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# Revisiting Livestock Feeding and Fodder: Silvipastoral Farm

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**Abstract – India with 2<sup>nd</sup> largest human population and only 2.29% of land area of world having pressure for both human and livestock food/feed resources. Due to climate change and decrease in feed and fodder cultivation area need of alternative sources for feed resources, silvipastoral system of feed resource availability is alternative to get tree leaves for livestock feeding and firewood also. Under common property resources in villages, silvipastoral system of fodder production is alternative for feed resources for small ruminants specially sheep, goat and other livestock. It has been possible to increase land productivity from 0.5-1.5 tonne/hactare/year to more than 15 tonne/hactare/year by developing suitable silvipasture models. The additional forage availability through such systems is likely to reduce grazing pressure and thus have important environmental implications.**

**Keywords – Silvipasture, Fodder Trees, Grazing, Fodder, Pasture, Natural Resources.**

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## I. INTRODUCTION

India with only 2.29% of land area of the world, is maintaining nearly 17.4% of world human population and 10.7% of livestock (more than 510 million heads) creating a huge pressure on land, water and other resources. India with largest livestock and second largest human population needs judiciously conceived strategy to meet the ever increasing food, feed and fodder demand with adequate quality and quantity. Furthermore some part of our country is also largely inhabitable due to harsh climate as reflected by very low population density. The major feed resources for livestock in our country are grasses, community grazing on common lands and harvested fields, crop residues and agricultural by-products, cultivated fodder, edible weeds, tree leaves from cultivated and uncultivated lands and agro-industrial by-products. Crop residues include fine straws, coarse straws, leguminous straws, sugarcane tops etc. and are the single largest bulk feed material available easily to the farmers for feeding ruminants.

Livestock is the only source of cash income for subsistence farms and also serves as insurance in the event of crop failure. It also offers alternative to global energy crisis as utilization of livestock based bio-energy as well as waste recycling for organic manure. With increasing health awareness and purchasing power the demand of organic farming is increasing for which livestock components have great role to play. While country has achieved to a large extent the food security, nutritional security parameters have not yet been achieved and livestock sector production has a great role to play in achieving these targets. Feed cost accounts for about 70-75% of the total cost of livestock production, particularly in milch animals.

Fodder crops are the plant species that are cultivated and harvested for feeding the animals in the form of green forage, silage, hay or other forms. India possesses a rich genetic diversity with reports of 245 genera and 1256 species of Poaceae of which one third are considered to have fodder value and are utilized in the form of

grazing and cultivation. Similarly, about 60 genera and 400 species of *Leguminosae* are reported out of which 21 genera are useful as forage.

Indeed, the actual milk yield of bovine animals is reported to be 26-51% below the attainable yield under field conditions, which otherwise could have been realized with better feeding, breeding and disease management (Dikshit and BIRTHAL, 2010).

The productivity of livestock often remains low in Indian condition, which is 20 to 60% lower than the global average. The major reason perceived is deficiency of feed and fodder followed by health, breeding/ reproduction and management. Around 80% of the livestock are with marginal, small and medium holdings farmers under rainfed situation, whereas, small ruminants are mostly reared under nomadic (30%) and sedentary (70%) systems. Goats are among the earliest animal domesticated around 10 to 11 thousand years ago (Joshi *et al.*, 2004). They are reared as a multipurpose animal for producing meat, milk, manure etc. Followed closely by sheep, later people began to domestic large animals such as cattle and horses for labour and transportation.

A balanced diet is required to keep an animal healthy and productive which can be met by variety of leguminous plants rich in protein which can be grown in the farm (Raju, 2013).

The three major sources of fodder supply are cultivated fodder from arable land (irrigated and rain fed) crop residues, and fodder from common property resources (like forests, permanent pastures, grazing lands etc.)

