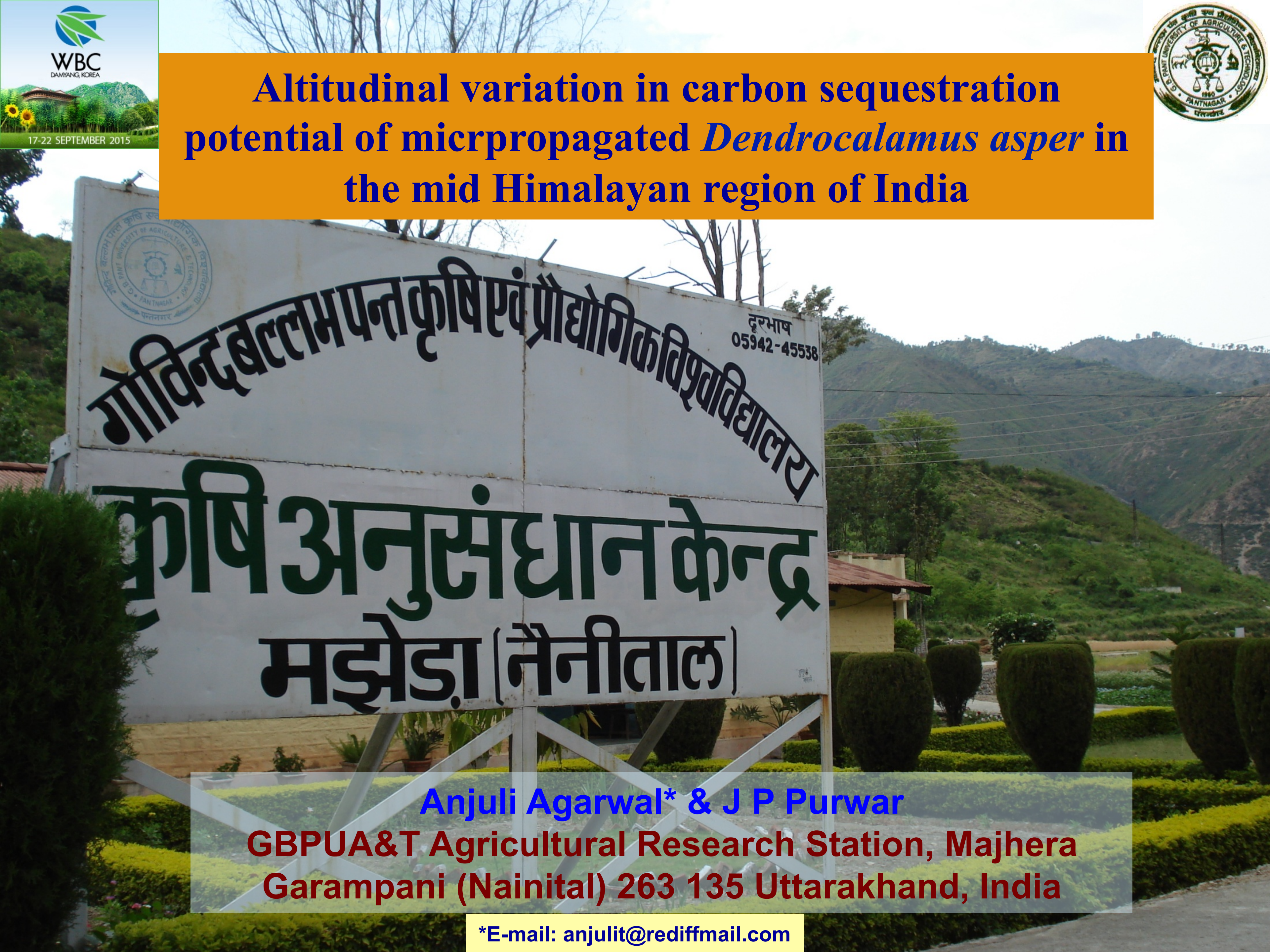
Altitudinal variation in carbon sequestration potential of micrpropagated *Dendrocalamus asper* in the mid Himalayan region of India



Anjuli Agarwal* & J P Purwar
GBPUA&T Agricultural Research Station, Majhera Garampani (Nainital) 263 135 Uttarakhand, India
*E-mail: anjulit@rediffmail.com

