The Ecoscan 10(1&2): 41-43, 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES
www.theecoscan.com

# BIOMASS PRODUCTION POTENTIAL IN DIFFERENT SPECIES OF BAMBOO IN CENTRAL UTTAR PRADESH

**PRASHANT KUMAR PATHAK, HEMANT KUMAR* GUNJAN KUMARI AND HALLIRU BILYAMINU**
*School of Forestry and Environment, SHIATS, Allahabad, U.P - 211 007
e-mail: hemantfri@gmail.com

**ABSTRACT**

To estimate the biomass production potential of different species of bamboo in Allahabad districts of U.P, total 7 species of bamboo viz. *Dendrocalamus strictus, Bamboosa bamboos, B. nutan, B. asper, B. bulgaris, B. tulda& B. balcooa* were selected. Each bamboo species was planted at spacing of 9 ×9 m. Each plot contains 124 number of clump per hectare of each bamboo species. This study assessed the growth performance and biomass potential of bamboo cultivation in the marginal upland in Allahabad of district of Uttar Pradesh. Research result shows that production system has significant ($p<0.05$) influence on growth performance and found maximum in *Bamboosa balcooa* (104.7t /ha) *and Bambusa bambos* (70.4 t /ha) while minimum in *B. asper* (7.12 t /ha). The result obtained shows that *B. balcooa* and *B. bambos* have comparatively high biomass accumulation potential than *B. nutanand D. strictus* while minimum *is* for *B.asper* for the dry areas. Therefore, a systematic bamboo cropping with sufficient management practices will be more beneficial towards the climate change mitigation and open up more opportunity for livelihood on a sustainable basis.

**KEY WORDS**
Bamboo cultivation
Biomass
Aboveground
Culms & potential

Received : 03.07.2015
Revised : 14.01.2016
Accepted : 24.02.2016

*Corresponding author

## INTRODUCTION

Bamboo is a woody grass belonging to the sub-family *Bambusoideae* of the family *Poacae*. Worldwide there are more than 1,250 species under 75 genera of bamboo, which are unevenly distributed in the various parts of the humid tropical, sub-tropical and temperate regions of the earth (Subramaniam, 1998). In India there are 125 indigenous and 11 exotic species of bamboo, belonging to 23 genera, distributedin 771821 sq. Km. area naturally and/or under cultivation (ISFR, 2013). Bamboo natural resource plays a major role in the livelihood of rural people and in rural industry. This green gold is sufficiently cheap and plentiful to meet the vast needs of human populace from the "child's cradle to the dead man's bier". That is why sometimes it is known as "*poor man's timber*". Bamboos has versatile uses as building material, paper pulp resource, scaffolding, food, agricultural implements, fishing rods, weaving material, substitute for rattan, plywood and particle board manufacture. Pickled or stewed bamboo shoots are regarded as delicacies in many parts of the country. A new land-use options that increase livelihood security and reduce vulnerability to climate and environmental change are necessary. Among these different cultivated bamboo species occurring in India, thorny bamboo or *Bambusa balcooa* is perhaps the most important in the rural areas of Uttar Pradesh. Due to its fast growth and development, bamboo is widely regarded as an ideal plant to sequester carbon and is expected to play a bigger role in mitigating the impact of future climate change.Beside its high economic value and importance, it has relatively highbiomass production potential (Scurlock et al., 2000).Traditional resource management adaptations such as agroforestry systems may potentially provide options for improvement in livelihoods through simultaneous production of food, fodder and firewood as well as mitigation of the impact of climate change (Anitha andPriya, 2012). One of the potential alternative energy sources which actively caters to the mitigation and adaptation of climate change and rehabilitation of marginal land is bamboo based agroforestry system. Bamboo has a great potential for biomass production and could be a significant net sink for Carbon dioxide sequestration(Kumar andKumari, 2010). In agroforestry, the potentially higher productivity could be due to the capture of more growth resources e. g. light or water or due to improved soil fertility. Several studies in different parts of the country suggested that agroforestry is more profitable to farmers than agriculture or forestry for a particular area of land (Tokey, 1997 and Samra *et al.,* 1999).The development and enhancement of bamboo cultivation can promotes economic and environmental growth, mitigates deforestation and illegal logging, prevent soil degradation and restores degraded lands in both village as well as urban area of India.The present study was conducted to estimate the biomass production potential of different species of bamboo viz. *Dendrocalamus strictus, Bamboosa bamboos, B. nutan, B. asper, B. bulgaris, B. tulda and B. balcooa* were selected.