## II. CULTIVATED FODDER FROM ARABLE LAND (IRRIGATED AND RAIN FED)

Fodder is cultivated on approximately 5 per cent of the gross cropped area in the country, which has remained nearly same over the last few decades. There is a need for restructuring the land use strategy to increase the fodder production to about 10%. Sorghum, Berseem, Lucerne, Maize, Bajra, fodder Cowpea and Oats are the major fodders grown and are cultivated in more than 50 % of the land under fodder.

## III. CROP RESIDUES

Among different resources, crop residues are major one and generally defined as feedstuffs, which are bulky and contain higher fibre content (18%). These form the bulk of feeding resources meeting more than 50% of the livestock sector demand in the country. In eastern and coastal belt, rice straw is the major residue whereas in northern and central part wheat straw constitutes the major ingredient of livestock feeding. In Sorghum, Pearl millet, Guar, maize stover forms the bulk of animal feeding in western and peninsular India. Similarly pulse straw, groundnut haulm, sugarcane top, vegetable, horticultural waste, top feed, kitchen waste etc. also form important component of feeding especially in household Dairies and peri-urban Diaries.

Concentrate feeds which include oil seed cakes, crushed pulses, grains, wheat and rice bran, husk etc. are also very important feed resource as they are rich in energy-yielding nutrients. However, at present the estimated annual availability of total concentrate feed is only 61 million tonnes against a demand of 96 million tonnes, indicating a deficit of 36% at national level (Anonymous, 2018).

*Fodder from Common Property Resources (Forests, Permanent Pastures, Grazing Lands etc.)*

21.54% of India's geographical area and 41.09% of Chhattisgarh geographical area, is covered by forest as per 2017 data. In India, grazing based livestock husbandry continues to play an important role in rural economy

of the country as around 50 per cent animals depend on grazing in forests and other grazing areas in many parts of the country. In India about 40% of total area is available for grazing of livestock in some form or other round the year or during year or particular period. The grazing intensity in the country is as high as 12.6 adult cattle units (ACU)/ha as against 0.8 ACU/ha in developed countries. Therefore, improvement of pastures, as well as judicious implementation of grazing management is required.

#### IV. PASTURE LAND

This is the main grazing resources of the country. 10.26 million hac area comprising 3.3% of the geographical area of the country are under permanent pasture. Furthermore, 3.10 million ha or 1.0% of total geographical areas are under miscellaneous tree crops and groves. Cultivated wasteland: 12.47 million ha or 4.1% of India's geographical area is under this category. The large proportion of cultivated wasteland viz. ravine areas, water logged areas, saline and alkaline lands, shrubs and bushes infested lands and riverine lands has a great potential to provide valuable fodder for livestock. 26.18 million ha of land constituting 8.5% of the total land area of India is under fallow land. These fallow lands actually are the cultivated lands which could not be utilised for cultivation due to scanty rainfall in some areas or due to heavy rain.

#### V. NON-AGRICULTURAL LAND

It includes the side of railway tract, roads and canals, dams or bunds and river banks etc. and provide considerable amount of forage for the grazing of livestock, such lands near the villages are used by animals for grazing especially the small ruminants.

#### VI. MISCELLANEOUS TREE CROPS AND GROVES

3.10 million ha or 1.0% of the total geographical area of India, is under this category. Such type of grazing resources is mainly found in NEH region. Leaves from fodder trees/ shrubs are important feeding resource especially in hills and arid zone. It is the main feeding component of small ruminants like goat. In household practice also tree leaves are fed to the animals.

The capacity of consumption for the appetite of the animal is measured by the amount of dry matter in the diet, which an animal can consume. For cattle and buffaloes total dry matter requirement was worked out to ranging from 1.8% to 2.8% of body weight depending on the age, sex, nature of work etc. Similarly for sheep and goat it was estimated to be 3.0% for 1.0 years and 3.5% for more than 1 year age group. The feeding ration was estimated to be combination of green fodder, dry matter and concentrates in varying proportion ranging from 40 to 80% for crop residue, 10 to 30% for green fodder and 10 to 30% for concentrates.