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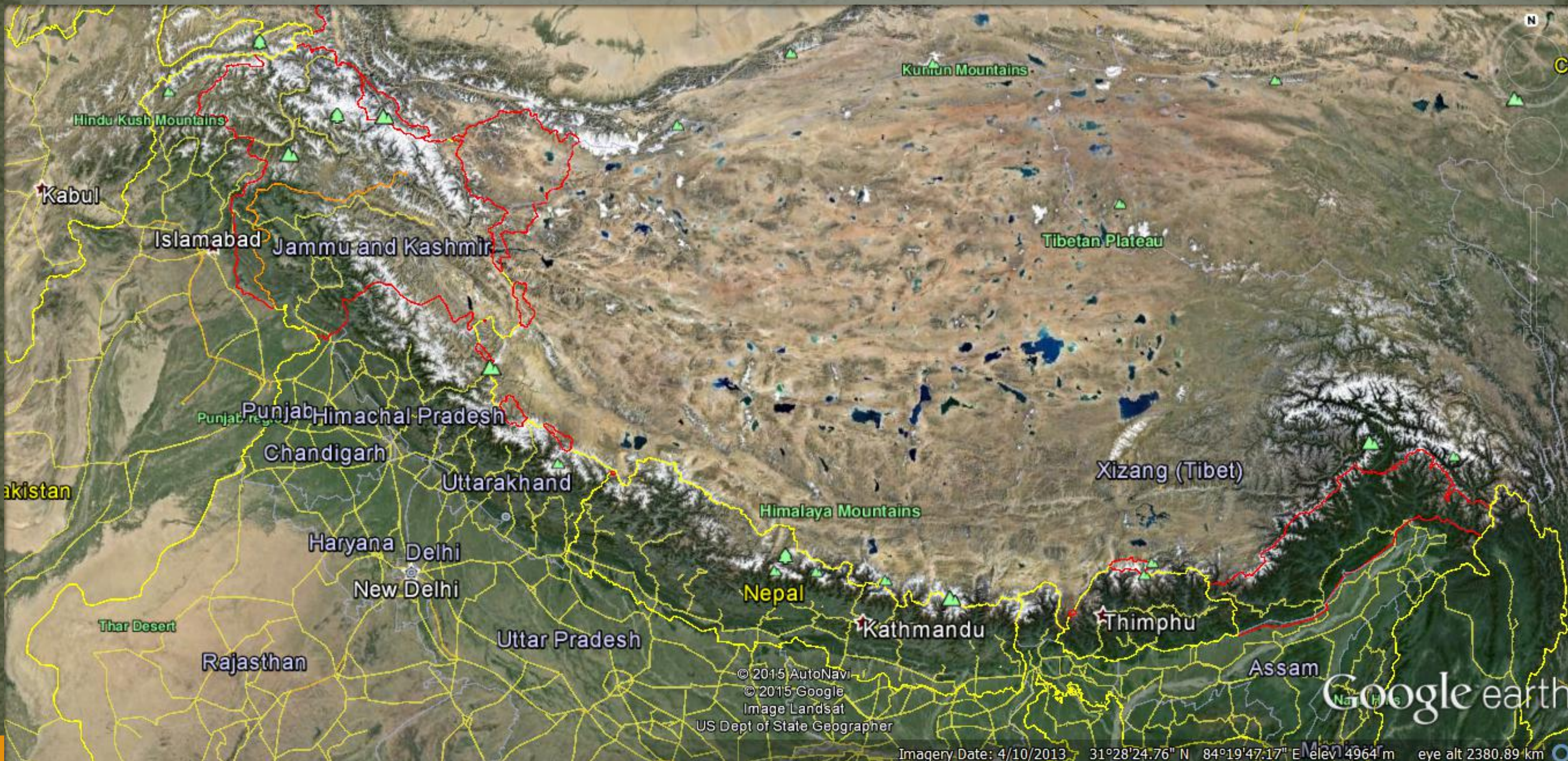
HIMALAYAS

World's longest and highest mountains (range 2,500 long & 400 km wide)



Includes - Most of Nepal, Bhutan, South Tibet, north of India up to Pakistan

Threat - Extremely sensitive to climate change
Great pressure on the forests

Dependence - High for forests reserves

BAMBOO STATUS

Shivalik Hills – Mountain range of outer Himalayas starts almost from the Indus and ends close to the Brahamaputra

