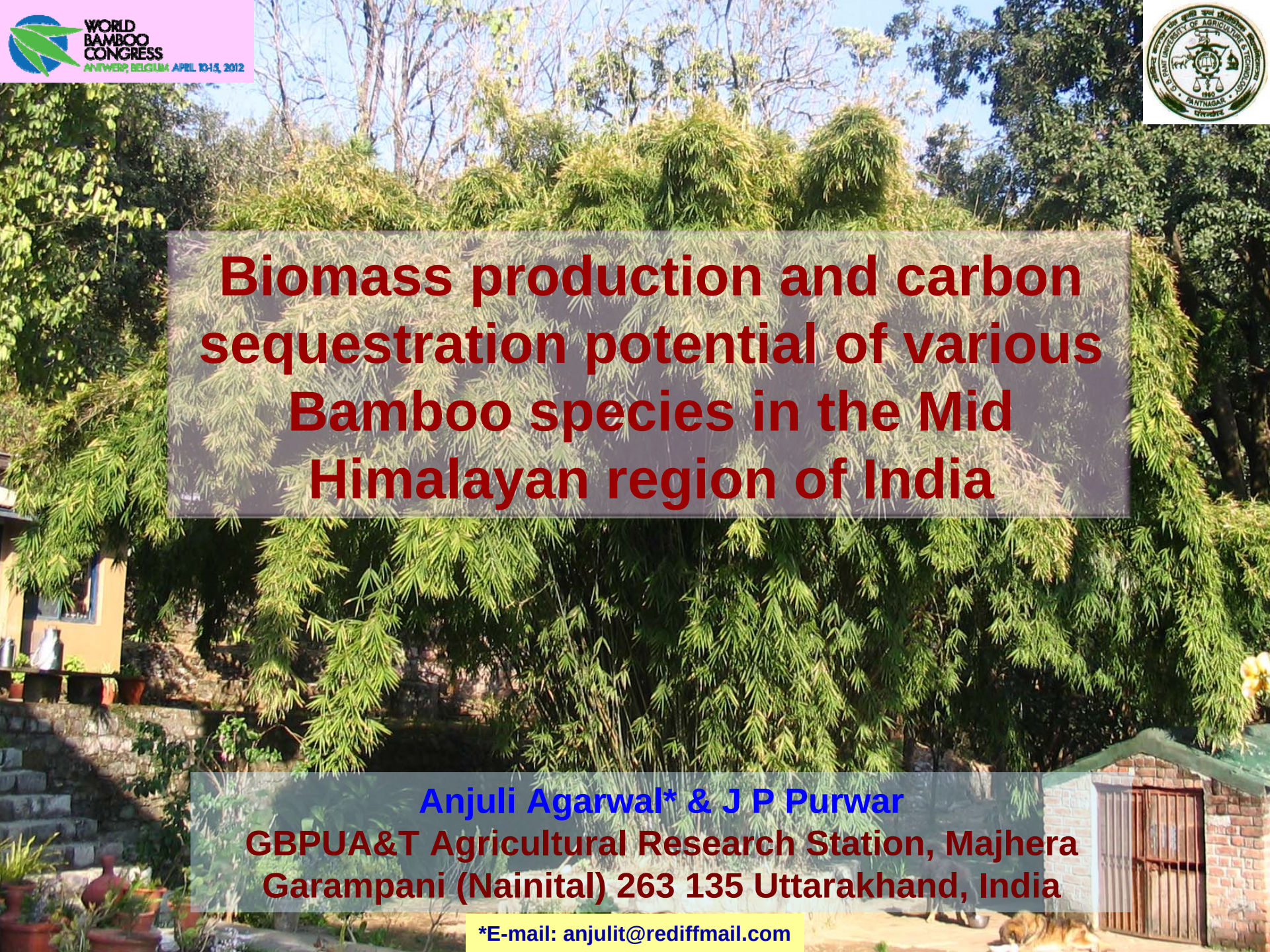

Biomass production and carbon sequestration potential of various Bamboo species in the Mid Himalayan region of India

