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Original Research Article

Study on Growth and Economics of Bamboo Based Silvipastoral System

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Keywords

Bamboo, Forage, Silvipasture, Agroforestry system, Sustainable agriculture

A B S T R A C T

The experiment was conducted to evaluate the growth of bamboo with intercrops of forages under silvipasture system of agroforestry in randomized block design consisting seven treatments i.e. Bamboo intercropping with Sudan, Napier and Guinea grass, as well as sole bamboo, Sudan, Napier and Guinea grass. The plant height and crude protein percent of all the forage in the intercrops was showed more as compared to sole bamboo plantations, which is significantly more in T_1 treatment (Bamboo + Sudan) compared to other treatments. The total yield of forage intercrops of treatment T_1 was also significantly higher than other. The net return of *Bambusa vulgaris* with intercrops of forage crop was found maximum of Rs.1,22,405/ha in treatment T_1 in compare to sole sudan T_5 i.e. Rs. 74,097. The B.C. ratio was also maximum in T_1 having 4.40. The result indicates that *Bambusa vulgaris* with intercrop of sudan grass is compatible providind high economic return.

Introduction

In agroforestry systems, particularly in silvipastoral system, the trees of the farm play important role in the livelihoods of rural people by providing employment, energy, nutritious foods and a wide range of goods and also balances ecosystem. Well managed forests, which are permanent greenery, have tremendous potential to contribute to sustainable development and to a greater economy. What is lacking is empirical data that provides clear evidence of this, (FAO's State of the World's Forests report SOFO 2014). According to India State of Forest Report (ISFR, 2015) revealed the total forest and tree cover is 79.42 million hectare, which is 24.16% of the total geographical area. According to Planning Commission report "Greening India", that 33.33% forest cover can only be achieved through agro-forestry. 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 (Toky, 1997). Ecologically and economically with the type of tree including bamboo, crop and livestock, the agroforestry is sub-divided into agrisilvicultural, silvipastoral, agrisilvipastoral, hortisilvicultural, agrihorticultural and agrihortisilvicultural systems.

Bamboo plays a vital role in improving the socio-economic status of rural population. Worldwide, approximately more than 2.5 billion people trade in or use bamboo. India is one of the leading countries of the world, second to China in Bamboo production with 32.2 million tonnes per year. Bamboo species cover an area of 10.03 million hectare with 22 genera and 135 species. They contribute 12.8% of total forest cover of India (Berry, *et al.,* 2008).

Silvipastoral land use has been identified as a holistic approach to rehabilitate the degraded lands and wastelands through trees and bamboos for meeting the demand and supply of multitude of commodities by rural masses and conservation of natural resources under land use planning along with ecosystem management point of view. Therefore growing of bamboo along with grasses and legumes should be considered in degraded land to meet the requirement and socio economic upliftment of the rural people. To meet the demand of fodder for livestock and increasing use of bamboo; the bamboo based silvipasture system is much beneficial of the growing population in recent days. The objective of the experiment to study the growth of bamboo and forage crops as well as to assess the economics under bamboo based agroforestry system.

Materials and Methods

The experiment was conducted at Birsa Agricultural University, Ranchi during 2013-15 in experimental field of Birsa Agricultural University, Ranchi, India for the purpose of improvement in existing bamboo stock with intercropping of selected forage crops. The altitude of site is about 620 m above mean sea level and is almost plain with very mild slope towards Southern site. Geographically the site is located at $23^0$26”58.8N latitude and $85^0$18”53.5E longitude. The general climate of the region is sub-tropical with average daily temperature of about 34.03^0C. The region is characterized by hot summer and cold winter with mean temperature of 38^0C and during hottest month (May) is as high as 42.4^0C while mean temperature during coldest month varies from 2.2^0C to 17.4^0C. The mean relative humidity is about 70.88% in the area. The monsoon breaks out in the middle of June and last till mid-October. The annual rainfall in the area is about 1450 mm.

