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Albizia procera Based Silvipastoral System: An Ideal Alternate Land Use System for Sustainable Forage Production in Semi-Arid Region

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Albizia procera based silvipastoral system: An ideal alternate land use system for sustainable forage production in semi-arid region

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Introduction

India's economy is agro-based and about 69% of the total population depends on it for their livelihood (GoI, 2013). Livestock is the integral component of Indian agriculture since time immemorial. Its contribution to national economy through milk, meat, wool as well as farmyard manure is enormous. India has the largest number of livestock, representing over 17% of the world. Among four important species of livestock, cattle represent over 43% of the population followed by buffaloes (19%), goats (26%) and sheep (10%). The share of livestock reared is highest in marginal followed by small and semi-medium land holders implying that marginal holders and small land holders are playing seminal role in development of livestock sector in country. The productivity of livestock and growth of animal husbandry are closely linked with the biomass and quality of forages. Currently there has been radical change in realising the importance of forages in integrated farming system, crop diversification, watershed management, restoration of degraded lands and climate resilient agriculture. Grasslands represent some 70% of global agricultural land area; unfortunately as much as 35% of the grasslands are degraded. The insufficient fodder availability has adversely affected all the three systems of livestock production. Silvipasture systems is an integrated approach of growing ideal combinations of grasses, legumes and trees for higher land productivity, conserving biodiversity and nutrients and producing forage, timber and firewood from a single unit area on a sustainable basis. The trees and shrubs used in silvipasture are used primarily to produce fodder for livestock. Looking at the enormous production potential of the slivipastoral systems, it is pertinent to introduce these in the arid and semi-arid regions so that large area of wasteland which is not suitable for crop production can be used for of fodder and biomass production. Dev *et al*. (2014) observed significant impact of participatory silvipastoral intervention and soil conservation measures for forage resource enhancement in western Himalaya. The study aims to present the suitability of silvipastoral systems in detail and advocate the extensive use of silvipasture in semi-arid regions for higher production.

Materials and Methods

The study was carried out at the research farm of Central Agroforestry Research Institute, Jhansi (Uttar Pradesh), India during 2007-2013 in an ongoing experiment on "Initiation of pruning and its intensity on productivity of *Albizia procera* based silvipastoral system". The site of experimental field was situated at 25° 30' - 25° 32' N latitude and 78° 32' – 78° 34' E longitudes at an altitude of 272 m. Annual rainfall of the area ranged from 700-1150 mm. The potential evaporation was quite high in the range of 1400-1700 mm with moisture index value of – 40 to – 50. The soil of experimental site was intermixed red and black soil covered under the order of alfisols (*Rakkar* soil). The soil pH was 6.5. The experiment on initiation of pruning and its intensity on productivity of *A. procera* based silvipastoral system was initiated during the year 2006 with plantation of *A. procera* saplings during August and the pasture component (*Chrysopogon fulvus* and *Stylosanthes seabrana*) was established during July-August, 2007. *A. procera* was pruned (25, 50 and 75% intensity) in 2nd, 3rd, 4th, 5th and 6th year pruning initiation treatments. Grass species was planted at a distance of 100 cm x50 cm, while legume component was sown in between the rows of *C. fulvus*. The experiment was laid out in split plot design and replicated thrice.

Results and Discussion

Tree component: The growth and biomass potential of tree component and understorey pasture component was assessed over the years. Data about growth and biomass potential (Table 1 and Figure 1) reveals that the survival was 94% (2007), which decreased upto 72% over the years, as the experimental area was totally a wasteland and rocky. *A. procera* attained an average height of 1.90 m (2007) and increased upto14.4 m in 2013. Significant increase was observed in diameter at breast height (DBH) over the years, which increased from 1.98 cm (2007) to 15.15 cm (2013). Leaf fodder production was recorded as 0.15 (2007) and 1.35 D.W t ha^{-1} (2013).