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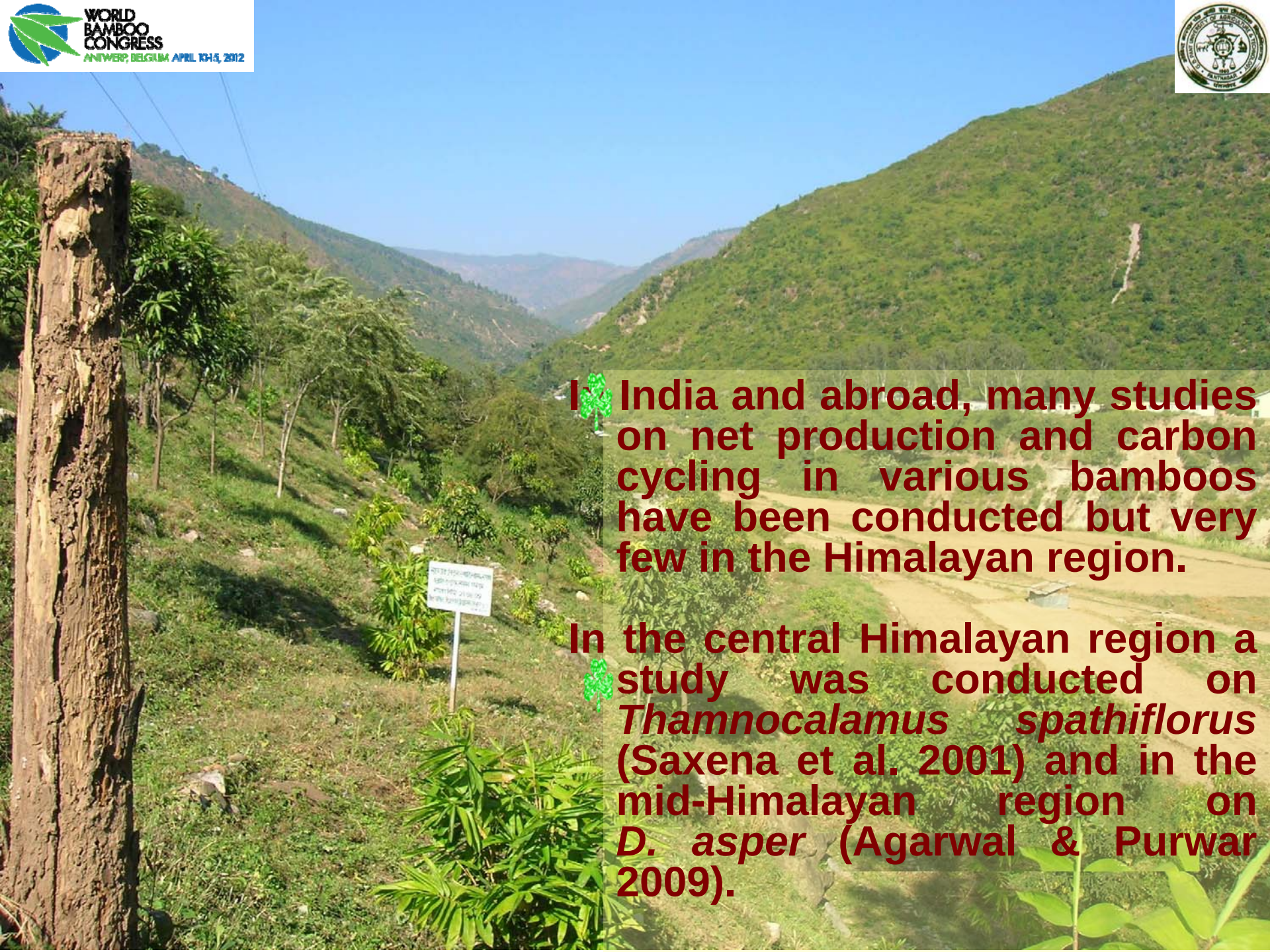
WORLD BAMBOO CONGRESS
ANTWERP, BELGIUM APRIL 10-15, 2012

