

Poplar culture for speedy Carbon Sequestration
in India: A case study from terai region of
Uttarakhand

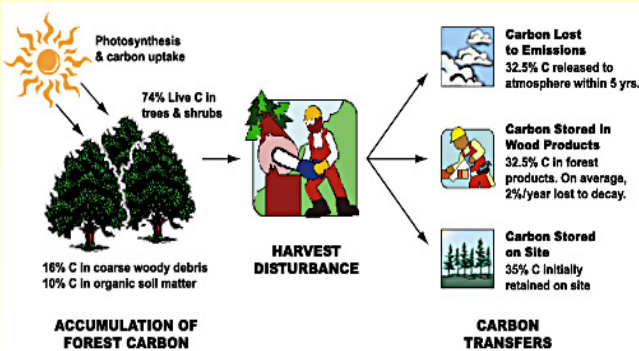
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Outline...

- Introduction
- Poplar and CDM requirements
- Study site and methodology
- Carbon sequestration potential & cost-effectiveness
- Challenges before Poplar A&R projects
- Agroforestry in REDD-plus

Carbon Sequestration in Forests

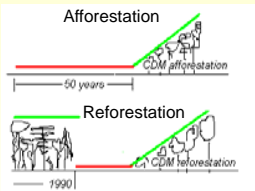


Important elements of Carbon Sequestration:

- Fast growth
- Rotation period
- Kinds of wood products

Forest sector and the CDM

- CDM forestry projects are limited to Afforestation and Reforestation (A&R).
- **Afforestation**
 - Planting with trees, the areas that have not been a forest for the last 50 years.
- **Reforestation**
 - Planting with trees the areas, that have not been a forest since 31st Dec 1989.



Contd....

Forest sector and the CDM

- A/R CDM project activities may include: *contd...*
 - Afforestation of wastelands
 - Reforestation of degraded forests
 - Agroforestry / Farm forestry
- CERs (**1CER = 1 tCO₂**) from forest sector are non-permanent (**two kinds – tCER & ICER**)
- Crediting period – 20x1, 20x2, 20x3, 30 years (fixed)
- Approved methodologies - 12 large scale & 7 small scale
- Registered projects in forest sector - 40 (7 from India)

Plantation models in Poplars



Block plantation on farm lands
(Agri-silviculture)

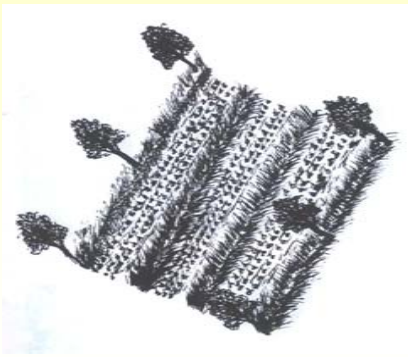
Plantation models in Poplars *contd...*



Bund plantation




Plantation models in Poplars

contd...



Inter-cropping on farm lands
(Agrisilvipastoral)

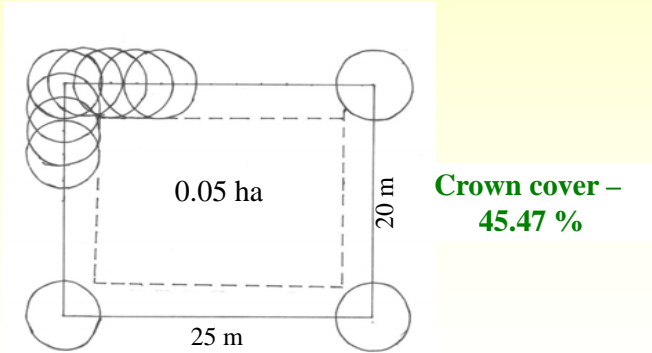
Whether Poplar meets CDM requirement on 'Forest' definition?