- **about 2400km long**
- **10 – 50 km wide**
- **average elevation 1500-2000m**

Bamboo Species – Limited range

- *Dendrocalamus strictus*
- *Bambusa bambos*
- *Bambusa nutans*
- *Dendrocalamus hamiltonii*

Temperate forests – *widely distributed genera are*

- *Himalayacalamus*
- *Thamnocalamus*
- *Drepanostachyum* &
- *Yushania*

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UNFORTUNATE PART – Depletion at an alarming rate

Reasons : are many

- Degradation of natural habitats
- Forest fires
- Unscientific and illegal harvesting
- Insufficient plantation

ISSUE OF IMPORTANCE TO DEVELOPING COUNTRIES

Vulnerability of natural and socio economic systems to the projected climate change

CDM – CLEAN DEVELOPMENT MECHANISMS

Reduction of emmissions ↔ Plantations (with high potential to fix atm. CO_2)

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BAMBOO is the answer……..

Carbon sequestration studies – Utmost importance

Focus - HIMALAYAN REGION

AIM OF THE PRESENT STUDY

To evaluate the potential of micropropagated *Dendrocalamus asper* in carbon sequestration at various altitudes in mid Himalayan region of Uttarakhand state of India

Jarmila	**900 m ASL**
ARS, Majhera	**1000 m ASL**
Jeolikote	**1200 m ASL**
Alchauna	**1300 m ASL**
Mehragaon	**1400 m ASL**

METHODOLOGY

AGB estimation at various altitudes

Planting Material:	**Micropropagated plants of *D. asper***
Year of Plantation:	**2006 – 07**
Places:	**Various altitudes (900–1400m a.s.l.)**
Parameters recorded: (7 years after the plantation)	**Length of poles** **Girth at 1.0 & 1.5m** **Total number of culms**
Data recorded:	**Three culms/clump**

Above ground biomass (AGB) in *D.asper* was estimated using following regression equation (Agarwal & Purwar, 2009)

$$Y=(-.809)+(.393)b_1+(-6.68)b_2+(18.43)b_3$$

$R^2=0.98$

Where

Y- AGB $Kg\,pole^{-1}$, b_1 - height, b_2 - girth to height at 1.0m, b_3 - girth to height at 1.5m

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Jarmila elevation 900m

ARS Majhera, elevation 1000m

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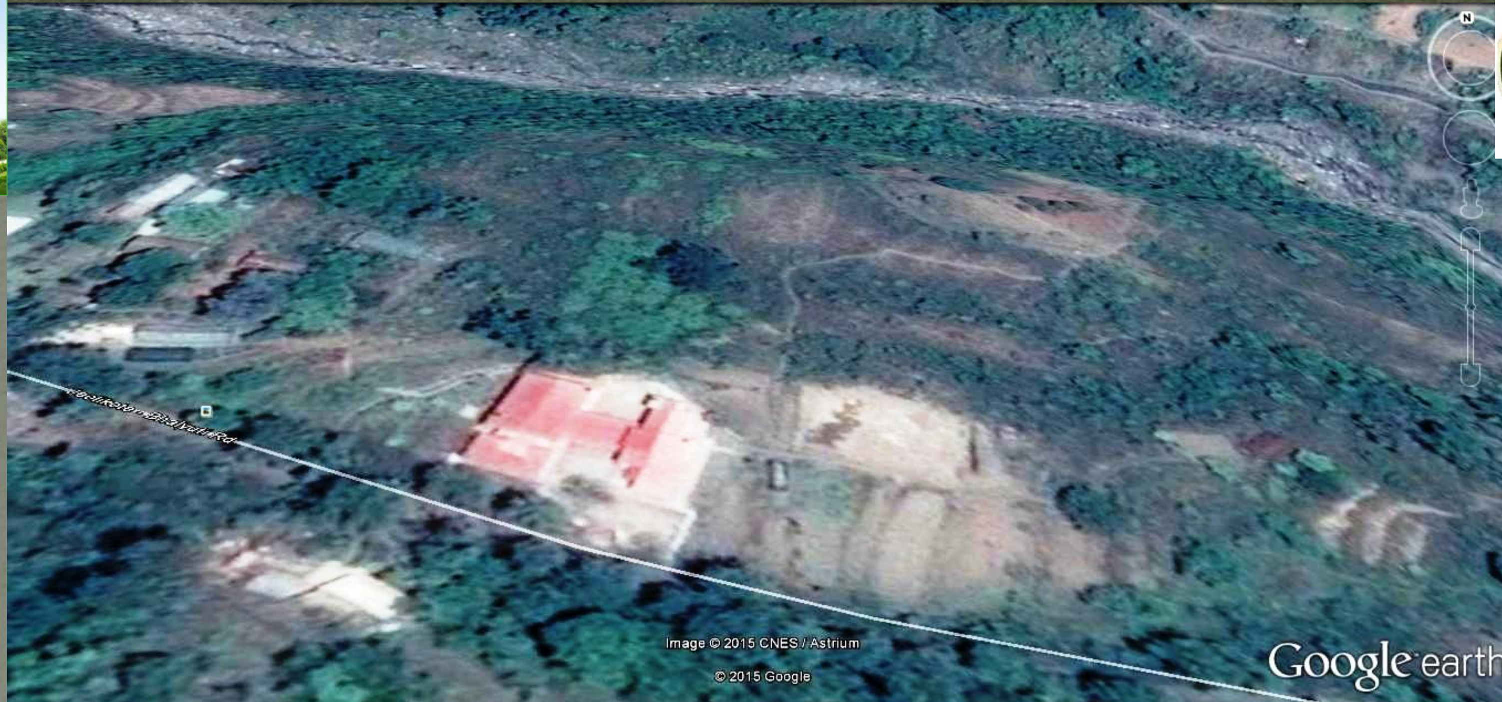

