

Enhancing fodder production in rainfed regions

Mukesh Choudhary*, S R Kantwa, S K Chowdhary, Rajiv Agarwal, A K Dixit, P D Vekariya, N Kumawat, D V Bhagat, S V Khadatre, O P Girothia and P K Pankaj

ICAR–Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh 284 003

*Livestock is an integral component of rainfed farming systems and main source of livelihood of farmers. Shortage of green fodder is the main reason for low productivity of livestock. Inclusion of fodder shrubs (*Sesbania* and *Leucaena*) and grasses (*Pennisetum tri-specific hybrid*) in the existing cropping system improve the fodder availability as well as soil quality. In degraded lands, planting of fodder trees, shrubs and grasses as a multitier system is able to provide fodder particularly during lean periods for livestock. Utilizing field bunds and rice fallow areas for fodder production makes the livestock more remunerative and sustainable for small and marginal farmers. Most of grazing lands and pasture are degraded, which must be rejuvenated by increasing the vegetative cover and management.*

Keywords: Arable and non-arable lands, Fodder production, Livestock, Rainfed areas

LIVESTOCK is the important subsidiary enterprise in supplementation to the crop husbandry in India. India has the largest number of livestock (537 million) in the world and produces about 200 million tonnes of milk. However, the average productivity of animals is low (1538 kg/year) compared to world average (2238 kg/year). An inadequate supply of feed and forage is estimated to cause half of the total economic losses in livestock productivity. India currently faces a shortage of 35.6% of green fodder, 10.95% of dry crop residues and 44% of concentrates.

Rainfed agriculture supports more than 60% of the livestock population. The farmers in rainfed areas are more dependent on livestock production for their livelihood due to low productivity and high uncertainty in crop production. Livestock rearing in rainfed areas often acts as a cushion and liquidity for the farmers. The livestock in these areas mainly depends on common property resources (CPRs) and crop residues for their feed requirement. Thus, shortage of adequate amount of high-quality forage to livestock poses a severe threat to sustainable livestock production. The livestock population is increasing and accordingly its feed requirements are also increasing. The availability of fodder resources must be enhanced in order to fulfil the demand of an expanding number of animals and to raise their productivity. There is little prospect of having

good quality arable land accessible for the production of fodder because of the ever increasing demand for food and cash crops. Almost all the grasslands and grazing areas are devoid of quality legumes in enough quantity, which obviously increase the pressure on limited fodder resources.

Fodder production from arable lands

Round the year fodder production in rainfed region

At present, about 50% cultivated area of the country is rainfed. In these areas, 90% of the rainfall is received during July–September therefore allowing a growing period of 20–25 weeks. In such situations, the scarcity of the green fodder availability is felt during November–June. A food-fodder production model with Tri-specific hybrid (TSH) + *Sesbania* + (Sorghum + Cowpea - Barley) has been developed at Indian Grassland and Fodder Research Institute (IGFRI) for rainfed conditions with soil and water conservation practices. In this system, TSH and *Sesbania/Leucaena* were planted on beds and seasonal crops like sorghum, cowpea (forage) and food crops (barley) were planted on furrows. The *Pennisetum Tri-specific Hybrid* (TSH) was planted in paired rows at 1.0 m × 0.75 m spacing. *Sesbania/Leucaena* was planted at 0.75 m plant to plant spacing in between pairs of TSH. The 2.2 m space between such two alleys was utilized for fodder sorghum + cowpea (2:1 ratio at 30 cm) - barley

cropping system. Emphasis was given for efficient *in situ* resource management practices (residue retention to 8–10 cm stubble height, weed mulch + litter fall) and farm pond for one hectare area (20 m × 20 m × 1.5 m) for providing life-saving irrigation to *rabi* crop.

This system has green fodder production potential of 78.5 tonnes/ha and 20.0 tonnes dry fodder besides producing 2.0 tonnes/ha barley grain. Technology can sustain 3–4 adult cattle unit (ACU) (if fed 100% DM based on forage diet) and 8–9 ACU (if fed 1/3rd DM based fodder diet) with quality fodder. It also has potential for taking second crop in *rabi* and provides food/feed grain for human/livestock consumption. This system enables fodder availability up to May–June (dry period).



