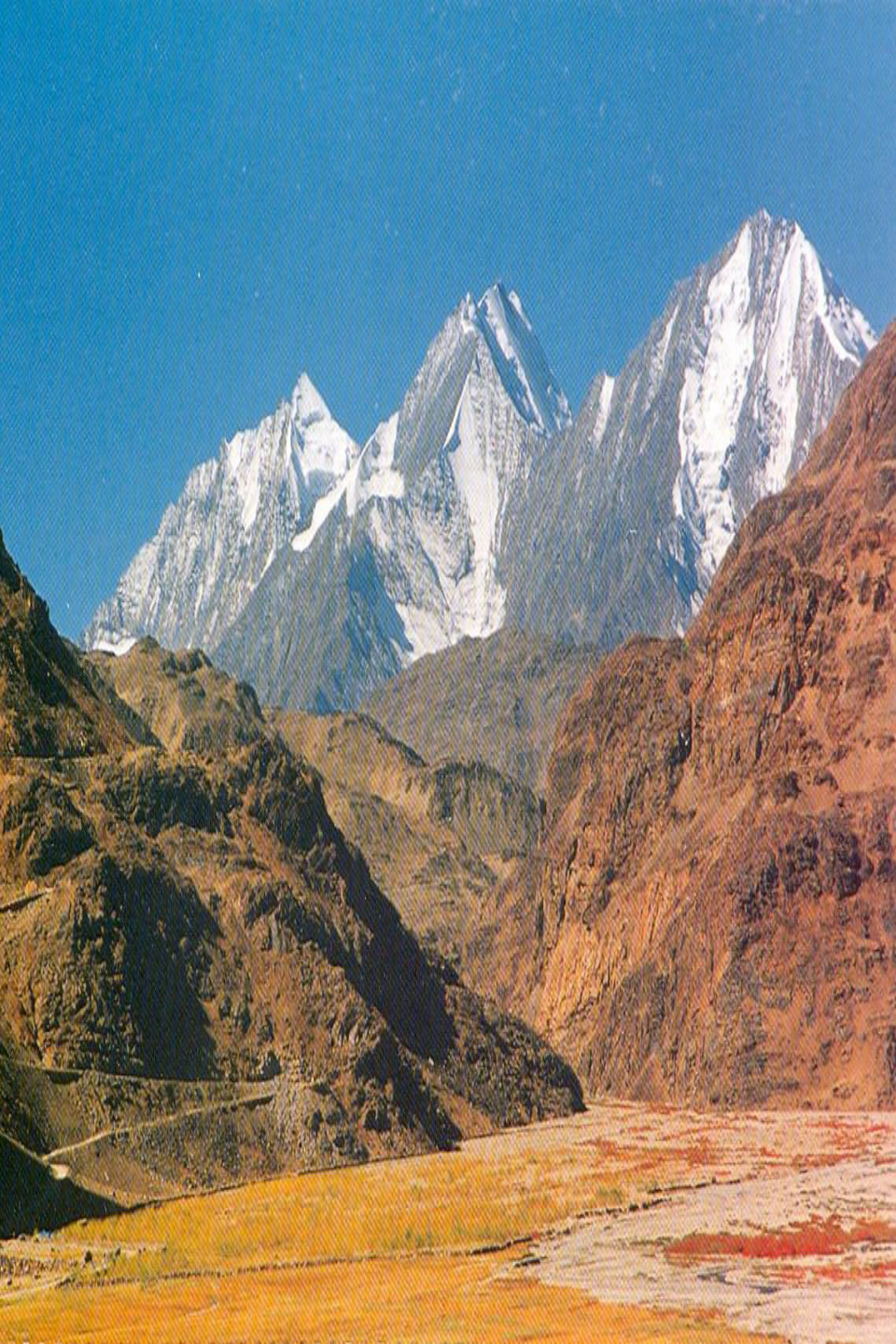
# Grow Trees

## Feasibility Assessment

- **Justification: Multiple Windows, Multi Layer Scrutinies**
- **Conditionality's; Standards; Methodologies**
- **Where: Land; Title, Boundary, its eligibility; requirements**
- **What: Species with all Technical/Silvicultural details**
- **General Requirements: Additionality, Leakage, Alternative Scenario Analysis, Baseline data**
- **Funding : Viability**
- **Documentation---PIN, PDD etc**

# Landscape

## Beyond Plains



- Availability
- Suitability
- Discreet Parcels
- Vicinity / Approachability
- Eligibility
- Strata
- Baseline
- Additionality
- Leakage

# FOREST S

- ✓ Eligibility
- ✓ Inventory
- ✓ Growth
- ✓ Composition
- ✓ Survival
- ✓ Permanence
- ✓ Existence for periodic Returns
- ✓ People Watch
- ✓ People Participation





Contd...

## STORE Carbon: Carbon Inventorying

- Quality Control and Quality Assurance
- Monitoring
- Samples ; Reporting
- All data to the minutest levels
- Records
- Verifications of Data, Field
- Numerous Steps; many Windows



## *Implementation Challenges*

*Contd....*

# Get Cash

- Market/Buyer(s)
- Money Transfer Mechanism
- Regulatory Levels
- Transaction Costs
- Payment mechanism

# Protection

- Institutional Arrangements
- Forest and Biomass Stock
- Climate/Calamity
- Maintenance Funding
- People's involvement





Pressure



# Suggestions Worth Sharing

- *Develop Project on Total Economic Beneficial plank: Highlight socio environmental outcomes*
- *Develop BC Project as a Sub Project of existing/ proposed Main Project*
- *Go for ERPA as soon as possible after Registration*
- *Keep Parameters Flexible to accommodate deviations*
- *Try to project the Project as a win –win work in any case*

*If not, better ignore it Or it will be pain not Gain*

*Uncooked is better than half cooked*



Gahin Lagore ( CDM Area )  
SP Gahin Lagore ( Nurpur Unit)



THANK YOU