Jeolikote elevation 1200m

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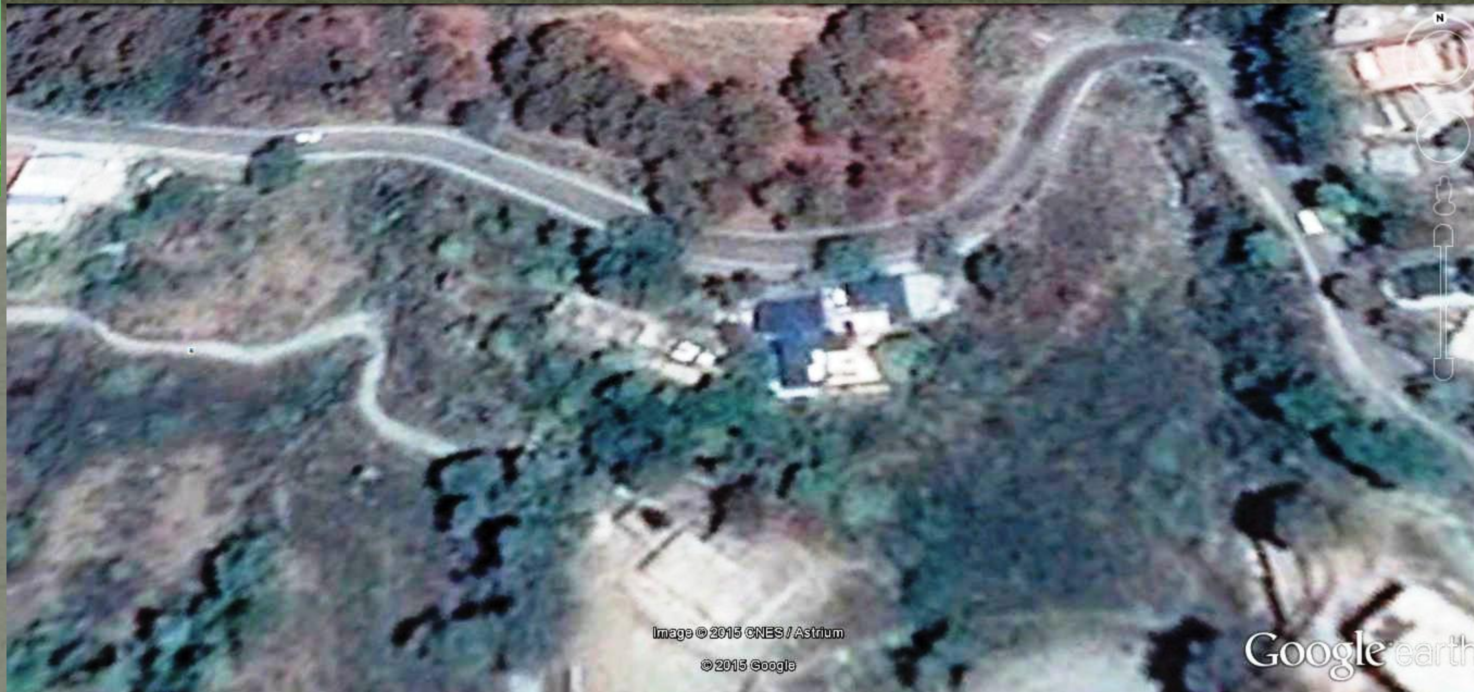


