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RESEARCH ARTICLE

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A novel silvi-pastural model to conserve natural resources in semi-arid regions

S.B. DEVARANAVADGI, S.B. PATIL, S.R. MULLA AND M.B. JAMBAGI

ABSTRACT

The semi-arid environment is characterized by hostile environmental conditions like high atmospheric water demand, high mean annual temperature and least variable annual rainfall. The precipitation exceeds potential evapotranspiration for 2–5 months in these areas. The dryland agriculture is the predominant land use system in the tract. These ecosystems have become fragile because of low and erratic rainfall, improper soil and water conservation practices and lack of perennial vegetation. The practice of agriculture in such fragile ecosystems is causing faster degradation of land resulting in loss of fertility and productivity. The arable crops grown in these areas cover the land generally for one season of about 3-4 months. Therefore, the rainfall received during uncropped season goes unutilized because of any perennial vegetation. The tree species in general are known to be more tolerant to adverse soil and climatic conditions than most of the arable crops. They can utilize the off seasonal rainfall and provide multiple benefits. In recent decades, drought and famines have underlined the need for the adoption of sustainable land use systems like silvi-pastural system, capable of responding flexibly to rapid shifts in economic and ecological conditions. In the dryland ecosystems the practice of agriculture is not yielding regular returns due to low and erratic rainfall. Hence, practice of silvi-pasteural system in dryland ecosystems will be helpful to improve the overall productivity and sustain it as well.In this context, pongamia based silvi-pastural model encompassing goat farming, vermiculture and apiculture could be an appropriate farming system for the semi-arid regions. This system also encourages other farming activities to conserve natural resources and to improve the economic status of farmers of the semi-arid regions.

KEY WORDS : Apiculture, Goat farming, Pongamia, Silvi-pastural, Vermiculture

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INTRODUCTION

The increasing area under marginal and sub-marginal wastelands, deterioration of forest land and increasing social needs of forage and firewood call for an early action to vegetate these lands with fast growing multipurpose trees, grasses and legumes under a kind of integrated management system. This system involving trees or woody perennials with grasses and legumes utilized by harvesting or grazing with an inbuilt component, which is known as silvi-pasture.

Pongamia is botanically called as *Pongamia pinnata,* is a fast growing tree reaches 40 ft in height and forming a broad spreading casting moderate shade. It can be grown in any type of well drained soil *i.e.* clay loam to sandy loam even slightly alkaline to acidic condition, it is highly drought tolerant tree and moderate in its salt tolerance. It is one of the nitrogen fixing tree and is often planted as ornamental and shade tree. Looking to its ability to produce multiple products, would be a better candidate, both in arable and non-arable lands. In recent days, particularly the increase in demand for bio-fuel has necessitated the adoption of tree based oilseed (TBOs) land use system involving pongamia, jatropha, neem, mahua, etc. *Pongamia pinnata* is an indigenous bio-fuel plant with 35-40% oil content. It can be grown well under variety of situations and it is more suitable for semi-arid regions where the rainfall is 500-750 mm. The trees start yielding the pods at the age of 5-6 years due to the long gestation period, farmers may not appreciate monoculture of pongamia. Therefore, the inter-space available in the plantation could be used for growing under storey forage components like grasses and legumes. The forage so produced could be used for stall feeding of goats. This sub-system will start production from first year itself. Further, the fecal matter of goat produced and the non forage green biomass available can be used to produce vermicompost simultaneously along with goat farming. When the plantation reaches an age of 5-6 years, the flowering starts during the months of March to May, at this stage apiculture can be introduced.

Correspondence to:
S.B. DEVARANAVADGI, University of Agricultural Sciences (D), Regional Agricultural Research Station, BIJAPUR (KARNATAKA) INDIA
Email : dnavadgi@rediffmail.com

Authors' affiliations:
S.B. PATIL, S.R. MULLA AND M.B. JAMBAGI, University of Agricultural Sciences (D), Regional Agricultural Research Station, BIJAPUR (KARNATAKA) INDIA

Our country as well as, our state is traditionally mixed farming type where livestock serve as an integral part of the farming. The area under fodder cultivation is not enough (4.8%) to meet the requirement of a huge cattle population (500 m heads). To overcome these deficits, the said silvi-pastural model (Trees+pastures) gained importance owing to its potential to increase production and economic returns per unit area, especially in arid and semi-arid regions of the country.

