broiler diets improved the shank and skin color of carcass to a desired level. Carcass yields and abdominal fat on all sorghum diets as well as sorghum diet fortified with *Stylosanthes* meal were comparable to that of maize. Thus, it appears that pelletization of 100% sorghum-based diets with *Stylosanthes* leaf meal at 3%, besides improving the skin and carcass color, improved the feed conversion ratio and lowered the total feed cost for production of live broilers.

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Socioeconomics

Economics of Improved Sorghum Cultivars in Farmers' Fields in Andhra Pradesh, India

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Introduction

India is the second largest producer of sorghum (*Sorghum bicolor*) in the world, producing 7.8 million t in 2001–02 (CMIE 2004). Sorghum in India is grown in the rainy season (June–October) on around 4.5 million ha and in the postrainy season (September–January) on around 5.4 million ha. In the state of Andhra Pradesh, rainy season sorghum is grown on 0.3 million ha, producing 0.29 million t of grain while the postrainy season sorghum accounts for 0.34 million ha producing 0.35 million t of grain (Government of Andhra Pradesh 2003). Generally, resource-poor small farmers in the semi-arid regions of Andhra Pradesh with less than 1 ha of land grow sorghum. The crop is mainly cultivated under semi-subsistence farming to meet household requirements of food and fodder with a small marketable surplus. While postrainy season sorghum is almost completely used for human consumption, rainy season sorghum, which is used for food, is also used for non-food purposes such as poultry and livestock feed, and alcohol and starch manufacturing (Kleih et al. 2000). Lack of availability of rainy season sorghum in bulk quantities and assured supplies is one of the main reasons constraining its usage in industry. High per unit cost of production of local sorghum and unremunerative grain price reduce its profitability to farmers. Although about 35% of marketable surplus is available, these are often scattered and hence non-economical to procure in sufficient bulk quantities by industrial users (Marsland and Parthasarathy Rao 2000).

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, along with Acharya NG Ranga Agricultural University (ANGRAU), Hyderabad, India has been implementing a project, funded by the Department for International Development (DFID), UK, in collaboration with the non-governmental organizations (NGOs), Federation of Farmers' Associations (FFA) and Andhra Pradesh Poultry Federation (APPF), and Janaki Feeds, a private poultry feed manufacturer.

The objective of the project is to enhance the access and availability of rainy season sorghum grain for poultry feed rations. Under this project, improved sorghum cultivars were identified and were distributed to selected farmers in target villages in Andhra Pradesh during the rainy season in 2003. Subsequently, attempts were made by the coalition partners to create a sustainable marketing linkage between sorghum growers and the poultry industry through innovative institutional systems. This article briefly highlights the economic returns of the improved sorghum cultivars compared to traditional varieties.

Materials and Methods

The Mahbubnagar and Ranga Reddy districts of Andhra Pradesh, where rainy season sorghum cultivation is predominant, were selected for the implementation of project activities at the field level. After a thorough study of district profiles, four mandals (two from each district) were selected. Based on the response from farmers to participate in project activities, proximity of villages to regulated market yards, existence of farmers' clubs and associations, and accessibility of these villages in all seasons, four villages (one from each mandal) were

Table 1. Economic structure and performance of improved and local sorghum cultivars in two selected districts in Andhra Pradesh, India during rainy season 2003[1].