Table 1. Estimates of green fodder availability ('000t) and deficit/ surplus status (In 000 tons).

State/ UT	Cultivated Land	Cultivabl Wasteland	Source Fallow Land	Pastur Land	Forest	Total Green Fodder Availability	Total Green Fodder Requirement	Percent Availability	Percent Deficit(-)/ Surplus(+)
Odisha	7176	220	619.6	3668	3594.2	15277.7	27700.6	55.2	-44.80
Jharkhand	3923.1	141.2	1002.8	558.6	2231.1	7856.8	24358.6	32.3	-67.70
Andhra Pradesh	21334	156.4	904	749	3485.4	26628.8	71799.5	37.1	-62.90

State/ UT	Cultivated Land	Cultivabl Wasteland	Source Fallow Land	Pastur Land	Forest	Total Green Fodder Availability	Total Green Fodder Requirement	Percent Availability	Percent Deficit(-)/ Surplus(+)
Uttar Pradesh	113249.2	162	652.4	318.5	117.4	114499.5	149959.2	76.4	-23.60
Madhya Pradesh	92323.3	404	348.4	4560.5	1548.3	99184.5	67264.6	147.5	47.50
Chhattisgarh	11217.7	140.4	210	3104.5	1666.4	16339	24430.8	66.9	-33.10

(Source: Ray *et. al.* 2019)

Table 2. Estimates of dry fodder availability ('000t) and deficit/ surplus status (In 000 tons).

State/ UT	Food Grains	Pulse Crops	Others (Groundnut+ Sugarcane)	Pasture Land	Forest	Total Residue	Top feed/ Kitchen/ Horticultural /Farm waste	Total Dry Fodder Availability	Demand	Net Surplus/ Deficit (-)	Percent Availability	Percent Deficit
Chhattisgarh	696.9	198.7	39	233.8	13886.8	15052.2	1505.2	16557.4	15083.5	1473.9	109.8	9.8
Madhya Pradesh	20920.9	3047.4	839.1	35	9289.7	34075.3	3407.5	37482.8	37174.2	308.6	100.8	0.8
Uttar Pradesh	29014.9	355.9	14600.9	1368.2	1174.3	46494.3	4649.4	51143.8	73513	-22369.3	69.6	-30.4
Maharashtra	4406.9	689.3	7453	2114	6081.8	20712.6	2071.3	22783.8	30659.7	7875.9	1.35	-98.65
Jharkhand	872.1	196.3	90.4	0	4648.2	5798.7	579.9	6378.6	13560	-7181.5	47	-53.00
Orissa	617.4	215.2	110.9	235.2	15403.5	16544.7	1654.5	18199.1	16120.2	2079	112.9	12.90
Andhra Pradesh	4970.1	1068.2	2140.4	5.6	3642.5	11713.8	1171.4	12885.1	33651.6	-20766.5	38.3	-61.70
All India (in 000t)	134394.2	8733.8	41605.7	10732.8	102005.4	296726.5	29672.7	326399.2	426105.3	-99706.1	76.6	-23.4

(Source: Ray *et.al.* 2019)

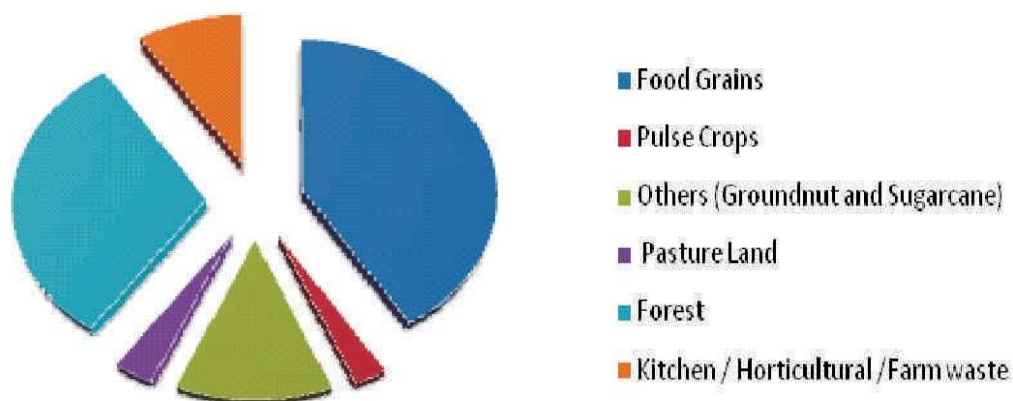


Fig. 1. Contribution of different sources to dry fodder.

