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Paddy-Sunhemp System as an Alternative Resilient Technology to Paddy–Fallow System

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A B S T R A C T

Economics of paddy relay sunhemp system was studied in comparison with economics of paddy-fallow system. Farmers of the Nacharam (V), Khammam (D), Telangana state are generally keeping the land fallow after harvesting *kharif* paddy due to water scarcity resulting in no income during *rabi*. As an alternative to the paddy-fallow system, farmers of the Nacharam (V), Khammam (D), Telangana state were educated by the scientists of KVK, Wyra under "National Innovations in Climate Resilient Agriculture (NICRA)" project to grow sunhemp as a relay crop after *kharif* paddy *i.e*., paddy-sunhemp system. All the cost economics including cost of cultivation, gross returns, net returns and cost benefit ratio of both the systems were calculated to recommend the best economical and sustainable system to the farmers. The net returns obtained from paddy-sunhemp system were recorded as Rs.76, 256/- ha^{-1} compared to Rs. 45,506/- ha^{-1} from paddy-fallow system. The cost benefit ratio of both the systems was calculated and paddy-sunhemp system recorded the higher cost benefit ratio (1:2.27) than the paddy-fallow system (1:1.90). Hence, it was concluded that, paddy-sunhemp system was the best economical income generation practice suitable to the prevailing situation of the village and was the best alternative system to paddy -fallow system.

Introduction

Nacharam one of the NICRA (National Innovations in Climate Resilient Agriculture) village belonging to Khammam (D), Telangana state has a population of 3246 individuals with 749 number of households. The total cultivated area is around 7424 hectares with cultivation of major crops like paddy, cotton, maize and chilli. The village receives an annual rainfall of 1054 mm with uneven distribution. The major soil types are black and red soils. The source of irrigation for cultivating crops is streams and bore wells. The major climate challenge is drought because of deficit rainfall observed in every year.

Farmers are cultivating rice during *Kharif* season are increasingly facing water shortages due to deficit rainfall, declining ground water table due to insufficient recharge. The condition gets even worsened during *rabi* season forcing the farmers to keep land fallow

without any income generation; thus affecting the livelihood of the farmers.

By studying the climatic conditions and considering the situation of the village, KVK, Wyra scientists have approached the farmers with a novel idea of cultivating sunhemp after paddy *i.e.*, paddy-sunhemp as an alternative cropping system to the paddy –fallow for income generation to the farmers for bringing the area under cultivation instead of leaving the land fallow in *rabi*.

Sunhemp (*Crotalaria juncea*) is a leguminous crop - a nitrogen fixer and can also be used for fodder purpose. Mansoer *et al.,* (1997) recorded that sunhemp is known to produce an average of 5.9 Mg ha^{-1} biomass and 134–145 kg ha^{-1} of Nitrogen in a 9–12-week period. It is a drought tolerant crop; can be grown in areas with average annual rainfall less than 200 mm. Even under terminal drought conditions by utilising the residual moisture good yields can be harvested.

Ram and Singh (2011) reported that, it is one of the green manure crops suited to almost all parts of the India. Sunhemp has the ability to fix atmospheric nitrogen, adds organic matter to the soil, suppresses weeds and reduces soil erosion. In addition, sunhemp as a cover crop (Wang *et al.,* 2002) and leaf extract is shown to have nematostatic effect against reniform nematode (*Rotylenchulus reniformis*) (Marahatta *et al.,* 2012), burrowing nematode (*Radopholus similis*) (Jasy and Koshy, 1994), and root-knot nematode (*Meloidogyne* spp.) (Fassuliotis and Skucas, 1969; Jourand, 2004). The research results of sunhemp were shown to be excellent in improving soil conditions (Cook & White, 1996).

Sunhemp biomass can be used for production of paper fiber, forage and as an alternative fuel crop (Rotar and Joy, 1983).The pods are small and inflated, having stiff hairs. It is commonly grown in India as fodder. Sunhemp seeds after crushing can be fed to cattle but feeding as such is not palatable. This can, however be mixed with other palatable feedstuffs in concentrate mixture for feeding of cattle. The crop can be grown in the fallow land by zero tillage; thus reducing the drudgery and cost involved for land preparation. One of the important reasons for reduced popularity of sunhemp is unavailability of good quality seeds (Chittapur and Kulkarni, 2003).

Materials and Methods

Conservation and effective utilization of residual soil moisture through cultivation of sunhemp for seed production in rice fallows was demonstrated under NICRA project. During the period of paddy harvesting in the month of November, farmers has broadcasted the sunhemp seed in the field so that they can germinate by utilising the residual soil moisture. The seed can be broadcasted easily without much labour requirement; thus helping in timely sowing and also reduces the cost involved for labour. About 25 kg of seed is broadcasted per hectare. Seeds germinated within 5-6 days after sowing. Flowering comes at 65 days after sowing and the total flowering period is about 30 days *i.e.*, from 65 days after sowing (DAS) to 95 days after sowing (DAS). Seed formation and seed hardening will complete within a period of 35-40 days. The crop can be harvested for seed production by 140-150 days after sowing (DAS).