## MATERIALS AND METHODS

The field experiment was carried out during year 2014-15 at Research Farm

School of Forestry and Environment, SHIATS, Allahabad (India) to assess the growth performance of bamboo cultivation on the marginal upland. The experimental site is situated at 25° 27' N latitude and 81° 51' E longitudes and at an elevation of 87 m above mean sea level. Total 7 species of bamboo viz. *Dendrocalamus strictus, Bambusa bamboos, Bambusa nutan, Bambusa asper, Bambusa bulgaris, Bambusa tulda* and *Bambusa balcooa* were selected. Each bamboo species was planted at spacing of 9 ×9 m. Each plot contains 124 nos. of clump per hectare of each bamboo species. After 5 years of plantation, each clump produces 15-20 harvestable culms from each clump. Harvest method was employed to estimate the aboveground. The sample from each clump was selected randomly and diameter and length were recorded by using tape.Biomass was calculated on hectare basis by multiplying the average weight of bamboo culm.The experiment was laid out by Completely Randomized Block Design (CRBD) replicated 5 times. In each replication, 5 culms were selected and data were recorded during the course of investigations subjected to statistical analysis of variance as suggested by Fisher and Yates (1963).

**Table 1: Variation in length (m) of bamboo culm of different species**

| Treatment | Length of Culm Mean | S.E. |
|---|---|---|
| *B.tulda* | 15.840 | 1.023 |
| *B.balcooa* | 15.620 | 0.999 |
| *B.nutan* | 11.860 | 0.279 |
| *B. asper* | 5.346 | 0.116 |
| *D. strictus* | 7.684 | 0.258 |
| *B. vulgaris* | 13.920 | 0.457 |
| *B. bambos* | 15.524 | 0.849 |
| C.D. | 2.085 | |
| SE(m) | 0.710 | |
| SE(d) | 1.004 | |
| C.V. | 12.956 | |
| F-test | S | |

## RESULTS AND DISCUSSION

### Culm height (m)

Culm height is mainly governed by genetic constitution of varieties but it's also significantly influenced by row spacing climatic condition prevailing and management practices. Perusal of Table 1 and Fig. 1, it was observed that the numerically maximum culm height was in *B. tulda*(15.84 m) followed by *B. balcooa*(15.62 m). The minimum culm height was observed in *B. asper* (5.34m). Culm height differs significantly from each other and so positive correlation in biomass production.

### Biomass allocation in different component of bamboo

The mean biomass allocation of the different culm component was in the order of culm (85.5%) > branch and leaves (7.51%) >rhizome (7.0%). ANOVA revealed significant difference between the values of biomass allocationamong these three components ($p < 0.05$). However, component wise changes in C concentration do not correlate with bamboo species and different culm age classes studied ($p > 0.05$) (Table 2).

### Biomass accumulation potential of different bamboo species (t/ hectare)

Though height and weight of bamboo culms related positively in different species but overall biomass and carbon sequestration in different bamboo species depends on length as well as diameter both. Estimation of above ground biomass is an important aspect of studies of carbon stock and effect of deforestation and sequestration on the global carbon balance estimating above ground biomass is a useful measure for comparing structural functional attributes of bamboo forest ecosystem across a wide range of environmental conditions. Total aboveground biomass accumulation was found maximum in *B. balcooa* followed *B. bambos* and *B. tulda* while minimum was in *B. asper* clumps after 4 years of age and ranged from 7.12 to 104 tons ha$^{-1}$ (Table 3). ANOVA revealed significant difference between the values of biomass accumulation among these seven species ($p < 0.05$). This

**Table 2: Biomass (kg) allocationsin different species of bamboo**

| Species | Avg. weight of culm(kg) | Weight of branch +leaves | Weight of rhizome | Total biomass |
|---|---|---|---|---|
| *B. tulda* | 33.62 | 2.194 | 2.03 | 37.85 |
| *B.bambos* | 35.92 | 2.254 | 2.5172 | 40.69 |
| *B. nutan* | 25.01 | 0.978 | 2.1152 | 28.10 |
| *B. asper* | 2.21 | 0.448 | 0.21 | 2.87 |
| *D.strictus* | 7.97 | 0.792 | 0.7186 | 9.48 |
| *B.vulgaris* | 30.97 | 2.678 | 2.2478 | 35.90 |
| *B.balcooa* | 48.06 | 3.488 | 4.7444 | 56.29 |