Mehra gaon elevation 1400m

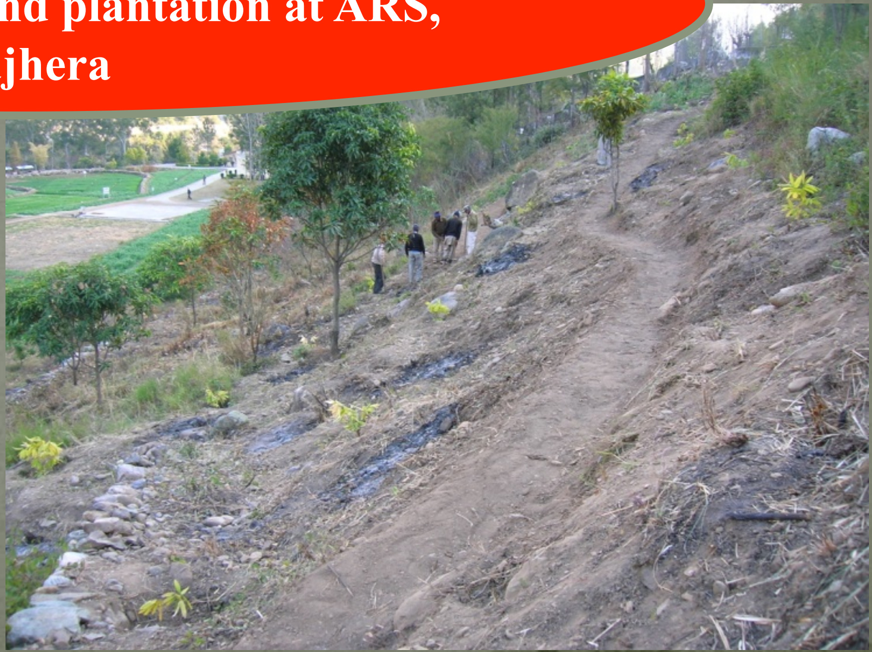
Cont……..

Annual increment in AGB at ARS, Majhera

Annual increment in the AGB of micropropagated plants of *D. asper*

Place:	ARS, Majhera
Year of plantation:	2009
Parameters:	as previous experiment
Data recorded:	Year (2011, 2012, 2013, 2014) (AGB could not be estimated in the year 2009 & 2010 as the height gained was less than 1.5 m)
Leaf area index recorded:	Every alternate month

