***THEME*:**
*AGROFORESTRY AND FARMERS INCOME*

**Title of the Technology**

Silvipastoral approach for augmenting the fodder availability during lean seasons in arid regions

**A. Nature of Technology**

Silvipasture models for hot arid region

**B. Process in brief**

The arid zone of Rajasthan popularly known as the Thar Desert and Kachchh in Gujarat state is characterized by hostile conditions such as low and erratic rainfall, intense solar radiation and high wind velocity. During most parts of the year, the evapotranspiration far exceeds precipitation. Soils in this region are immature, structureless and very coarse in texture with low water holding capacity and poor nutrient status. In the absence of favorable conditions for agriculture, livestock rearing is the alternative source of livelihood for majority of rural population in the arid zone. It has been observed that in the region every farm family keeps a herd of 15-20 animals, which sustains on crops residues and grazing on fallow lands. Agronomic researches have shown that under specific soil and climate conditions, planting of certain combination of crops and trees simultaneously and/or sequentially can increase efficiency in resource use. *Prosopis cineraria* (Khejri) and *Zizyphus* spp. (bordi) are two main tree/shurb spp. of the arid region. Research trials with various tree grass combination were conducted in Nagaur (frosty) and Pali arid locations of Rajasthan and Bhuj in Gujarat to find out the best performing tree grass combination At Nagaur site, a silvi-pastoral trial was conducted with five fodder tree species (*Z. mauritiana, A. excelsa, Azadirachta indica, A. nilotica* and *D. nutans)* in combination with *C. ciliaris,* in August 1996 at a spacing of 5m x 5m in frost prone area of western Rajasthan, a part of the hot arid region of India. At Pali site four species of tree/shrubs (*Z. mauritiana, A. excelsa, P. cineraria and D. nutans)* were planted in August 1996 at a spacing 5m x 5m along with improved variety of *C. ciliaris*-358 from CAZRI, Jodhpur in Pali district. And at Bhuj site the experimental trial with *C. ciliaris* (sown at low seed rate, 4 kg $ha^{-1}$) in combination with four tree species namely *Cordia gharaf, P. cineraria, Z. mauritiana* and *Colophospermum mopane,* was laid in RBD at a spacing of 6m x 4 m in July 2006.

Out of seven species tried *Z. mauritiana* maintained more than 90% survival on all the three sites after 42 months, followed by *P. cineraria* 96.2% indicating its adaptability to all types of climate.. *A. excelsa* recorded 96.6% at Pali but was 79% at Nagaur (frosty site). *C.gharaf* also maintains more 90 % at Bhuj site. *D. nutans* and *C. mopane* performed poorly at Nagaur, Pali and Bhuj respectively.

At Nagaur, above ground biomass yield of *A. excelsa* (12.81 kg tree$^{-1}$) was 58% more than *Z. mauritiana* (8.11 kg tree$^{-1}$). Production of leaf fodder was maximum in *A.nilotica* in monsoon season. *A. excelsa* and *Z. mauritiana*. Although rainfall was insufficient for crop maturity, however, grass yield was not adversely influenced and leaf fodder from tree species also supplemented the fodder yield. The analysis of data of four years of experiment indicates that Z. *mauritiana* is best tree species for adopting in silvipastoral systems in frost prone area of arid zone. *A. indica* and *D. nutans* are not found suitable as they are very susceptible to frost. *A. excelsa* and *A. nilotica* may be introduced in silvipastoral systems with less success. Production of two or more than 2 t ha$^{-1}$ grass yields in the last year of the study with *Z. mauritiana, A. excelsa* and *A. nilotica* also supports the beneficial role of trees.

Fig. 1. Silvipastoral trials of *Ailanthus excelsa* with *Cenchrus ciliaris* (left) and *Zizyphus mauritiana* with *Cenchrus ciliaris* (right)

At Rohat Pali , only *A. xcels* and *Z. mauritiana* attained good growth and total per tree biomass is double for *A. xcels* (10.5Kg) as compared to *Z. mauritiana* (4.8 Kg). However, *A. xcels* recorded 0.5 kg yield of dry leaves which was only 4.8% of the total mass while yield was 0.9 kg for *Z. mauritiana* resulting in 18.8% contribution to total biomass. In the four year old study the mean grass yield was 2.19 t ha$^{-1}$ with Z. *mauritiana* and 2.13 t ha$^{-1}$ with *A. xcels.* Overall *Z. mauritiana* recorded maximum fodder production followed by *A. xcels* and *A. indica*. *P. cineraria* plants were small and *D. nutans* was found unsuitable, due to its active suckering it reduced grass yield.