Sesbania + *Pennisetum* trispecific hybrid (TSH) grass based alley cropping system for rainfed areas

At Western Regional Research Station, IGRI, Avikanagar, Rajasthan indicated that *Sesbania sesban* + *C. ciliaris* + pearl millet (fodder) alley cropping system had produced 32.9 tonnes/ha green fodder equivalent yield which was 47.5% higher over pearl millet sole cropping. About one-third of total green fodder was produced from perennial, a component that extends the green fodder availability up to December. Thus, this alley cropping system would be able to provide green fodder during lean period.

Forage production in rice fallows

About 12 mha area of *kharif* rice in India remains fallow in the subsequent *rabi* season due to lack of irrigation facilities. This area is mainly confined to eastern, central and central peninsula of India. This unutilized area offers enormous opportunities to strengthen fodder security. In low lying areas, the forage legumes like *Lathyrus*/single cut berseem are planted in standing rice crop before 15 days of rice harvest. The seed requirement of forage legumes under such situation is 25% higher than normal seed rate.

Fodder production on bunds

Farmers with marginal and small land holdings, and livestock keepers with limited forage requirement can effectively grow forages on bunds. These areas pose no competition with existing crops/cropping system

and utilizes the land which is otherwise not used for any agricultural purposes. In this system, forage crops especially perennial grasses, viz. BN hybrid, *Pennisetum* tri-specific hybrid (TSH), guinea grass and *Setaria* are planted on bunds, irrigation channels, terrace risers, steep uncultivable slopes etc. These grasses do not require extra input like fertilizer and irrigation. Fodder yield recorded from on-farm demonstrations indicated 1.75–2.50 kg green fodder per meter per cut and an average of 7–11 quintal green fodder/100 m bund length in 4 cuttings possible in a year. Besides, additional farm productivity, fodder production on bunds also works as a guard crop for main crop, reduces runoff loss of water and controls soil erosion.

Spineless cactus: It is a newly introduced alternative and non-conventional feed resource especially for drought affected areas in arid and semi-arid tropics of India. It can be the best option to meet the fodder scarcity during lean period in these areas. Moreover, it can be grown on lands that are not suitable for other crops. It has potential of producing 80 kg of fresh weight per plant (3-year plantation) and 100 m row length planted at 1 m spacing of cactus can provide 4 months fodder for one ACU during lean period of summer (April–July). Cactus (90–92% water, 6–7% crude protein) can be successfully fed to livestock as supplementary feed (30% replacement for dry matter requirement) along with green fodder, hay and straw, but not as sole feed. Planting of cactus is advocated on degraded lands, pasture lands, farm boundaries etc. (with protection from direct grazing) as it has production potential of 80–100 t/ha of green biomass (cladodes) and 1/3rd of cladodes are left for regeneration.



Spineless cactus: An alternate fodder resource for arid and semi-arid areas

Fodder production from non-arable lands

Fodder trees: Fodder trees are an important source of fodder for livestock especially for small ruminants in rainfed areas. Fodder tree species such as *Prosopis cineraria*, *Acacia nilotica*, *Albizia lebbec*, *Azadirachta indica* and *Ailanthus excels* are suitable for rainfed areas. These tree species besides producing fodder during lean period, yield sufficient fuel wood and timbers. Tree leaves are being increasingly used to provide fodder for livestock, as they have a number of unique characteristics which make them attractive for both small holder and

large scale livestock enterprises. On an average, tree leaf fodder production of 0.2–2.0 tonnes/ha/year is obtained by pruning upto 50% height of the trees every year from the various agroforestry systems in various agro-climatic zones. Tree leaves are rich in quality nutrients like protein, minerals and vitamins and are used as valuable supplements to provide considerable variety to grass/crop residues based diets of livestock. Trees are commonly used for both browsing and cut-carry/feed system. In arid and semi-arid region, tree fodder serves as a concentrate to sheep and goat at a very low cost and is virtually free to both sedentary and marginal farmers.