(Source: Ray *et.al.*2019).

Table 3. Green Fodder availability scenario of different States (Year 2018).

Percent deficit			Percent surplus		
<25	25-50	> 50	<25	25-50	> 50
Assam, Karnataka, Tamil Nadu	Rajasthan, Uttar Pradesh, Maharashtra	Gujarat, Jharkhand, Andhra Pradesh, West Bengal, Bihar	Chhattisgarh, Madhya Pradesh, Tripura, Jammu & Kashmir, Odisha, Haryana	Goa	Punjab, Mizoram Himachal Pradesh, Meghalaya, Manipur, Sikkim, Uttarakhand, Arunachal Pradesh, Kerala, Nagaland

(Source: Ray *et. al.* 2019)

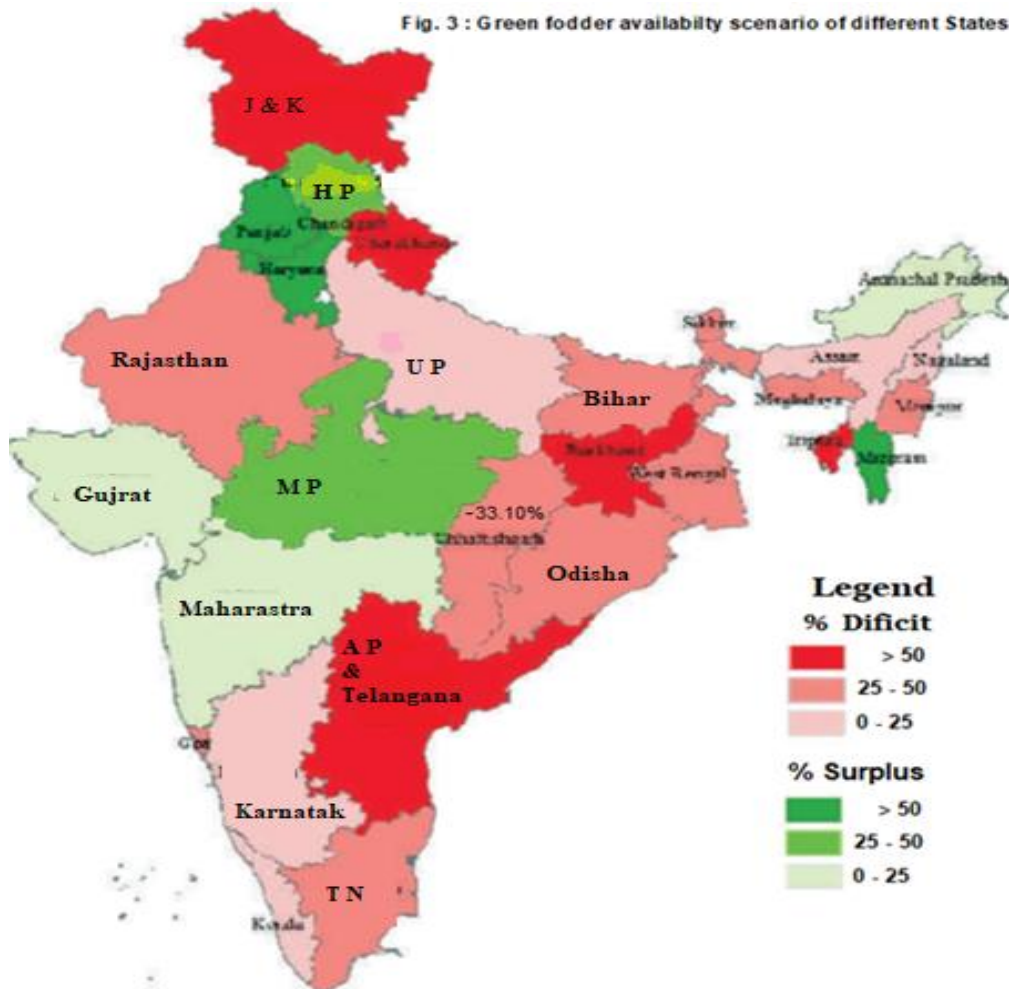


Fig. 2. Green fodder availability scenario of different states (%).

(Source: Ray *et.al.*2019).

Table 4. Dry fodder availability scenario of different States (Year, 2018).

Percent deficit			Percent surplus		
<25	25-50	> 50	<25	25-50	> 50
Assam, Karnataka, Tamil Nadu	Rajasthan, Uttar Pradesh, Maharashtra	Gujarat, Jharkhand, Andhra Pradesh, West Bengal, Bihar	Chhattisgarh, Madhya Pradesh, Tripura, Jammu & Kashmir, Odisha, Haryana	Goa	Punjab, Mizoram Himachal Pradesh, Meghalaya, Manipur, Sikkim, Uttarakhand, Arunachal Pradesh, Kerala, Nagaland

(Source: Ray *et. al.* 2019).