Bamboo plant production through micropropagation and plantation at ARS, Majhera



RESULTS

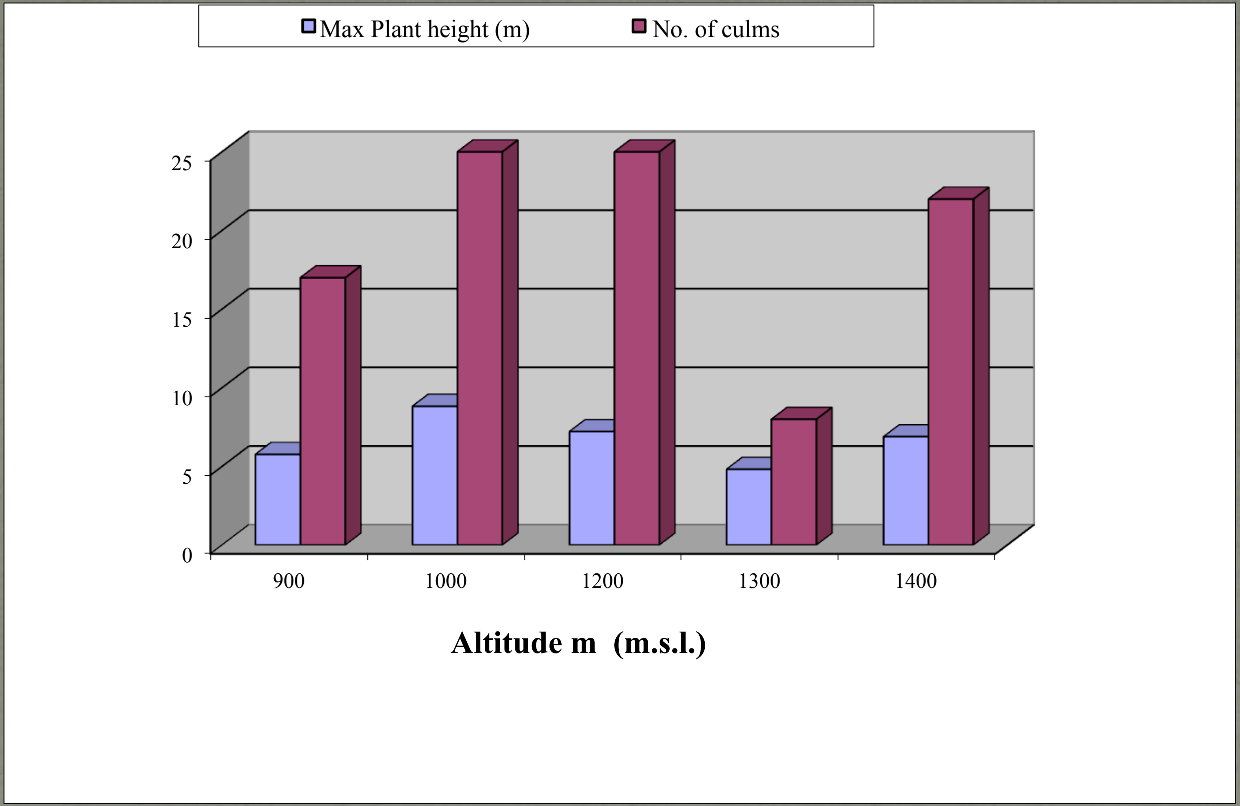
Above ground biomass and carbon sequestration by *D. asper* at various altitudes

Place	Altitude in meter (a.s.l.)	On dry weight basis above ground biomass (kg plant^{-1})	Carbon sequestered (kg plant^{-1})	Carbon sequestered (t ha^{-1})
Jarmila	900	45.38	22.69	9.08
ARS, Majhera	1000	121.70	60.85	24.34
Jeolikote	1200	66.89	33.45	13.38
Alchauna	1300	18.55	9.37	3.71
Mehragaon	1400	85.04	42.52	17.00

Per cent decrease in CS at other four places as compared to ARS, Majhera was

Alchauna	(84.75)
Jarmila	(62.70)
Jeolikote	(45.03)
Mehragaon	(30.12)