Fodder production through agroforestry: Agroforestry can be defined as multiple land use system involving trees/shrubs, food or forage crop sp. (pasture grasses and legumes) and livestock raising simultaneously or sequentially in a single farming system. Several small trees like subabul, shevri and agathi can be used as tree component with several fodder crops/grain crops as intercrops. These trees provide green fodder especially during lean periods. Cereal fodders like sorghum, pearl millet, maize and teosinte could be grown along with subabul both under managed canopy up to height of 50–100 cm and also as a full tree. Under managed tree canopy as hedge rows, the productivity of associated crop yield was reduced by only 15–20% whereas under non-managed situations, the reduction in yields of associated fodder crops is 40–60%. The planting of subabul can be done in hedge rows with 2–4 m inter row spacing. Fruit crops like ber (*Ziziphus nummularia*), guava (*Pisidium guajava*) and aonla (*Phyllanthus emblica*) could be grown as woody plants under agroforestry. Some fodder crops like guinea grass, signal grass and



Silvipasture system (*Hardwickia binata* + *Chrysopogon fulvus*) for degraded lands

congo signal grass are shade loving and suitable to grow under or near the horticultural trees.

Silvipasture: In this system, improved pasture species is introduced with the tree species. In this, grass and grass legume mixture is grown along with woody perennial simultaneously on the same unit of land. This is the best management system for the wastelands with marginal fertility. This system has an additional advantage of providing green fodder through tree loppings during extreme dry season and during lean periods. Higher forage yield up to 8–11 t/ha is possible through silvipasture system which includes forages from understorey grasses and also loppings from the fodder trees. Important tree species of fodder value are *Leucaena leucocephala*, *Sesbania aegyptica*,

Table 1. Promising silvipasture models for degraded grazing/forest lands in semi-arid rainfed region

Tree species	Pasture grass	Legume
<i>Acacia nilotica</i>	<i>Cenchrus ciliaris</i> <i>Dichanthium annulatum</i>	<i>Stylosanthes hamata</i> , <i>S. scabra</i> <i>S. hamata</i>
<i>Acacia tortilis</i>	<i>Cenchrus ciliaris</i> , <i>C. setigerus</i> <i>Dichanthium annulatum</i>	<i>S. hamata</i> , <i>S. scabra</i> <i>S. hamata</i>
<i>Azadirachta indica</i>	<i>Cenchrus ciliaris</i> <i>Dichanthium annulatum</i>	<i>S. hamata</i> <i>S. hamata</i>
<i>Albizia amara</i>	<i>Cenchrus ciliaris</i> , <i>C. setigerus</i> <i>Dichanthium annulatum</i> <i>Panicum maximum</i>	<i>Macroptilium atropurpureum</i> , <i>S. hamata</i> <i>S. hamata</i> <i>S. hamata</i>
<i>Albizia lebbeck</i>	<i>Cenchrus ciliaris</i> , <i>C. setigerus</i> <i>Chrysopogon fulvus</i> <i>Sehima nervosum</i>	<i>Clitoria ternatea</i> , <i>S. hamata</i> <i>Clitoria ternatea</i> , <i>S. hamata</i> <i>Clitoria ternatea</i> , <i>S. hamata</i>
<i>Albizia procera</i>	<i>Cenchrus ciliaris</i> , <i>C. setigerus</i>	<i>Clitoria ternatea</i> , <i>S. hamata</i>
<i>Dalbergia sissoo</i>	<i>Cenchrus ciliaris</i> <i>Dichanthium annulatum</i>	<i>S. hamata</i> , <i>S. scabra</i> <i>S. hamata</i> , <i>S. scabra</i>
<i>Embllica officinalis</i>	<i>Cenchrus ciliaris</i> <i>Dichanthium annulatum</i>	<i>S. hamata</i> <i>S. hamata</i>
<i>Hardwickia binata</i>	<i>Cenchrus ciliaris</i> + <i>Chrysopogon fulvus</i> <i>Sehima nervosum</i> <i>Panicum maximum</i>	<i>Macroptilium atropurpureum</i> , <i>S. hamata</i> <i>Clitoria ternatea</i> , <i>S. hamata</i> <i>S. hamata</i>
<i>Leucaena leucocephala</i>	<i>Cenchrus ciliaris</i> , <i>C. setigerus</i> <i>Dichanthium annulatum</i> <i>Panicum maximum</i>	<i>S. hamata</i> , <i>S. scabra</i> <i>S. hamata</i> , <i>S. scabra</i> <i>S. hamata</i>
<i>Zizyphus mauritiana</i>	<i>Cenchrus ciliaris</i>	<i>S. hamata</i>