BACKGROUND

- Bamboo is a versatile non-timber plant and produces substantial biomass.
- There are about 100 genera and 1000 species of sympodial and monopodial bamboos, distributed throughout the tropics, subtropics and temperate zones of the world.
- Among the 130 wild and cultivated bamboo species occurring in India (Sharma 1987), some are distributed throughout the Himalayas, with a variety of different genera adapted to different ecological zones.
- In the Siwalik hill region which is hot and dry, a limited range of species occurs, such as *D. strictus* & *B. bambos*.
- At higher altitudes, bamboos in the genera *Arundinaria, Thamnocalamus* & *Himalayacalamus* are common.

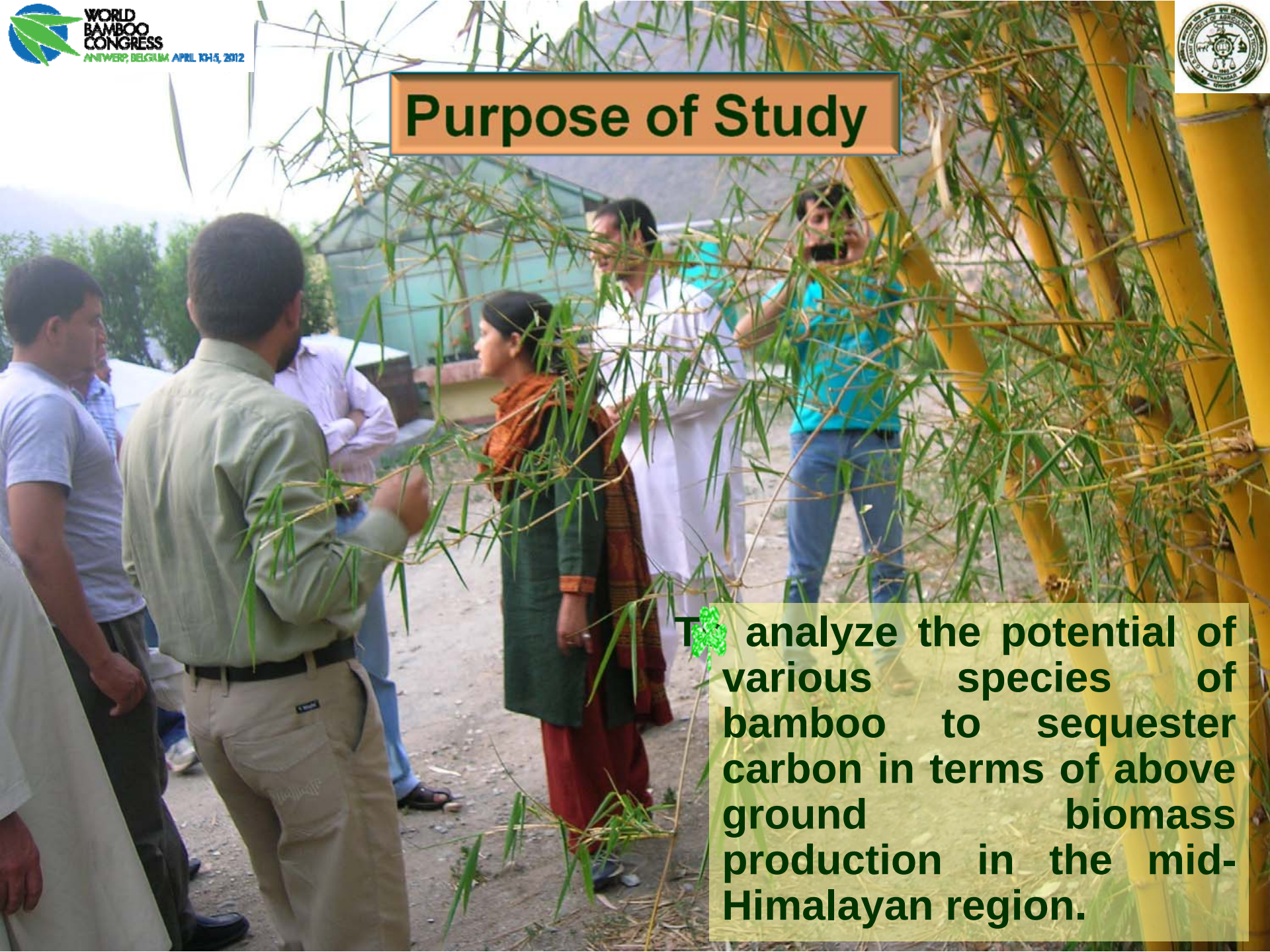


- In India and abroad, many studies on net production and carbon cycling in various bamboos have been conducted but very few in the Himalayan region.

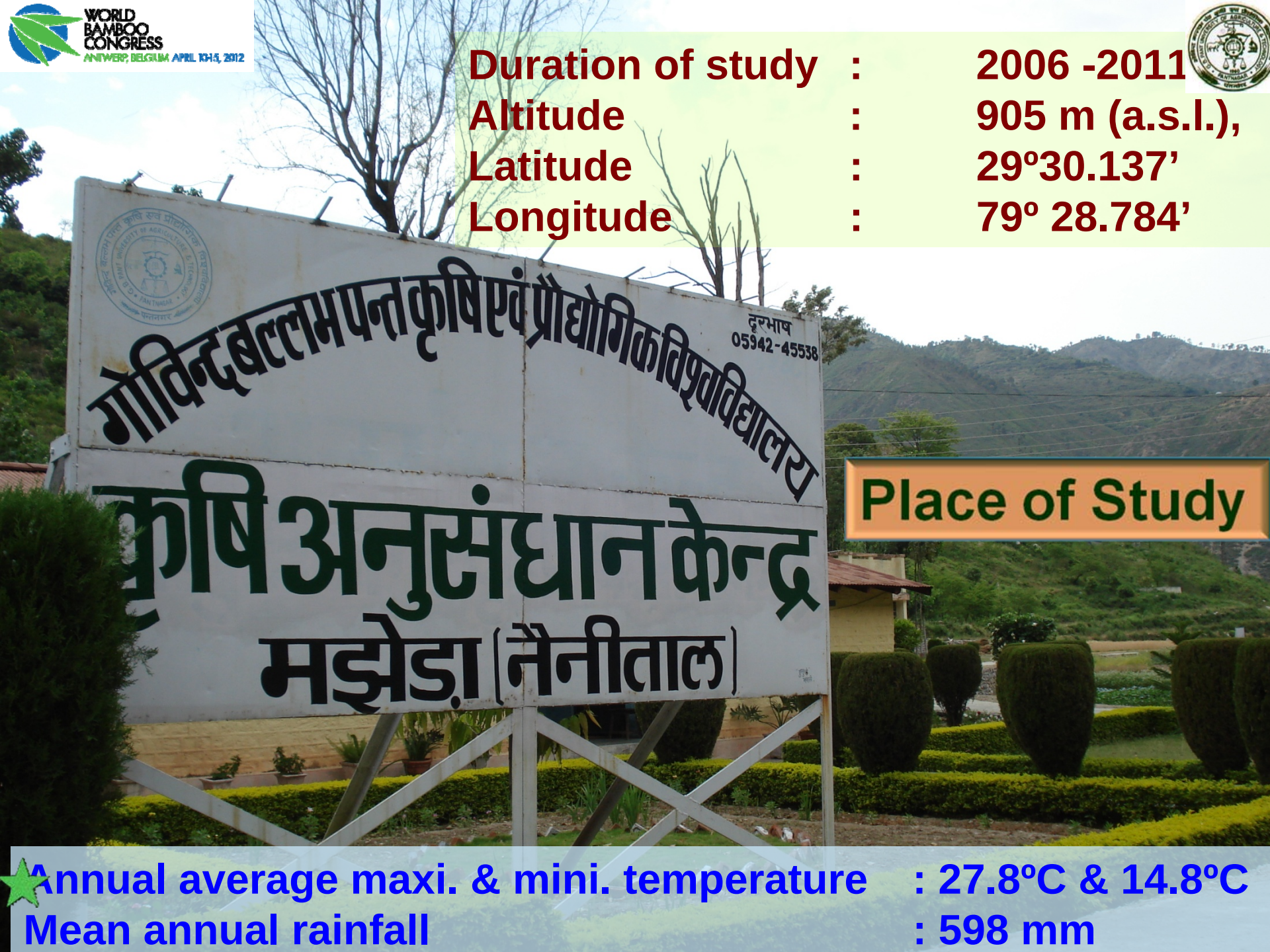
- In the central Himalayan region a study was conducted on *Thamnocalamus spathiflorus* (Saxena et al. 2001) and in the mid-Himalayan region on *D. asper* (Agarwal & Purwar 2009).