Growth pattern of micropropagated *D. asper* at various altitudes



No correlation between the altitude and different growth parameters

Maximum height -at 1000 m

No. of culms at par-at 1000 & 1200 m

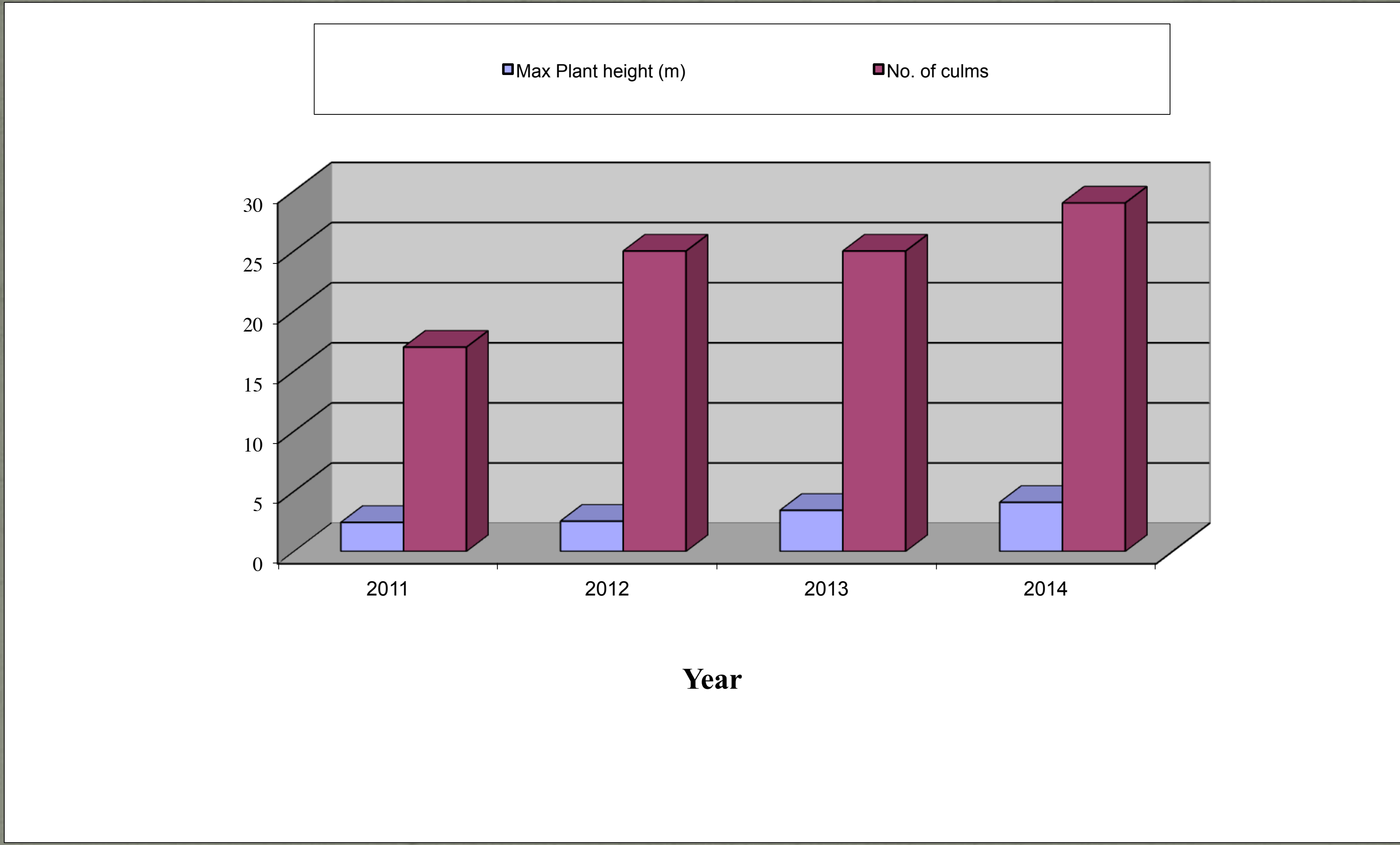
Pattern of annual increment in above ground biomass of *D. asper* at ARS Majhera

Year	Above ground biomass (On dry weight basis) kg plant^{-1}	Annual Per cent increase in above ground biomass	Carbon sequestered kg plant^{-1}	Carbon sequestered t ha^{-1}
2011	11.06 ± 1.6	-	5.53	2.21
2012	13.97 ± 2.0	26.31	6.99	2.79
2013	15.54 ± 2.0	11.23	7.77	3.11
2014	23.51 ± 2.4	51.28	11.76	4.70