MATERIALS AND METHODS

The pongamia plantations were taken up in nine locations of Bijapur district during 2007-08, which represents semi-arid environment. The system needs to be carefully developed by appropriate technology. It is possible to accommodate 500 Pongamia trees per ha with a spacing of 5 x 4 m. The trees are to be planted along the contour lines/across the slope by digging staggered trenches (5x4x0.6 m size) which is useful efficient water harvesting. This type of planting method is very much essential for higher survival, early establishment and better growth of seedlings planted out. Further, the trees are to be regularly cleaned, pruned and earthing up taken up at least two times in a year. While attending pruning a crown ratio of 0.40 needs to be maintained by removing the lower branches with the help of hand saw (Devaranavadgi and Murthy, 2005). It is also important that the tree should be guarded against fire and cattle menace particularly from goats. The trees should be trained to shape an umbrella shaped crown to harvest maximum solar radiation to facilitate higher pod yield. In the inter space of pongamia tree rows forage components which are shade tolerant like *Cinchrus ciliaris* (grass) and *Styloxanthus hamata* (legume) can be raised in 3:1 ratio (Kalaghatagi, 2000). This under storey component should be allowed to establish during the first year and cutting of forage component not practiced. However, from second year onwards under pongamia plantations 6.8 tons/ha of green forage can be harvested and stall fed to the goats. Normally the forage component is harvested 3-4 times in a year. During the last cutting (October/November) the forage component should be left uncut in small blocks (2x2m) to produce seeds which help in perpetuation in the productivity of under storey component. The goat droppings along with cow dung can be used for vermicompost production which will be another best income generating component (Biradar *et al.,* 2000). For this purpose the pongamia leaf litter and other non-forage green biomass can be utilized. Each location of pongamia plantation can carry 4-5 goats. This way till the pongamia plantation attains maturity and starts production, farmers can get economic returns from the second year itself.

After 5-6 years, the flowering and fertility can be seen. The pongamia plantation can yield 4-5 tons/ha (8-10 kg/plant) of pods per year. Here the key point is that proper water harvesting structures are adopted looking to the site conditions for efficient conservation of rain water which will be otherwise lost as runoff. In moderately slopy areas which are non-arable, staggered trench is the ideal planting method. When the pongamia trees mature (5-6 years age), there will be huge flowering in the months of March to May and the same could be utilized for bee keeping. *Apis mellitera* Linn. can be very well utilized in North Karnataka even in migratory bee keeping because of its sweet temper, rare occurrence of swarming absconding and high honey yield (25 kg/year/colony) (Sunitha *et al.,* 2003). It is possible to maintain 4 colonies in every hectare of pongamia plantation and which can produce 50 kgs of honey/ha/year. Thus, it is possible to integrate pongamia (bio-fuel) cultivation with goat farming, vermicomposting and apiculture. Besides above component, the excess runoff water can be stored in mini farm pond and utilized for the cultivation of seasonally grown high value vegetables.

RESULTS AND DISCUSSION

The average nine locations, the survival of seedlings after one growing season was 79.8% (Fig. 1). The other silvicultural parameters like plant height (89.0 cm), clear bole height (42.1cm), crown spread (N-S: 39.0 cm and E-W: 41.7 cm), collar diameter (1.37 cm) and number of branches (3.8/plant) were recorded. The results indicate encouraging growth at the end of first growing season. The results are in conformity with the findings of Devaranavadgi and Murthy (1995). It is also important that due to long gestation period of Pongamia, certain

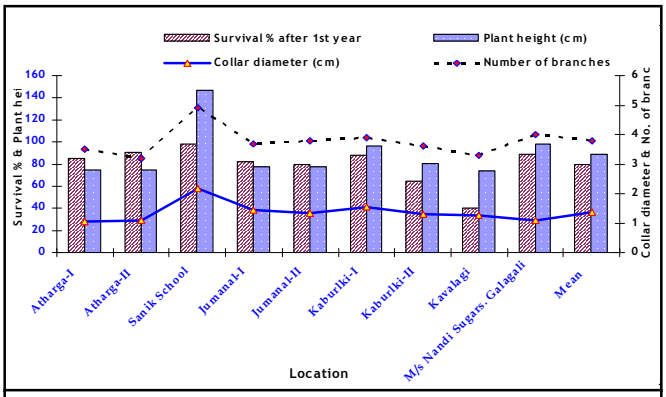

Fig. 1: Performance of pongamia in different locations under semi-arid conditions of Bijapur district (2007-08)