Table 2. Suitable range of grass species of India based on rainfall and soil type

Rainfall	Grass species	Soil type	DMY (tonnes/ha)
Less than 350 mm	Buffel grass (<i>Cenchrus ciliaris</i>)	Sandy to sandy loam	4.0
	Bird wood grass (<i>C. setigerus</i>)	Sandy to sandy loam	3.0
	Sain (<i>Sehima nervosum</i>)	Red, gravelly to sandy loam	2.5
	Stylo (<i>Stylosanthes scabra</i>)	Sandy to sandy loam	2.5
	Butterfly pea (<i>Clitoria ternatea</i>)	Sandy loam to silty clay loam	3.0
	Bankulthi (<i>Cajanus scarabaeoides</i>)	Gravelly, sandy loam, well drained	2.0
350–500 mm	Blue panic (<i>Panicum antidotale</i>)	Loam to sandy loam	3.0
	Marvel (<i>Dichanthium annulatum</i>)	Loamy to clay loam	2.5
	Dinanath grass (<i>P. pedicellatum</i>)	Loamy to clayey loam	3.0
	Bahia grass (<i>P. notatum</i>)	Light soil	3.5
	Sabi grass (<i>U. mosmabicensis</i>)	Sandy to sandy loam	3.0
	Stylo (<i>Stylosanthes hamata</i>)	Sandy loam to loam	3.5
500–700 mm	Rhodes grass (<i>Chloris gayana</i>)	Sodic, loam to sandy loam	2.5
	Stylo (<i>Stylosanthes hamata</i>)	Sandy loam to loam	3.5
	Siratro (<i>M. atropurpureum</i>)	Sandy to sandy loam	1.8
More than 700 mm	Napier grass (<i>P. purpureum</i>)	Sandy loam to clay loam	4.0
	Marvel (<i>Dichanthium annulatum</i>)	Loamy to clay loam	2.5

Hardwickia binata, *Dalbergia sissoo* and *Acacia albida* etc. In silvipasture system, *Cenchrus ciliaris*, *Dichanthium annulatum*, *Chrysopogon fulvus* are important grass species for rainfed areas (Table 1). In a pasture, grass-legume mixture is always better in terms of fodder quality as compared to grass alone. Besides, it also improves the soil quality. The promising legumes species are *Stylosanthes hamata* and *Clitoria ternatea*. The degraded waste lands (shallow red gravelly soils) under semi-arid conditions at Jhansi producing 1 tonnes/ha/year have been improved to produce up to 10 tonnes/ha/year at 10 years rotation through silvopastoral systems. Besides, yield improvement by 8–10 times, the quality of mixed forage has also improved by 6–7 times.

Fruit trees are also grown in place along with tree species and suitable pasture in this system. These multipurpose tree species (MPTS) also provide green fodder and fuel wood in addition to protecting fruit trees. These trees help in improving the soil by virtue of N fixing ability. *Leucaena* can be planted in lines between the fruit trees such as ber, guava etc.

Grazing lands: Land degradation is unabated both in arable and non-arable lands. In India, available waste land (63.85 mha) and forest area (78 mha) provide varied degree of grazing to animals. Due to tremendous

grazing pressure, most of these lands are devoid of vegetation. It is very essential to improve grasslands through reseeding with proper pasture grass and legume species. Controlled grazing should be practiced and these lands have to be fertilized annually with N, P and K for realizing good forage yield. Selection of grass species for different regions and soil types are important for realizing potential fodder yield (Table 2).

SUMMARY

Forage security is must for ensuring sustainable development of the livestock sector in rainfed areas. The only way to meet the fodder needs of livestock is to look for increased productivity per unit land area and also through integration of fodder crops in various arable and non-arable land use systems. There is a need to focus on non-arable or degraded lands for fodder production through technological interventions. Introduction of suitable range grasses and legumes along with soil and moisture conservation techniques will enable to make productive and sustainable systems.

*Corresponding author's e-mail: selmukesh@gmail.com



**Plant trees, Conserve water,
Protect environment.**