The forages were procured from the Faculty of Veterinary Science and Animal Husbandry, Birsa Agricultural University. The experiment was carried with Bamboo species (*Bambusa vulgaris*) planted in 2011 with intercropping of annual grasses viz. Sudan grass (*Sorghum sudanense*), Napier grass (*Pennisetum purpureum*) and Guinea grass (*Megathyrsu maximus*) in RBD design with three replications and seven treatment (T1=Bamboo + Sudan, T_2=Bamboo + Napier, T_3=Bamboo + Guinea, T_4=Bamboo, T_5=Sole Sudan, T_6=Sole Napier and T_7=Sole Guinea). The spacing of Bamboo species as 5 x 5 m and the row spacing of forage crops 25 cm x25 cm. Observation on parameters of the growth parameters of forage crops like plant height (cm), dry matter accumulation and yield were taken on harvesting *i.e*. after six months. The quality of forage crops like crude protein percent were estimated from forage sample nitrogen (N) content. The average all biological proteins contain 16% N, therefore protein content is estimated by multiplying N% by 6.25.

The cost of cultivation which is the expenditure incurred from sowing to harvest including the field preparation, cost of input materials such as seeds, fertilizations, insecticides, pesticides and the labour cost. Gross return is the total income obtained from multiplication of unit cost of main product as well as byproducts and its total yield, whereas net return is obtained by subtracting cost of cultivation from gross return. Also Benefit Cost Ratio (BCR) was calculated as the ratio of discounted value of benefit and discount value of cost.

Results and Discussion

The plant height of all the grasses in intercropping was found more as compared to sole forage (Table-1). The average height obtained in intercropping was 232.17, 139.68 and 166.92cm in T_1, T_2 and T_3 respectively; whereas in sole forage, the length was 221.37, 133.49 and 148.50cm in T_5, T_6 and T_7. Similar observation has been also reported who worked on by Katuromunda, (2001) *P. purpureum*, a perennial grass with a creeping rhizome and usually attains a height of 2-6 m at maturity, depending on the soil type and climatic conditions under which it is grown. The percentage of crude protein of all the forage in intercropping was observed more than sole grass. The crude protein percent of grasses is obtained in intercrop was 12.60, 14.03 and 12.05% in T_1, T_2 and T_3 respectively; whereas in sole forage, the crude protein percent of the grasses were 11.40, 13.23, and 12.30% in T_5, T_6 and T_7 respectively. Luis *et al.*, (2001) have indicated that the leaves of the grass *Penisetum purpureum* increases the percentage of crude protein (9.86 vs 7.97%), neutral detergent fiber (76.67 vs 74.87%), and acid detergent fiber (49.49 vs 38.37%) in situations under shade of *Enterolobium maximum* versus full sun.

The dry matter yield of all the grasses in intercropping was more as compared to sole grass except in T_3 where sole grasses had more dry matter as compared to intercrop. The yield obtained in intercropping was 80.16, 81.78 and 86.96 qha^{-1} in T_1, T_2 and T_3 respectively whereas in sole forage, the yield was 79.63, in T_5, 68.20 in T_6 and 84.51 qha^{-1} in T_7. The forage yield (qha^{-1}) under silvipasture system indicated that the yield of all the grasses in intercropping was maximum as compared to sole forage. The dry matter yield were 432.82, 126.48, and 227.68 qha^{-1} in T_1, T_2 and T_3 respectively; whereas in sole forage, the dry matter yield were 376.39 qha^{-1} in T_5, 121.33 qha^{-1} in T_6 and 231.84 qha^{-1} in T_7.Similarly, Boonman, (1993) has reported that the yields surpass those of Rhodes grass (*Chloris gayana*), Setaria (*Setaria sphacelata*) and Kikuyu grass (*Pennisetum clandestinum*) which are popular pasture grasses but which yield between 5 to 15 tonnes of DM per year. Similar finding was found by Aderinola, (2007) explaining that yield of the native *Panicum maximum* during the rainy season could be somewhat high; the productivity however declines sharply during the dry season.

The difference between all treatments in the present experiment was found highly significant in plant height, crude protein content and dry matter yield and forage yield of grasses.

The economics of *Bambusa vulgaris* based agroforestry system in terms of money, i.e. financial yield was calculated for each treatments including sole of *Bambusa vulgaris* and pasture on the basis of market rate (*Bambusa vulgaris*- Rs. 60/culm, Sudan grass-Rs.250, Napier grass -Rs. 225 and Guinea grass-Rs. 250 q^{-1} as fresh pasture) and are presented in Table 2. The net return of *Bambusa vulgaris* and pasture showed maximum in treatment T_1 (Rs.122405/ha) followed by T_3 (Rs.48499/ha) and minimum in T_2 (Rs.65858/ha) whereas in sole pasture, the maximum total return was in T_5 (Rs.74097) followed by T_7 and minimum in T_6 (Rs.11499). These indicate that in silvipastoral system, the net return was more than that of sole forage. Similar trends were found in case of net return.