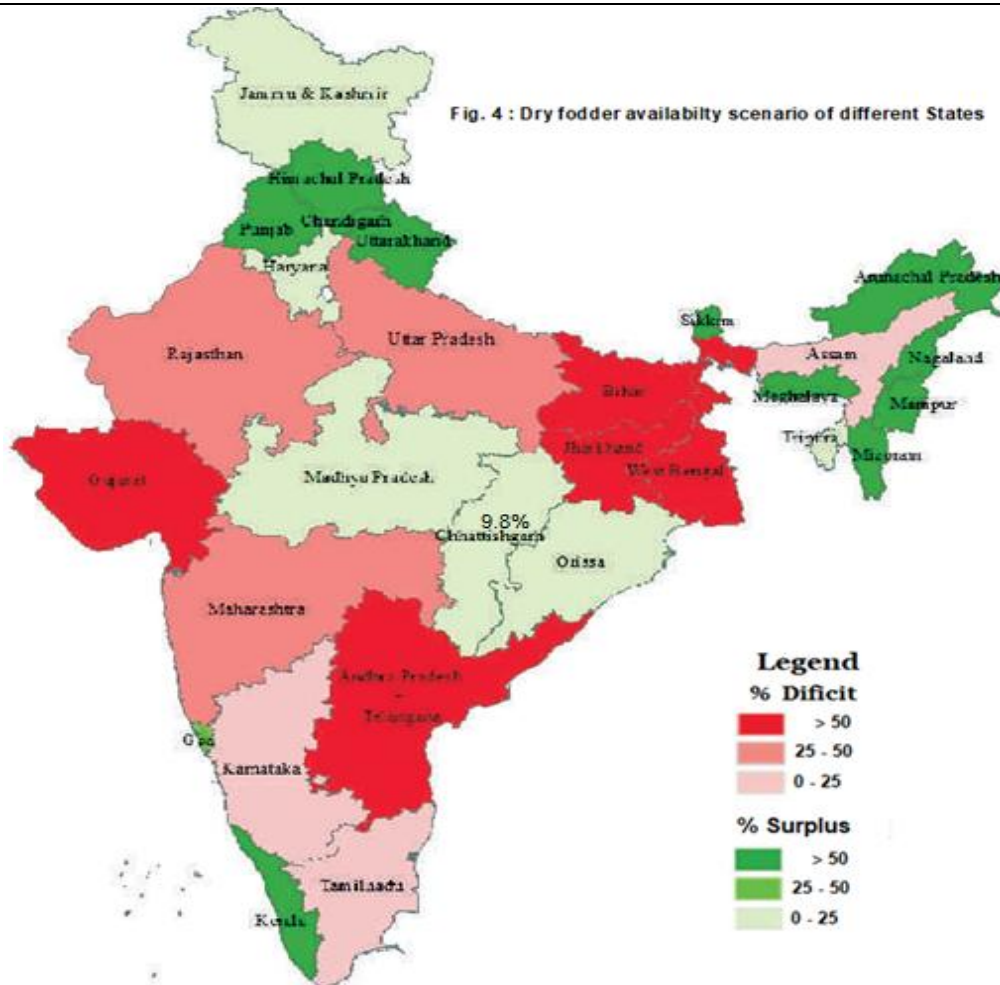


Fig. 3. Dry fodder availability scenario of different states (%).

(Source: Ray et. al. 2019)

#### *Alternate Land use Systems Silviculture:*

Silvi-pasture is being practiced in big scale as it integrate the concerns for productivity, conservation of resources and environment and profitability. Silvicultural Farm (Latin, silva forest) is the practice of integrating trees, forage, and the grazing of domesticated animals in a mutually beneficial way. It utilizes the principles of managed grazing, and it is one of several distinct forms of agroforestry. Properly-managed silvicultural farm can increase overall productivity and long-term income due to the simultaneous production of tree crops, forage, and livestock, and can provide environmental benefits such as carbon sequestration. Silvicultural farm is one of the oldest known forms of agriculture, and has been practiced in many parts of the world for centuries. Silvicultural farm is not the same as unmanaged grazing in woodlands, which has many known negative environmental consequences. Silvicultures integrate pasture and/or animals with trees. This system aims at optimizing land productivity, conserving plants, soils and nutrients and producing forage, timber, fruit and firewood on a sustainable basis. The biodynamic of system involves four major distinct life forms, viz., the herbaceous vegetation (mostly grasses and legumes), the foraging component (fodder trees), and the domesticated animals surviving on the vegetation. It is associated with soil and climate to compliment the diversity. These systems offer an ecologically viable and sound approach. The tree lopping/ pruning are also used as top feeds. It has been possible to increase land productivity from 0.5-1.5 t/ha/year to > 15 t/ha/yr by