(a) Tree crown cover: 10~30%	
(b) Land area value: 0.05~1ha	
(c) Tree height: 2~5m	

The definition accepted by India is:
Minimum area – 0.05 ha
Minimum tree ht. at maturity – 2 m
Crown cover – 15%

Indian definition of 'Forest' & agro/farm forestry

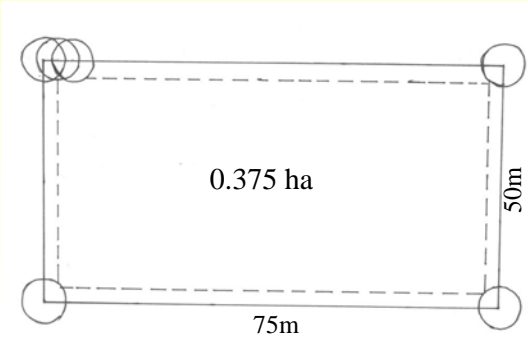
Poplar bund plantation - small farm
(Spacing – 2 m, crown dia. – 5.8 m²)



*Source: Dr. R.C. Dhiman

Poplar bund plantation - large farm

(Spacing – 2 m, crown dia. – 5.8 m)



Crown cover - 18.44 %

Gera Mohit, 2007

Poplar bund plantation: Farm size Vs Crown cover

(Crown dia. at 6 year – 5.8 m)

Farm size (ha)	Spacing (m)	Crown cover (%)
0.05	2	45.47
0.10	2	34.34
0.13	2	30.14
0.30	2	20.15
0.375	2	18.43
0.45	2	16.65
0.50	2	15.77

(Source: Gera, Mohit, 2007)

Carbon Pools eligible under A&R CDM Projects



AGB & BGB - One year old block plantation of Poplar, Vikrampur, Uttarakhand



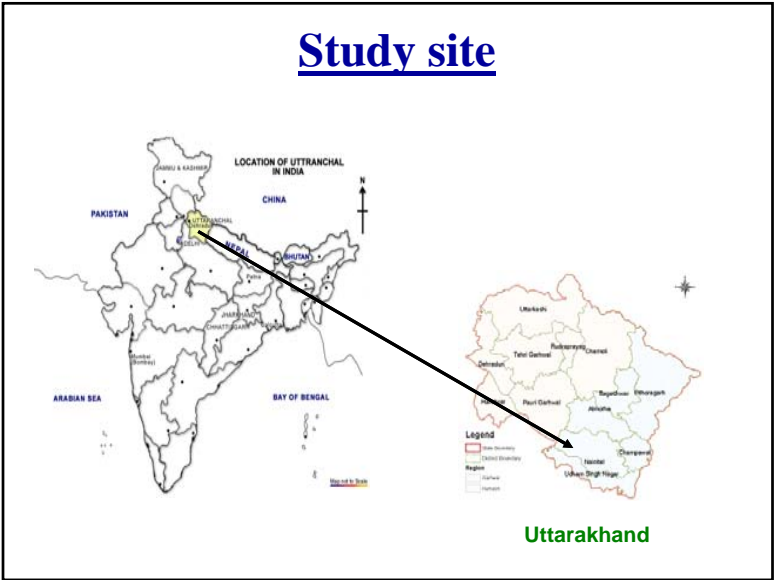

A sample of woody litter



Collection of a soil sample



Case study on estimation of Carbon Sequestration potential in Poplar



Location of selected villages

District – Nainital
Block - Ramnagar

Name of the village	Gram Panchayat	Latitude	Longitude	Altitude (m)
Kanchanpur Choi	Choi	29°21'46"	79°08'52"	369
Nandpur	Khempur	29°20'13"	79°11'30"	314
Kyaribandobasti	Kyari	29°21'59"	79°11'30"	361

Source : GPS readings

(Study period: 2005-06)

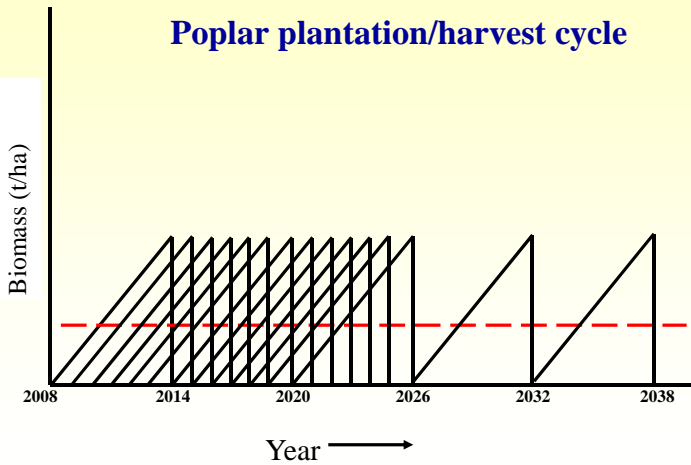
**Brief silvicultural details of selected
Poplar plantation**