Table.1 Plant height, crude protein content, dry matter yield and forage yield of forage

Treatment	Plant height (cm)	Crude protein %	Dry matter yield (qha^{-1})	Forage yield (qha^{-1})
T_1	232.17	12.6	80.16	432.82
T_2	139.68	14.03	81.78	126.48
T_3	166.92	12.05	86.96	227.68
T_4	No forage crops			
T_5	221.37	11.4	79.63	376.39
T_6	133.49	13.23	68.20	121.33
T_7	148.50	12.30	84.51	231.84
CD (5%)	12.602	2.029	9.966	20.184
CD (1%)	17.924	2.886	14.175	28.709
CV%	12.612	28.125	21.465	13.882

Table.2 Economics of *Bambusa vulgaris* based agroforestry system

Treatments	Total cost	Total return			Net return	B:C ratio
		Bamboo	Forage	Total		
T_1	27800	42000	108205	150205	122405	4.40
T_2	24600	62000	28458	90458	65858	2.60
T_3	23800	55999	56920	112919	48499	3.74
T_4	18500	67999	-	67999	48499	2.67
T_5	20000	-	94097	94097	74097	3.70
T_6	15800	-	27299	27299	11499	0.72
T_7	18600	-	57960	57960	39360	2.11

The ascending order of B: C ratio of the treatments was followed as T_6>T_7>T_2>T_4>T_5>T_3>T_1. Similarly, Ahlawat, *et al.*, (2008) reported that the benefit-cost ratio (B:C ratio) of chickpea intercrop varied from 2.05-2.86 as compared to 2.13-3.60 of the sole crop during initial three years in bamboo based agroforestry system; whereas the B: C ratio of sesame intercrop varied from 1.14-1.95 as compared to B:C ratio 1.43-2.43 of sole crop and Proyuth *et al.*, (2012) described that a bamboo-based cropping system compared favorably to several other land use alternatives in the area.

Compared to cassava, rice and maize intercrops, bamboo provides 49–89% higher average return.

The present study has guided to draw conclusion that the bamboo based agroforestry system are viable in degraded or waste land having significant implication on the nutritive quality of grasses; besides also gives higher return through different intercrops viz., sudan, napier and guinea grasses.

These forage intercrops also help to improve the soil health. There is still a substantial need to promote bamboo-based agroforestry systems as well as utilization of bamboos to the extent possible in wasteland particularly in economic backward areas.

The cumulative outcome of silvipasture system is found more than that of either sole bamboo planting or sole pasture practices.

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References

Aderinola O A 2007. Herbage Production and Utilization of *Andropogon tectorum* as Influenced by fertilizer application and legume intercrop. Ph.D Thesis Department of Animal Production Health, Ladoke Akintola University Technology, Ogbomoso.

Ahlawat S P, Kumar R V, Gupta V K, and Dhayni S K 2008. Scope of bamboo based agroforestry system in India. In proceeding of national conference of "Bamboo management, conservation, value addition and promotion" Held at TFRI Jabalpur, India, 89pp.

Berry N, Singh Neelu, Pal R S 2008. Bamboo Potential in agroforestry systems. In: proceeding of national conference of "Bamboo management, conservation, value addition and promotion" held at TFRI Jabalpur, India, 103pp.

Boonman J G 1993. East Africa's grasses and fodders: Their ecology and husbandry. Kluwer Academic Publishers, Dortrecht, Nethelands, 343pp.

FSI 2015. State of Forest Report, Ministry of Environment and Forests, Dehradun, India.

Katuromunda S 2001. Enhancing and sustaining the productivity of crop-livestock. Ph.D. thesis, Uganda.

Luis F I, Melode M E, Ferreira V J, and Alexandre V F 2001. Effect of shading by native tree legumes on chemical composition of forage produced by *Penisetum purpureum*in Acre, western Brazilian Amazon. In Proceedings of the second International Symposium on Silvopastoral Systems. Second congress on Agroforestry and livestock production in Latin America. M. Ibrahim (eds.), San Jose CR, CATIE-GTZFAO, 197 – 202pp.

Proyuthly, Didier Pillot, Patrice Lamballe, Andreas de Neergaard 2012. Evaluation of bamboo as an alternative cropping strategy in the northern central upland of Vietnam: Above-ground carbon fixing capacity, accumulation of soil organic carbon, and socio-economic aspects. *Journal of Agricultural Ecology and Environment*, 149: 80-90.

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