The Himalayas are extremely vulnerable to climate change, hence 'Sustaining the Himalayan Ecosysytem' is one of the missions under the National Action Plan on Climate Change

Purpose of Study



- To analyze the potential of various species of bamboo to sequester carbon in terms of above ground biomass production in the mid-Himalayan region.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ANTWERP, BELGIUM APRIL 10-15, 2012
Duration of study : 2006 -2011
Altitude : 905 m (a.s.l.),
Latitude : 29º30.137’
Longitude : 79º 28.784’
गोविन्दबल्लभपन्तकृषिएवंप्रौद्योगिकविश्वविद्यालय
दूरभाष
05942-45538
कृषिअनुसंधानकेन्द्र
मझेड़ा (नैनीताल)
Place of Study
Annual average maxi. & mini. temperature : 27.8ºC & 14.8ºC
Mean annual rainfall : 598 mm

METHODOLOGY

Bamboo Species

Dendrocalamus strictus	Sympodial
Bambusa vulgaris	
Bambusa multiplex	
B. bambos	
Phyllostachys nigra	Monopodial

Sampling

- July, 2011
- Five culms of various diameters and heights

Parameters recorded

- Total length, girth of culms at 1.0 m and 1.5 m, fresh and dry wt with branch and leaves of harvested culms
- Culms were harvested and FW with branch & leaves was recorded.
- DW estimation was done by shade drying until a constant weight achieved.

Statistical Analysis

- On the basis of FW & DW, linear regression equations were developed for the estimation of above ground biomass (Singh et al. 2009).
- Biomass accumulation per clump was extrapolated to per ha basis by multiplying with (KAU 2002).

Species	No. of Plants ha^{-1}	Spacing
D. strictus, B. vulgaris	400	5 x 5 m
B. multiplex	900	3 x 3 m
B. bambos	100	10 x 10 m
P. nigra	Culms per square meter	-

Carbon content estimation

- 50 % of the total above ground biomass (Scurlock et al. 2000).

Regression Equation		
Fresh wt	$Y=(5.31)+(-1.79)b_1+(-607.73)b_2+(764.36)b_3$ $S.E._1=2.47, S.E._2=935.44\ S.E._3=972.64$	$R^2=0.96$
Dry wt	$Y=(5.99)+(-1.77)b_1+(-584.09)b_2+(712.13)b_3$ $S.E._1=1.82, S.E._2=689.10\ S.E._3=716.50$	$R^2=0.96$

Y=Above ground biomass (y kg culm^{-1}), b_1= height (m), b_2 =Girth to ht at 1m, b_3 = Girth to ht at 1.5 m