developing suitable silvipasture models. The additional forage availability through such systems is likely to reduce grazing pressure and thus have important environmental implications.

Silvipastoral Farm can be established by planting trees into existing pasture or by establishing pasture in existing woodland.

These two establishment methods differ significantly and challenging.

### 1. *Integrating Trees into Pasture*

Planting trees into existing pasture presents several challenges: young trees must be protected from livestock, trees may take years to become productive (depending on the species), and planting trees in a pasture can limit the ability to use that land for other purposes in the future.

### 2. *Integrating Pasture into Woodland*

Integrating pasture into existing woodland presents challenges as well: the woodland likely needs to be thinned to increase light infiltration, which is time consuming and may require heavy machinery, as well as a strategy for dealing with felled trees. Thinned woodlands are also likely to experience a flush of growth in weeds and seedling trees that must be dealt with to prevent the pasture from being overgrown. Pasture forages may also need to be established beneath the trees, a process which can be difficult if trees have already been felled.

Dau Sri Vasudev Chandrakar Kamdhenu University is working on the alternate land system using silvipasture concept. We have worked out three model of silvipastoral farm.

- A. Short life Silvipastoral farm.
- B. Medium life Silvipastoral farm.
- C. Long life Silvipastoral Farm.

#### A. *Short Life Silvipastoral Farm :-*

This farm can be developed within two years and remain viable for five year. In every five year, farm need to renovated.

#### B. *Medium Life Silvipastoral Farm :-*

This farm will be developed within 4 years and remain viable for 10 year. In every ten year, farm need to renovated.