Pasture component: The observations recorded on understorey pasture component reveals that the height gained by *C. fulvus* ranged from 1.1 to 1.63 m over the years, while *S. seabrana* gained height of 0.38 to 1.28 in 2008 and 2013, respectively. Biomass potential of understorey pasture component increased significantly upto initial five years and during the subsequent years by and large similar biomass was obtained. The understorey pasture biomass was recorded as 0.43 (2008), 3.62 (2009) and 6.15 D.W t ha^{-1} (2013). The significant increment in tussock diameter was noticed over the years. It increased from 4.1cm (2008) to 32.36cm (2013), respectively. Similarly, tillers $tussock^{-1}$ followed the same trend as observed in tussock diameter. Number of tillers $tussock^{-1}$ increased with advancement of the age, highest numbers of tillers $tussock^{-1}$ was observed in 2013. As *C. fulvus* is a perennial grass, so initially during the establishment phase tussock diameter and number of tillers were poor but later on both the parameters increased over the years. Likewise *S. seabrana*, which is a perennial legume grass observed with increased number of branches $plant^{-1}$ and dry weight with the advancement of the establishment. The total pasture production (c+d; Table 1) increased from 0.43 t ha^{-1} (2008) to 6.15 t ha^{-1} (2013) (Table 1). Plate 1. depicts the biomass potential of *A. procera* based silvipastoral system.

Table 1. Survival (%), growth and biomass production in ***Albizia procera*** based silvipastoral system

Tree/pasture component	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Tree component							
Survival (%)	94	87	82	78	72	72	72
Plant height (m)	1.90	3.75	3.95	4.88	6.26	12.7	14.4
DBH (cm)	1.98	5.3	6.73	8.38	11.6	13.77	15.15
Canopy spread (m)	1.39	3.11	3.32	3.69	3.92	2.65	2.57
Fodder production D.W t ha^{-1} (a)	0.15	0.35	0.81	1.11	1.17	1.24	1.35
Fuelwood production t ha^{-1} (b)	0.52	0.82	1.34	1.38	1.46	1.58	1.74
Pasture Component							
C. fulvus							
Height (m)	-	1.1	1.45	1.38	1.52	1.63	1.57
Tussock dia (cm)	-	4.1	12.8	21.78	31.02	25.13	32.36
Tillers $tussock^{-1}$	-	10.9	38.2	42.76	46.46	58.74	62.07
Grass fodder D.W t ha^{-1} (c)	-	0.21	2.46	2.53	2.68	3.12	3.45
S. seabrana							
Height (m)	-	0.38	0.95	1.02	1.08	1.17	1.28
Branches $plant^{-1}$	-	9.7	10.9	33.6	39.8	59.4	63.5
legume fodder D.W t ha^{-1} (d)	-	0.22	1.16	1.93	2.34	2.72	2.70
Pasture production t ha^{-1} (c+d)	-	0.43	3.62	4.46	5.02	5.84	6.15
Silvipastoral system							
Fodder production D.W t ha^{-1} (a+c+d)	0.52	1.25	4.96	5.84	6.48	7.42	7.89
Total biomass D.W t ha^{-1} (a+b+c+d)	0.67	1.6	5.77	6.95	7.65	8.66	9.24

Plate 1: *Albizia procera* based silvipastoral system

Total biomass potential: Tree component also contributed to fodder production and the highest total (understorey pasture + tree leaf) fodder production (7.89 t ha^{-1}) was observed in year of 2013. In the era of climate change, agroforestry is one of the efficient green technology for carbon sequestration. Agroforestry produces higher biomass as compared to crops and cropping systems and act as a sink for atmospheric CO_2. The total biomass potential of the silvipastoral system was recorded as 9.24 t ha^{-1} in 2013 (Table 1).

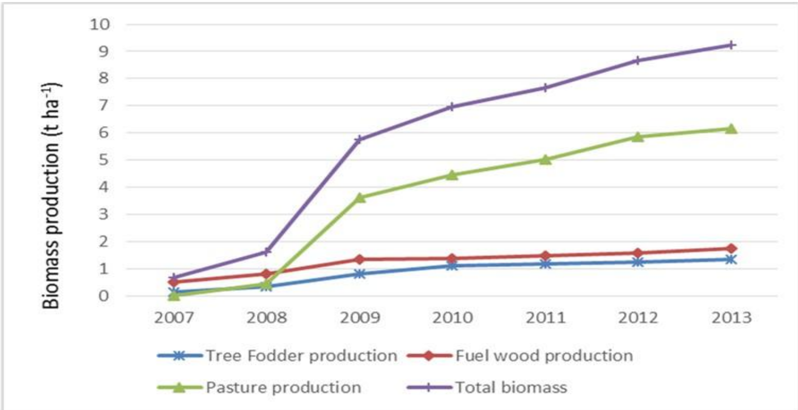

Fig. 1. Biomass potential of *A. procera* based silvipastoral system

Conclusion

The *A. procera* based silvipastoral system is an efficient land use system, which is producing enough fodder for the livestock in wasteland of arid and semi-arid system. Besides fodder production, it is also helpful in mitigating climate change through biomass production and helps in restoration of degraded/wasteland.

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