Regression Equation		
Fresh Wt	$Y=(-4.82)+(3.52)b_1+(56.66)b_2+(-155.46)b_3$ $S.E._1= 0.28, S.E._2 = 24.16\ S.E._3 = 30.00$	$R^2=0.99$
Dry Wt	$Y=(-2.85)+(2.20)b_1+(19.43)b_2+(-79.86)b_3$ $S.E._1= 0.67, S.E._2 = 58.44\ S.E._3 = 72.56$	$R^2=0.99$

Y=Above ground biomass (y kg culm^{-1}), b_1= height (m), b_2 =Girth to ht at 1m, b_3 = Girth to ht at 1.5 m

Bambusa vulgaris

Regression Equation		
Fresh Wt	$Y=(-0.16)+(0.07)b_1+(4.41)b_2+(-2.54)b_3$ $S.E._1=15.75, S.E._2 = 210.06\ S.E._3 = 1785.04$	$R^2=1.00$
Dry Wt	$Y=(0.055)+(-0.035)b_1+(-0.20)b_2+(3.27)b_3$ $S.E._1=1.29, S.E._2 = 17.17\ S.E._3 = 145.91$	$R^2=0.99$

Y=Above ground biomass (y kg culm^{-1}), b_1= height (m), b_2 =Girth to ht at 1m, b_3 = Girth to ht at 1.5 m

Regression Equation		
Fresh Wt	$Y=(2.95)+(0.63)b_1+(-210.01)b_2+(265.86)b_3$	$R^2=0.93$
	$S.E._1=2.69$, $S.E._2=214.75$ $S.E._3=245.24$	
Dry Wt	$Y=(5.17)+(-0.14)b_1+(-323.78)b_2+(363.98)b_3$	$R^2=0.97$
	$S.E._1=1.32$, $S.E._2=105.59$ $S.E._3=120.58$	

Y=Above ground biomass (y kg culm^{-1}), b_1= height (m), b_2 =Girth to ht at 1m, b_3 = Girth to ht at 1.5 m

Bambusa bambos

Regression Equation		
Fresh Wt	$Y=(-1.23)+(0.93)b_1+(-20.70)b_2+(13.29)b_3$ $S.E._1=0.54$, $S.E._2=17.95$ $S.E._3=11.45$	$R^2=0.98$
Dry Wt	$Y=(-1.34)+(0.88)b_1+(12.20)b_2+(-22.44)b_3$ $S.E._1=0.68$, $S.E._2=22.45$ $S.E._3=14.33$	$R^2=0.93$

Y=Above ground biomass (y kg culm^{-1}), b_1= height (m), b_2 =Girth to ht at 1m, b_3 = Girth to ht at 1.5 m

Carbon sequestration on the basis of estimated above-ground biomass

amboo species	Biomass Kg culm^{-1}		No. of culms per clump	Biomass Kg clump^{-1}		No. of plants ha^{-1}	Biomass (t ha^{-1})		Carbon sequestered (t ha^{-1})
	FW	DW		FW	DW		FW	DW	
D. stritcus	6.05	2.22	44	266.2	97.6	400	106.5	39.1	19.5
B. vulgaris	2.53	1.62	16	40.4	26.0	400	16.2	10.4	5.2
B. multiplex	0.05	0.02	261	14.0	5.3	900	12.6	4.7	2.4
B. bambos	6.21	4.31	07	43.5	30.1	100	4.4	3.0	1.5
P. nigra	0.41	0.39	23*	54.4	51.9	2,30,000	94.1	89.8	44.9

*Number of culms per sq mt

CONCLUSION

- In all the five species girth at 1.5 m was the major deciding independent variable for biomass estimation.
- In the present study above ground biomass of *Dendocalamus strictus* was estimated to be 39.1 t ha^{-1} after six year of plantation.
- *Bambusa bambos* showed maximum biomass (6.21 kg) on a per culm basis among all the five species but culm density was poor and as a result total biomass estimated per hectare was low.

Cont..

Monopodial species (*Phyllostachys nigra)* has more potential to sequester carbon due to high density of culms and high per cent dry matter in the Himalayan region.

ACKNOWLEDGEMENT

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Thank You