From 2011 to 2014 – Per cent increase in CS 112.65

Bamboo plantation and growth in subsequent years at ARS, Majhera

Growth pattern of micropropagated *D. asper* at ARS, Majhera



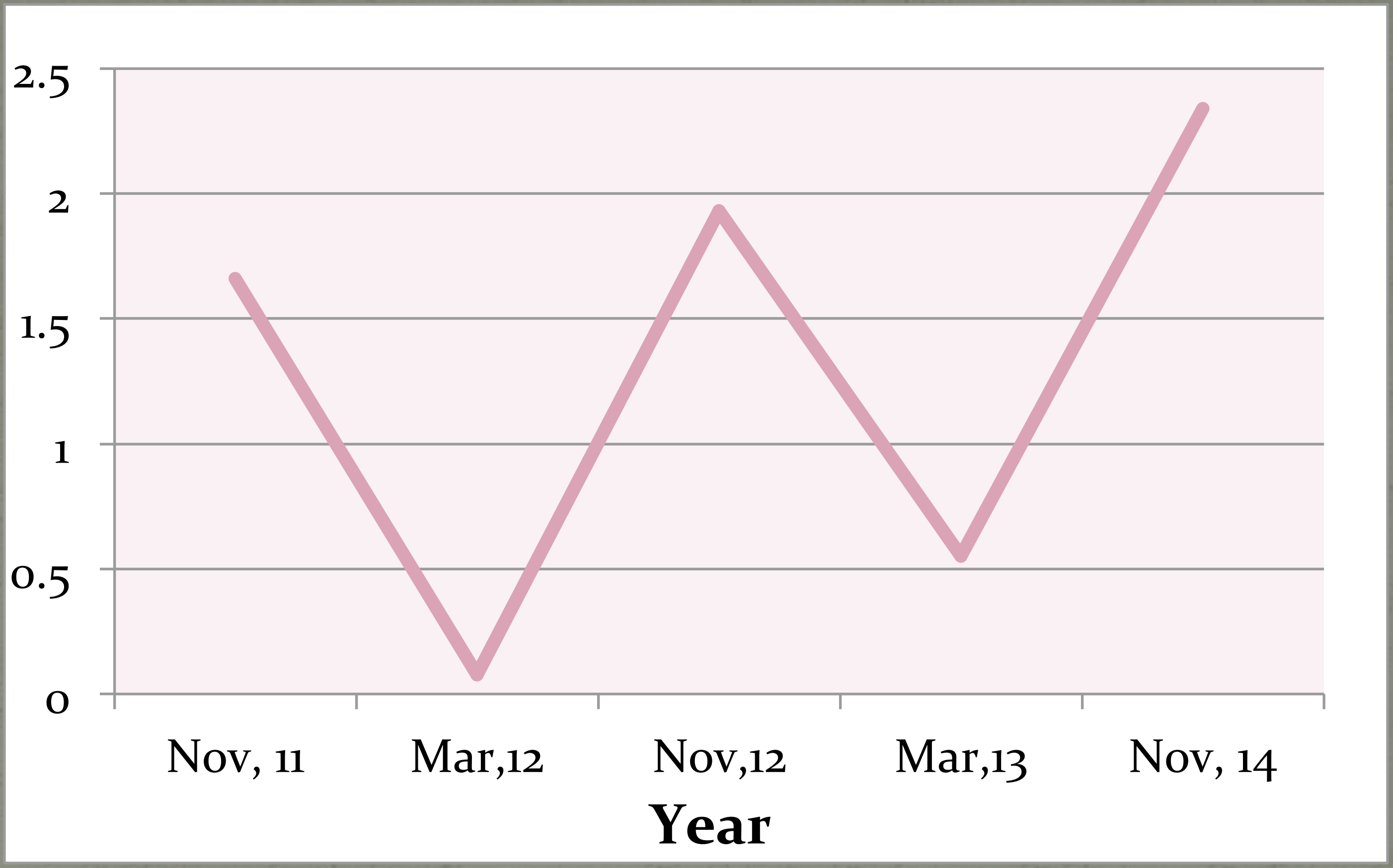
Annual per cent increase- **26.31 (III yr)**
11.23 (IV yr)
51.28 (V yr)

Leaf Area Index (LAI)

LAI is defined as the one sided green leaf area per unit ground surface area

LAI is used to predict photosynthetic primary production as a reference tool for crop growth

Leaf Area Index of *D. asper* at ARS, Majhera



Increasing trend from month of March to November indicates

ACTIVE PERIOD OF GROWTH

In consecutive years LAI varied from 1.66 to 2.14 of the November month

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CONCLUSION

	Present study	Other study	Remark
Total Carbon sequestration	24.3 $t\ ha^{-1}$ (7th year)	41.4 $t\ ha^{-1}$ (8th year)	Kao & chang, 1989
Annual increment in AGB	3.2 $t\ ha^{-1}$ (5th year)	9.3 $t\ ha^{-1}$ (12-15 year)	

FUTURE PLAN

Estimation of AGB in the managed and unmanaged micropropagated *D. asper* stands in the mid Himalayan region

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