Plantation intervention	Spacing (m)	Trees/ha	Survival (%)	Rotation (yrs)	Planting material	Harvest and planting
Poplar block	5×4	500	100*	6	ETP of G3, G48 & other clones	Uprooted and planted afresh on completion of every rotation during the CDM project period.
Poplar bund	2m	384**	100*	6	ETP of G3, G48 & other clones	Uprooted and planted afresh on completion of every rotation during the CDM project period.

* All failed plants assumed to be replanted

** For bund plantation, a farm size of 0.25 ha was assumed.

Poplar plantation/harvest cycle



Methodology - Biomass

- ❖ Selected representative Poplar plantation for measurements of AGB, Woody litter and Soil Organic Carbon (SOC).
- ❖ Randomly laid out 3 quadrats (25x20 m) in 3 different age classes for biomass estimation.
- ❖ Measured girth, height of all trees within a quadrat. AGB calculated using standard volume equation.
 - ❖ $AGB = \text{stem volume} \times BEF \times \text{wood density}$
- ❖ BGB was calculated by $AGB \times 0.27$.
- ❖ Carbon calculated by multiplying biomass value by 0.45.
- ❖ Woody litter samples (3No.) were also taken randomly from within the selected plots on 1x1m area.

Methodology - SOC

- 3 soil samples were taken from within the quadrats laid out for biomass estimation.
- Dug out a pit of 45 cm and collected the entire soil and made a representative sample for analysis from each quadrat/plantation.
- Analyzed the sample for SOC.
- Estimated the SOC in t/ha using standard methods.

Key input data on carbon pools

Plantation intervention	Mean annual increment (t/ha/yr)	Baseline AGB (t/ha)	Baseline soil carbon (t/ha)	Soil carbon uptake (t/ha/yr)	Woody litter (t/ha)
Poplar block	19.35	0	29.60	0.93 (6)*	0.26 (2.94)**
Poplar bund	14.86	0	33.75	0.56 (6)*	0.21 (2.94)**

* Accumulation period in years

** Decomposition period in years

Key input data on wood products

Plantation intervention	Wood product as % of MAI		
	Chip logs	Veneer logs	Fuel wood
Poplar block	20 (30)*	60 (30)*	18 (0)*
Poplar bund	20 (30)*	60 (30)*	18 (0)*

* Product life in years

PRO - COMAP MODEL

“Comprehensive Mitigation Assessment Process” (COMAP) for project activities (spread sheet model).

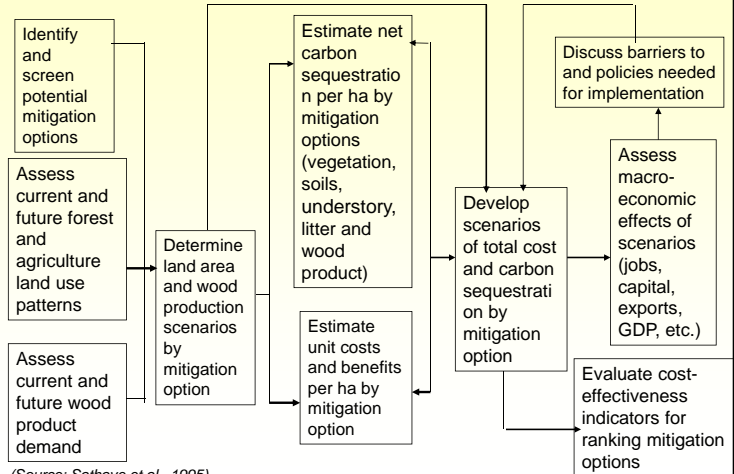
The model is used to analyze mitigation potential and cost effectiveness of C- sequestration projects.

It takes into account 5 C-pools

- ❖ Above Ground Biomass
- ❖ Below Ground Biomass
- ❖ Woody litter
- ❖ Soil carbon
- ❖ Harvested Wood Products

PRO - COMAP contd...