#### C. *Long Life Silvipastoral Farm :-*

This farm will be developed within 6 years and remain viable for many years to come.

#### A. *Short Life Silvipastoral Farm:*

Following tree will be planted in a mixed row or single row:

- 1. Moringa oleifera, Sahjan, Munga, Drumstick, etc.
- 2. Sesbania glandifora, Agusti, Agathi.

3. *Gliricidia maculate*.

Following Forages/perennial grasses will be shown between the two rows of the plants:

*Leguminous Forages*

1. Stylosanthes (Stylo) Botanical Name: Stylosanthes sp.
2. Hedge Lucerne Botanical Name: Desmanthes virgatus.

*Graminacious Forages*

1. Anjan Grass (Buffel Grass) Botanical Name : Cenchrus ciliaris.
2. Dinanath Grass: Botanical Name : Pennisetum pedicellatum Trin.
3. Guinea Grass Botanical Name : Panicum maximum Jacq.

S. No.	Specification	Other specification
1	Preparation of soil for grasses and digging of pit for plant	Before rainy session land will be cultivated and make it weed free & dig pit of 45x45x45 cm size for plants.
2	Distance between plant to plant	1x1 Meter, Mixed row or Individual Row.
3	Sowing of Leguminous grasses & Graminacious (cereal) grasses.	Between two row of non-leguminous grasses one leguminous grass. Distance between two row 30cm and seed to seed distance 30 cm
4	Fertilizer application /year/ tree	50+25+50 gram N <sub>2</sub> , P&K & 10 Kg cow dung/ tree.
5	Fertilizer application in Grasses: 40+30+30 N <sub>2</sub> , P & K Kg @ use N <sub>2</sub> in two equal parts.	

A small life Silvipastoral farm model develop from using tree Moringa & Sesbania: Intercropping with Hedge lucern.



Fig. 4. Silvipasture fodder land developed by DSVCKV, Durg (Chhattisgarh).

**B. Medium Life Silvipastoral Farm :**

Following tree will be planted in a mixed row: tree already growing well in the area will be preferred.

1. Guava: *Psidium guajava*.
2. Awala *Phyllanthus emblica* is commonly known as an Indian gooseberry or Nelli.
3. Ber: *Ziziphus mauritiana*.
4. Hybrid Mango.
5. Hybrid Kathal.



Fig. 5. Wasteland/ Barrenland Developed as Silvipasture fodder land by DSVCKV, Durg (Chhattisgarh).

Attempts are in progress in developing several model of Silivipastoral Farm i.e.

1. Using tree Awala: Natural Intercropping with Desi Grass.
2. Using tree Kathal: Intercropping with Stylo and Desi Grass.
3. Using tree Guava: Intercropping with Desi Grass.
4. Using tree Ber: Intercropping with Desi Grass and Anjan Grass.

#### C. Long Life Silvipastoral Farm :

Following tree will be planted in a mixed row: tree already growing well in the area will be preferred.

1. Desi Kathal.
3. Peepal.
4. Desi Imali.
5. Desi Mango.
6. Babool.
7. Ria.

A long life Silivipastoral farm develop from using tree Desi kathal, Peepal and Imali: Natural Intercropping with Desi Grass/Stylo grass.

Attempts are in progress in developing several model of long life Silivipastoral Farm i.e

1. Using tree peepal: Natural Intercropping with Desi Grass.
2. Using tree Imali: Intercropping with Stylo and Desi Grass.
3. Using tree Bel: Intercropping with Desi Grass.
4. Using tree Babool: Intercropping with Desi Grass and Anjan Grass.

## VII. CONCLUSION

Due to unavailability of pasture land due to urbanization, the land available should be used in such a way that both livestock and human can get benefit in long run and it is concluded that the silvipastoral model is alternative for fodder development and sustainable agriculture in context of Chhattisgarh state which is rich in

natural resources including forest and wild life and silvipastoral system will help to reduce feed and fodder scarcity along with wood requirement in semi-arid and arid areas.

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