

Multi-storied Pastoral system for sustainable sheep and goat production in arid and semi-arid regions of India

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Animal husbandry plays an important role in livelihood security and the economic sustenance of people in arid and semi-arid zones because crop production is a big gamble due to uncertainties of normal rainfall. In semi-arid zones, nearly 15-20% of the land is available as rangeland beside community land, fallow and wasteland. In arid zones, rangelands occupied 45% and in extreme arid districts of Rajasthan, nearly 95% of the land is available as grazing land after harvesting Kharif crops. Further, the main constraints to animal production on rangelands in arid and semi-arid zones are progressive shrinkage in grazing land due to intensive land reclamation for raising crops, the simultaneous increase in livestock population resulting in overstocking, overgrazing by all kinds of livestock depleting the grazing resources leading to soil erosion and ecological degradation.

In this situation, the adoption of a multi-storied pastoral system may be a feasible approach for providing adequate fodder to livestock, employment generation and source of income to the farmers of this region. A multi-storied pastoral system refers to the combinations of trees, fruit trees along with other pasture crops or forages crops in a manner that farmers get return throughout the year. However, it is variable and depends on the demand of the farmer eg. If a farmer's approach is livestock oriented, he can opt for a cropping model such as khejri + ber + lasoda + grass. Through this system, the farmers can obtain fodder through khejri, ber and lasoda leaves as top feed whereas, fodder through grasses beside this green fruits of lasoda are used for making mixed pickles and vegetables. A multi-storied pastoral system may be classified as two tiers or three tiers Silvi-pastoral or Horti-pastoral system.

Silvi-pastoral system: It integrates pasture and/ or animals with trees. Hence, woody perennial, preferably of fodder value are introduced deliberately and systematically and

managed scientifically under poor soil, water and nutrient conditions where crop production is not possible. Such systems can serve twin purposes of forage and ecosystem conservation. For degraded and problematic soil, the indigenous Silvi-pastoral management system is most appropriate. It will not only supplement the additional requirement of forage from lopping of trees and fuelwood which in turn help in checking deforestation but also will ameliorate the soil properties. A three-tier Silvi-pastoral system developed at NRCAF, Jhansi with the woody component of *Dichrostachys cinerea* + *Albizia amara* + *Leuceana leucocephala* revealed that top feed (dry leaf + Pod) production of 0.04, 0.26, 0.48, 1.15, 0.53, 0.55 and 0.54 t ha⁻¹ during I, II, III, IV, V, VI and VII year, respectively when pruned up to 50% height of the tree from the ground.

Table 1: Mean forage production (dry) under different silvi-pastoral system

Tree species	Pasture species	Pasture yield (t ha ⁻¹)
<i>Albizia lebbeck</i>	<i>Cenchrus ciliaris</i>	7.4
	<i>Chrysopogon fulvus</i>	7.8
	<i>Schima nervosum</i>	7.8
<i>Dalbergia sisso</i>	Natural pasture	2.9
<i>Dichrostachys cinerea</i>	<i>Cenchrus ciliaris</i>	4.3
	<i>Chrysopogon fulvus</i>	5.2
<i>Leuceana leucocephala</i>	<i>Cenchrus ciliaris</i>	4.1
	<i>Cenchrus setigerus</i>	3.2

(Source: Deb Roy, 1998; Singh and Pathak, 1992)



Mulberry based pastoral system

In marginal land and wasteland *Leuceana leucocephala* + guinea grass + sitaro or buffel grass + *Sytlosanthes hamata* based Silvi-pastoral system can be adopted for generation of bio-mass and fodder.

Horti-pastoral system: Such systems integrate fruit trees with pasture. The main objective is to obtain fruits and fodder. Trees become a focus of the system and activities to establish pasture or produce animals are secondary. Farm boundaries, banks, riverbanks etc. may also be suitably utilized for lean period fodder. At Jhansi, Horti-pastoral system established with four fruit trees viz. *Emblica officinalis*, *Ziziphus mauritiana*, *Carissa carandus* and *psidium guajava* and five grass species viz. *Cynodon dactylon*, *cenchrus ciliaris*, Napier Bajra, Pennisetum tri-specific hybrid and *Brachiaria decumbens*; and two legumes species viz. *Stylosanthes hamata* and *Cajanus cajan*. The results of this system revealed that, among the different tree-grass-legume combinations, *Carissa carandus* - Napier Bajra - *Stylosanthes hamata* recorded the highest forage yield and the effect of forage species on the survival and growth of fruit species was negligible.



Ber based pastoral system

The fodder species selected for this purpose should be adaptable to local agro-climatic conditions, of fast growth rate, of high coppicing ability and should provide higher economic returns.

Table 2: Fruit trees suitable for developing horti-pastures in arid and semi arid conditions

Category	Fruit Trees	
	Local name	Botanical name
Indigenous drought hardy fruit trees	Ker	<i>Capparis decidua</i>
	Pelu	<i>Salvadora oleoides</i>
	Gondi	<i>Cordia gharaf</i>
	Jhar ber	<i>Ziziphus mummularia</i>
Fruit trees for rainfed conditions	Ber	<i>Ziziphus mummularia</i>
	Guava	<i>Psidium guajava</i>
	Karonda	<i>Carissa sp.</i>
	Pomegranate	<i>Punica granatum</i>

	Custard apple	<i>Annona squamosa</i>
	Aonla	<i>Emblica officinalis</i>
Fruit trees for irrigated conditions	Fig	<i>Ficus carica</i>
	Phalsa	<i>Grewia subinequalis</i>
	Date palm	<i>Phoenix dactelifera</i>
	Papaya	<i>Carica papaya</i>
	Lime	<i>Citrus aurointifolia</i>
	Sweet orange	<i>Citrus sinensis</i>

(Source: Singh and Roy, 1991)

Conclusion: Based on the above discussion, it is concluded that, a multi-storied pastoral system is a potential system to meet the deficit of food, fodder, fuel, fruits and other tree products as well as resource conservation in the arid and semi-arid region of the country. It is very important especially in the case of small ruminants (sheep and goats) as these animals utilized the products of the system very efficiently. Sheep like the ground grasses very much and effectively used these grasses whereas, goats like the top feed and browse the tree leaves very well. It is also reported that sheep and goats raised on pastoral systems are well adapted to climatic conditions and are relatively tolerant of local diseases