All the economics from the seed cost, sowing to harvesting was studied in the sunhemp seed production. Similarly, all the economic parameters *i.e.*, cost of cultivation, gross returns, net returns and cost benefit ratio obtained was carefully studied, calculated and compared in both the systems *i.e.*, paddy-sunhemp and paddy-fallow.

Results and Discussion

The results indicated that the total cost of cultivation for sunhemp seed production was Rs. 9,250/- including the seed cost (Rs.1000/- ha^{-1}), broadcasting (Rs. 500/- ha^{-1}), plant protection measures (Rs.2750/- ha^{-1}) and harvesting (Rs. 5000/- ha^{-1}). All the plant protection measures were taken at appropriate time during the crop period to reduce the pest incidence and to obtain good yield. The total yield of sunhemp seed production achieved was 10 quintals ha^{-1}. The total income generated by selling the 10 quintals of produce was Rs.40,000/- ha^{-1} (price per quintal was Rs. 4000/-). The net returns obtained by removing all the cost of cultivation was Rs.30,750/- ha^{-1} (Table 1).

Table.1 Sunhemp seed production under rice relay Economics (per Ha)

Details of cost of cultivation	**Economics ha^{-1}**
Seed (25 Kg)	Rs. 1000/- (40 Rupees per kg)
Broadcasting sunhemp seed in paddy fields	Rs. 500 /-
Weed management	-
Plant protection measures	Rs.2750/-
Harvesting	Rs. 5000/-
Total cost of Cultivation	Rs. 9,250/-
Total production (Ha)	10 quintals
Price per quintal	Rs.4,000/-
Total income	Rs. 40,000/-
Net Returns from sunhemp	Rs. 30,750 /-

Table.2 Paddy –fallow comparison with paddy- Sunhemp

Details of cost of cultivation	**Economics ha^{-1}**
Cost of seed - sunhemp	**Rs. 1000/- (40 Rupees per kg)**
Broad casting of sunhemp seed as paddy relay	Rs. 500 /-
Weed management	-
Plant protection measures	Rs.2750/-
Harvest of sunhemp	Rs. 5000/-
Total cost of Cultivation	Rs. 9,250/-
Total production (Ha)	10 quintals
Price per quintal	Rs.4,000/-
Total income	Rs. 40,000/-
Net Returns from sunhemp	Rs. 30,750 /-
Paddy Grain yield (Kg Ha^{-1})	6187.5 kg Ha^{-1}
Price per quintal	Rs. 1550
Total income	Rs 95,906.25/-
Paddy cost of cultivation	Rs.50,400/-
Net returns	Rs.45,506.25/-
Net Returns from paddy -fallow	Rs. 45,506.25/- (CB Ratio 1:1.90)
Net Returns from paddy – sunhemp	Rs.76,256.25 (CB Ratio 1:2.27)

As in Table 2, the paddy-fallow cropping system was compared with paddy-sunhemp system shown that the total cost of cultivation of paddy was Rs. 50,400/- ha^{-1}. The total yield obtained from one ha of paddy was 6187.5 kg (61.87 quintals). The total income gained by selling 6187.5 kg produce was Rs. 95,906 /- ha^{-1} and the net returns obtained after removing all the cost of cultivation was Rs. 45,506/-. If the land is kept fallow after paddy harvesting, then the farmers are left with only the net income gained from selling of paddy produce was Rs. 45,506/-. Thus the cost benefit (CB) ratio was 1:1.90. Farmers who have grown sunhemp after paddy are able to get the total net returns of Rs. 76,256 /- ha^{-1} (Rs. 45,506 /- ha^{-1} from paddy and Rs. 30,750/- ha^{-1} from sunhemp). The cost benefit (CB) ratio was 1:2.27 which is more than the cost benefit ratio (CB) of paddy -fallow *i.e*., 1:1.90. Thus, farmers by growing the sunhemp after paddy are able to gain an additional net income of Rs. 30,750/- ha^{-1} through the seed production of sunhemp.

It is concluded as in the present day situation, due to monsoon vagaries and delayed and limited rainfall farmers are cultivating crops during *kharif* but with lot of difficulty by conserving the moisture available; but they are leaving the lands barren during *rabi.* Paddy-sunhemp system was the best alternative income generation system suitable to the situation prevailed in the village and was the best alternative system to Paddy -fallow system.

Farmers of Nacharam (V) have got an average yield of 10 q ha^{-1} from sunhemp cultivation with net returns of Rs. 30,750/- ha^{-1}. The technique fits into alternate planning to the farmers during the Rabi season as it provides flexibility in growing the crop with utilisation of residual moisture and fits into the season without keeping the land fallow.The technology which started with an area of 16 ha has now being followed by more than 60% of farmers in the village with successful income generation.

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