**Table 3: Biomass accumulation potential of different bamboo species (t/ hectare)**

| *Species* | Avg. Length(m) | Total weight above ground (kg) | Avg. diameter of culm(cm) | No. of culms produced/ year/clump | No. of clump/ ha | Avg. culm production /ha/year | Total biomass production (t/ ha) |
|---|---|---|---|---|---|---|---|
| *B. tulda* | 15.84 | 37.85 | 0.086 | 15 | 124 | 1860 | 70.4 |
| *B.bambos* | 15.62 | 40.69 | 0.099 | 15 | 124 | 1860 | 75.69 |
| *B. nutan* | 11.86 | 28.1 | 0.080 | 15 | 124 | 1488 | 41.82 |
| *B. asper* | 5.346 | 2.87 | 0.041 | 20 | 124 | 2480 | 7.12 |
| *D. strictus* | 7.684 | 9.48 | 0.059 | 11 | 124 | 1364 | 12.94 |
| *B.vulgaris* | 13.92 | 35.9 | 0.102 | 12 | 124 | 1488 | 53.42 |
| *B. balcooa* | 15.524 | 56.29 | 0.091 | 15 | 124 | 1860 | 104.7 |

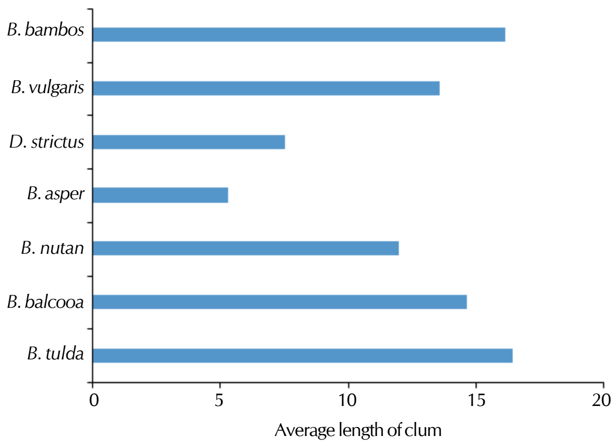


**Figure 1: Variation in length (m) of bamboo culm of different species**

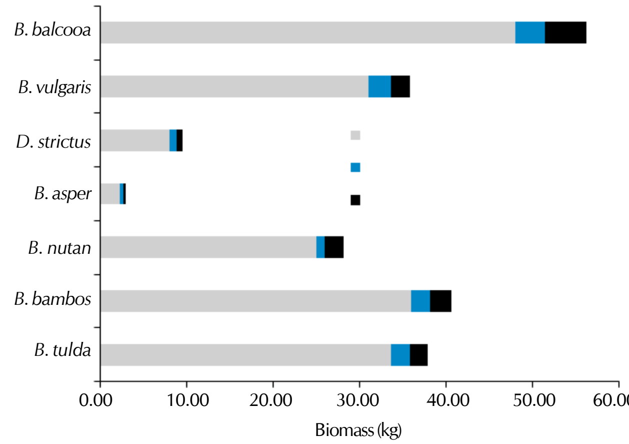


**Figure 2: Biomass (kg) distributions in different species of bamboo**

works out that *B. asper* has much lower biomass productivity than the reported value of Shanmughavel *et al*. (2001).

## ACKNOWLEDGEMENT

The authors gratefully acknowledge the School of Forestry and Environment, Allahabad, Sam Higginbottom Institute of Agriculture, Technology and Sciences Deemed- to be University, Allahabad for facilitating this experiment and providing basic facilities.

## REFERENCES

**Allen, S. E. 1989.** *Chemical Analysis of Ecological Materials*. 2nd edn. Blackwell Scientific Publications, Oxford. pp. 155-176.

**Anitha, S. and Sathya, R. and Priya 2012.** Review on benefits of Agroforestry system. *International J. Agricultural Science & Research*. **2(3):** 80-91.