In Bhuj trial, *Z. mauritiana* and *C. gharaf* grew enough to estimate biomass. Maximum mean green leaf yield (1.29 kg) was recorded with grass treatment compared to 1.16 kg in control but the difference was not significant. Species wise *C. gharaf* recorded higher leaf yield (1.55 kg) than *Z. mauritiana* (0.83 kg ). Total green/ dry biomass yield was 4.5/1.68 to 5.3/1.9 kg tree$^{-1}$ for *Z. mauritiana* and 8.0/2.73 to 8.6/2.81 kg tree$^{-1}$ for *C. gharaf*. Sandy soil, grass growth improves the soil moisture and % SOM was more inside plant pit for with grass treatment as compared to control plants for both the plant species. In the four years of grass establishment

maximum mean dry grass yield was 3.15 t $ha^{-1}$ with *Z. mauritiana* and 2.95 t $ha^{-1}$ with *C. gharaf*. However, grass yield in control plot was slightly higher 4.01t $ha^{-1}$ indicating that tree growth is influencing the grass yield.

Fig. 2. Silvipastoral trials of *Z. mauritiana* with C*enchrus ciliaris* (left), *Z. mauritiana* with *C. setigerus* (center) and *Cordia gharaf* with *C. setigerus* (right)

## C. Beneficiaries of the Technology

1. ***Prominent beneficiaries/user groups***
   State Forest Departments of Rajasthan, Gujarat and Haryana, Scientists, NGOs and progressive farmers,
2. ***No of clients to whom technology has been transferred/ sold***
   SFD Gujarat, farmers, villagers.
3. ***Potential for further dissemination***
   Significant increase in productivity of degraded Pasteur land by introducing different tree species of fodder value and grass species are in benefits of local people to meet their requirement of fodder for their livestock and hence may be replicated in similar climate for enhancing productivity of such degraded land.

### Publications


1. Arya, R., Kachhwaha, G. R. Chaudhary, K.R. and Lohara, R.R. (2008) Growth and Biomass production of fodder species in agroforestry systems under arid conditions - in Diversification of Arid Farming Systems(Eds. Pratap Narain, M. P. Singh, Amal Kar, S. Kathju and Praveen Kumar) pub. Arid Zone Research Association of India and Scientific Publishers(India) Jodhpur, pp124-131
2. Arya, R.(2006) Studies on growth and biomass production of different fodder tree species in a silvi-pastoral trial under hot arid conditions in India. *Journal of Arid Environment* 65(1)179-191

3. Tewari, V.P. and Arya, R. (2005) Degradation of Arid Rangelands in Thar Desert, India: A Review- Arid Land Rerearch and Management 18(1): 1-12.
4. Arya, R. (2003). Yield of *Cassia angustifolia* in combination to different tree species in a silvi-herbal trial under hot arid conditions in India. *Bioresource technology*, 86(2): 165-169.

## D. Economic significance

### 1. *Potential to address Livelihood issues and generate additional income*

Successful integration of trees in pasture land has enhanced the productivity of degraded waste land thus addressing the livelihood and additional income issues.

### 2. *Productivity enhancement and economic benefits over replaced technology*

*Ailanthus excelsa*, *Acacia nilotica* and *Zizyphus mauritiana* gave highest yield over control. More than two tons per hectare grass yield seems to be better under this practice as compared to less than 0.5 ton/ha. under normal conditions. Harvesting of these products for fuel wood and fodder may be beneficial in enhancing socio-economic conditions of the local people.

### 3. *Impact of technology*

Four years of experimentation on all the three trials indicate that *Z. mauritiana* is the most suitable top feed species as it maintain appreciably high survival and provide top feed within three year and remain green even in summers closely followed by *C. gharaf* at Bhuj and *A. excelsa* at Nagaur and Pali. In Nagaur overall, *Z. mauritiana* and C. *ciliaris* was the best silvipastoral combination for maximum dry fodder yield (3633 kg $ha^{-1}$).

## E. Developed by

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