A broad framework



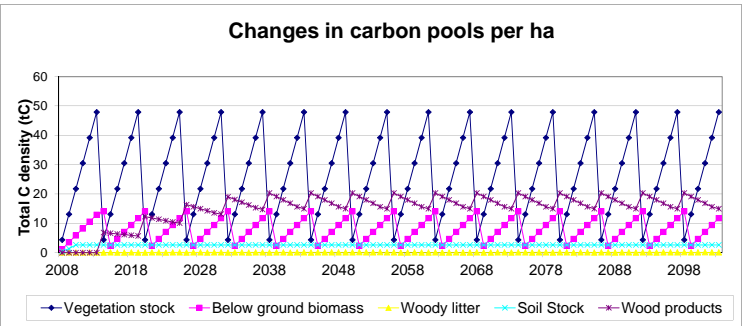
(Source: Sathaye et al., 1995)

Annual incremental carbon, total carbon sequestered, and likely annual carbon benefits

Plantation intervention	Initial cost [^] (Rs/ha)	Incremental carbon		Annual sequestration (tCO ₂ /ha/yr)*	Benefit @ \$5/t CO ₂ (Rs/ha/yr)**
		Per unit-area (tC/ha)	Annual (tC/ha/yr)		
Poplar block	13,700	39.76 (72.17)	1.33 (2.41)	4.86 (8.83)	1337/- (2428/-)
Poplar bund	7,450	31.48 (53.86)	1.05 (1.80)	3.85 (6.61)	1060/- (1817/-)

[^] Includes all costs incurred for establishment of plantations.
* $1tC = 3.67tCO_2$ ** $1\$ = Rs. 55/-$
(Figures in parenthesis refer to values for ‘with wood products’ case.)

Poplar block plantation



Internal rates of returns under different carbon price scenarios

Plantation intervention	Internal Rate of Return (IRR %)			
	Without carbon benefits	with carbon benefits		
		Scenario I	Scenario II	Scenario III
Poplar block	61.20	69.5 (69.8)*	70.9 (71.5)	74.3 (75.4)
Poplar bund	52.20	58.3 (58.6)	59.6 (60.2)	62.7 (63.9)

Scenario I - Carbon price \$5, IUS \$ = Rs. 55/-
Scenario II - Carbon price \$5 + 2% annual increase (backstop price \$50/tCO₂)
Scenario III - Carbon price \$5 + 5% annual increase (backstop price \$50/tCO₂)
(* Figures in parentheses show values for the ‘with wood products’ case.)

Carbon-sequestration potential of poplar as reported by different researchers

S. No.	Nature of plantation	C- sequestration potential tC/ha/yr	Reference
1.	Block Bund	2.54 (4.42)* 1.42 (2.46)	Gera <i>et al.</i> , 2006
2.	Block	1.98 (3.33)	Hooda <i>et al.</i> , 2007
3.	Block	1.33 (2.41)	Gera <i>et al.</i> , 2011a
4.	Block Bund	2.20 (3.83) 1.23 (2.13)	Gera <i>et al.</i> , 2011b
Average	Block Bund	2.01 (3.50) 1.33 (2.30)	

* Figures in parenthesis are for ‘with wood products’

Annual carbon sequestration by *Populus deltoides* at national level

- Total area – 312,000 ha
- Ratio of block and bund plantation – 60% : 40%
- Carbon sequestration (*without wood products*) –
542,240 tC/ha
- Carbon sequestration (*with wood products*) –
942,240 tC/ha

Challenges before forestry CDM projects

- Competing land uses
- Complex modalities & procedures under CDM
- Higher transaction costs
- Non-permanence (*low price of tCER or ICER*)
- Limited demand for CERs from forest sector
- Addressing 'additionality' may be difficult.
- Non-inclusion of HWP pool.

Agroforestry in REDD-plus

- Indian's definition of 'forest' favour agroforestry
- Plays key role in preventing deforestation and forest degradation
- Enormous scope for increasing removals
- Need for enabling legal and policy environment for
 - Tree rights and ownership
 - Security of investment
 - Market reforms

Thanks for your kind attention...