**Anonymous 2013.** India State of Forest Report, Forest Survey of India, p. 68.

**Dhyani S. K., Sharda, V. N. and Sharma, A. R. 2003.** Agroforestry for water resources conservation: issues, challenges and strategies. *In: Agroforestry: Potentials and Opportunities* (Pathak, P.S. and Ram Newaj. Eds.). *Agribios (India) and ISA*. **34:** 1-12

**Dixon, R. K. 1995.** Agroforestry system: sources or sink of greenhouse gases, *Agroforestry System*. **31:** 99-116.

**Gadgil, S. 1995.** Climate change and agriculture – an Indian prospective, *Current Sciences*. **69:** 649-659.

**Kumar, A. and Kumari, S. 2010.** Sustainable development and bamboo cultivation for combating climate change in the Indian context-a review, *The Bioscan*. Special issue. **1:** 135-140.

**Kumar, B. M., Rajesh, G. and Sudheesh, K. G. 2005.** Aboveground biomass production and nutrient uptake of thorny bamboo [*Bambusabambos*(L.) Voss] in the homegardens of Thrissur, Kerala, *J. Tropical Agriculture*. **43(1-2):** 51-56,

**Newaj, R. and Dhyani, S. K. 2008.** Agroforestry system for carbon sequestration: Present status and scope, *Indian J. Agroforestry*. **10(1):** 1-9.

**NRCAF 2006.** Perspective Plan Vision 2025, NRCAF, Jhansi, U.P, 19-35.

**Ram, N., Lal, S. and Pramod Kumar 2010.** Bamboo plantation diversity and its economic role in North Bihar, *India, Nature and Science*. 8(11).

**Roelyn, F. Paelmo and Virgilio T.Villancio 2014.** Growth of Jatropha curcus L. under different short rotation-based agroforestry in Cuenca, Batangas, *Philippines, Crop Science Society of Philippines*. **39(3):** 34-44.

**Sampson, N. and Scholes, R. J. 2000.** Additional humaninduced activities.*In*: B. Watson, I. Noble, B. Bolin, N. R. Ravindranath, D. J. Verardo and D. J. Dokken (eds.) *Land Use, Land-use Change*pp. 157-245.

**Samra, J. S., Dhyani, B. L. and Sharma, A. R. 1999.** Problem and prospects of natural resource management in Indian Himalayas- A base paper. *Hill and mountain Agro-ecosystem Directorate, NATP, CSWCRTI, Dehradun.* p.146.

**Sathaye, J. A. and Ravindranath, N. H. 1998.** Climate change mitigation in the energy and forestry sectors of developing countries.*Annual Review of Energy and Environment*. **23:** 387-437.

**Shanmughavel, P. and Francis, K. 1996.** Aboveground biomass production and nutrient distribution in growing bamboo (*Bambusabambos*(L.) Voss). *Biomass Bioenerg.* **10:** 383-391.

**Shanmughavel, P., Peddappaiah, R. S. and Muthukumar, T. 2001**. Biomass production in an age series of *Bambusa bambos* plantations. *Biomass Bioenergy*. **20:**113-117.

**Sharma, Y. M. L. 1987.** Inventory and resources of bamboos, In: *Recent Research on Bamboos*, A.N. Rao, G. Danarajan and C.B. Sastry (Eds), Chinese Academy of Forestry and International Development Research Centre. pp. 14-27.

**Smith, J. and Scherr, S. 2002.** *Forest Carbon and Local Livelihoods. Policy Report.* Center for International Forestry Research (CIFOR) and Forest Trends, Bogor, Indonesia. pp. 38-227.

**Subramanium, K. N. 1998.** Bamboo Genetic Resources in India, K.Vivekanandan, A.N.Rao and V.Ramanatha Rao (Eds) *Bamboo And Rattan Genetic Resources In Asian Countries*, IPG-APO, Serdang Malaysia. pp. 18-27.

**Toky, O. P. 1997.** Poplar an economy booster and eco-friendly agroforestry tree. *Agroforestry News Letter*, NRC for Agroforestry. **9:** 2-3.

**Tripathi, S. K. and Singh, K. P. 1994.** Productivity and nutrient cycling in recently harvested mature bamboo savannas in the dry tropics. *J. Appl. Ecol.* **31:** 109-124.