enterprises like goat farming and vermicompost can be introduced from the first year itself so that the early returns will be attractive to the farmers. Once the Pongamia plantation attain maturity and start flowering, bee keeping (apiculture) can be incorporated into the system to utilize the profuse pongamia flowering in the months of March-May. The goat droppings, pongamia leaf litter and other non-forage green biomass can be used for vermicompost production (5 t/ha/year) with gross returns of Rs. 15,000/ ha/year (Table 1). The initial cost of each unit of system is presented in Table 2. Thus, the proposed integrated pongamia based farming system can produce an annual net return of Rs. 41,500/- (Table 2) on sustainable basis.

Keys for success of the system:

– Plant taller seedlings (< 60 cm) in staggered contour trenches for better harvesting of rain water facilitating the higher pongamia pod yield.

Table 1:Cost and production account of vermicompost unit (per ha)

Sr. No.	Filling material	Cost in Rs.	Vermicompost
1.	Fecal matter 2.0 kg/day x 180 days = 360 kgs	1,800	5 t/ha/year (Rs. 3,000/t)
2.	Farm waste (3200 kg)	3,200	
	Total	5,000	15,000

Table 2 : Estimate of cost of each unit

Sr. No.	Unit	Cost (Rs)
1.	Planting cost of pongamia per hectare	20,000
2.	Vermicompost unit (5)	5,000
3.	Apiculture unit (5 boxes)	10,000
4.	Goat unit (5)	7,500
5.	Mini farm pound (1)	75,000

– In silvi-pasture system protect the under storey component from fire and leave seed belts of forage component for perpetuation of pasture production.

– Vermicompost can be practiced by utilizing the goat dropping (stall fed goat farming) and leaf litter along with non forage green biomass.

– The bee keeping can be practiced by installing 4-5 colonies.

– Dug the trenches between the two pongamia plants in zig zag manner to harvest rain water for subsequent utilization.

– The excess runoff water can be stored in mini farm pond and utilized for cultivation of high value seasonal vegetable/flower crops.

Conclusion:

In semi-arid tracts of north Karnataka there is lot of migration of rural people in search of livelihood due to the occurrence of frequent droughts and also due to the absence of alternative employment opportunities. Therefore, alternative land use system with integrated farming system approach can bring the following benefits.

– Increase in the economic status of farmer.

– Increase in employment opportunities in rural areas.

– The plantation will help in maintaining ecological balance by reducing global warming effect.

– The tree plantation will bring ecological security and improve the aesthetic value of landscape.

– The bio-fuel plantations of pongamia will be helpful in effective soil and water conservation.

This type of integrated pongamia based farming systems will be taken up in non-arable lands in drylands. But for the success of this model, the plantations should be developed by the states as a part of national infrastructure development programme. Further, the programme needs to be supported by constant Research and Development programmes.

Table 3 : The returns from pongamia based farming systems under semi-arid situations

Sr. No.	Year	Maintenance cost (Rs)	Receipts					Net returns (Rs/ha)
			Pongamia pods (Rs)	Vermicompost (Rs/ha)	Goat farming (Rs/ha)	Bee keeping (Rs/ha)	Total (Rs/ha)	
1.	1st	4,000	-	4,000	3,000	-	7,000	3,000
2.	2nd	5,000	-	9,000 (3.0 t)	4,500 (3 goats)	-	10,500	8,500
3.	3rd	5,000	-	9,000 (3.0 t)	4,500 (3 goats)	-	10,500	8,500
4.	4th	5,000	-	15,000 (5 t)	6,000 (4 goats)	-	14,000	16,000
5.	5th	6,000	20,000 (4,000 kg)	15,000 (5 t)	7,500 (5 goats)	5,000 (50 kg)	40,500	41,500
6.	6th	6,000	20,000 (4,000 kg)	15,000 (5 t)	7,500 (5 goats)	5,000 (50 kg)	40,500	41,500

*It stabilizes after 6th

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