	Mahbubnagar		Ranga Reddy	
Cost / Income measure	Improved sorghum + pigeonpea	Local sorghum + pigeonpea	Improved sorghum + pigeonpea	Local sorghum + pigeonpea
Variable costs (Rs ha^{-1})				
Human labor[2]	2021.70	1238.20	1563.70	924.70
Bullock labor	1138.90	1327.10	1024.80	1292.00
Machine labor	458.60	–	175.10	–
Farmyard manure	481.60	410.30	201.00	183.70
Seed of main crop	125.90	57.70	128.40	52.60
Seed of intercrop	120.00	76.60	41.20	81.50
Fertilizer	772.10	712.10	523.70	508.00
Pesticides	182.30	323.80	316.80	260.60
Interest on working expenses	171.20	139.30	106.90	108.90
Subtotal	5472.30	4285.10	4081.60	3412.00
Fixed costs[3] (Rs ha^{-1})	1331.30	1337.90	1182.80	1166.30
Total cost (Subtotal + Fixed costs) (Rs ha^{-1})	6803.60	5623.00	5264.40	4578.30
Main crop (sorghum)				
Grain yield (kg ha^{-1})	1210	270	540	120
Price of grain (Rs 100kg^{-1})	419.20	428.00	428.00	412.00
Total value of grain (Rs)	5072.32	1155.60	2311.20	494.40
Fodder yield (kg ha^{-1})	2297	1900	1560	1260
Price of fodder (Rs 100kg^{-1})	21.10	22.30	20.10	22.80
Total value of fodder (Rs)	484.66	423.70	313.56	287.28
Intercrop (pigeonpea)				
Grain yield (kg ha^{-1})	520	380	330	250
Price of grain (Rs 100 kg^{-1})	1585.00	1585.00	1493.00	1493.00
Total value of grain (Rs)	8242.00	6023.00	4926.90	3732.50
Gross returns	13798.98	7602.30	7551.66	4514.18
Net returns	6995.38	1979.30	2287.26	–64.12
Output/input ratio	2.02	1.35	1.44	0.98

1. Total sample farmers surveyed: 69.
   Study area: two villages each from Mahbubnagar and Ranga Reddy districts.
2. Includes the wages paid for the hired casual labor and family labor.
3. Include the cost imputed for owned land rent and the expenditure made towards the land revenue, depreciation and interest on fixed costs excluding land rent.

Source: Survey data from Project villages.

selected for the study. Almost all the sorghum farmers in the selected villages were cultivating a traditional yellow sorghum variety, locally called *'patcha jonna'* which was intercropped with pigeonpea (*Cajanus cajan*). Sixty-nine sorghum growers spread over the four villages were selected randomly for this study.

Four improved high-yielding sorghum cultivars, CSH 16, CSV 15, PSV 16 and S 35, suitable for the agroclimatic area and known to be less susceptible to grain mold attack were supplied to the selected farmers for sowing in 2003. All farmers grew pigeonpea (local variety) as an intercrop along with sorghum with a row arrangement of 5:1 (sorghum : pigeonpea). The seed was treated with Endosulfan dust and packed in cloth bags. Each bag of 3.5 kg seed is sufficient for sowing 0.4 ha as a sole crop. An information brochure printed in the local language was supplied along with the seed bag to enable the farmers to follow the recommended cultivation practices. A postharvest survey was conducted through structured schedules by direct interview methods to assess the cost-return profile of improved sorghum cultivars supplied under the project.

Results and Discussion

Around 26% of the project farmers grew the traditional sorghum variety during the rainy season in 2003. The crop was harvested between the last week of November and the first week of December. Because of early season drought, the crop was exposed to long dry spells during both the vegetative growth and flowering stages and was also exposed to continuous rains during grain development which resulted in grain mold attack. Since improved as well as local sorghum cultivars were grown in similar agroclimatic conditions, the crop yields of both were comparable. The yield of improved sorghum cultivars (weighted average of all four) was higher than local cultivars by about 348% in Mahbubnagar district and 350% in Ranga Reddy district (Table 1). The cost of cultivation of improved cultivars was Rs 6803 ha^{-1} and Rs 5264 ha^{-1} compared to Rs 5623 ha^{-1} and Rs 4578 ha^{-1} for traditional cultivars in Mahbubnagar and Ranga Reddy districts, respectively. Despite higher cost of cultivation, the net returns/benefit-cost ratio obtained for the improved sorghum + pigeonpea intercropping system were higher in both districts. Also, per unit cost of production was lower than that of traditional varieties in both the districts, ensuring higher profitability to the farmers. Similar results were reported by Kiresur et al. (1999). In Ranga Reddy district, the cultivation of local sorghum intercropped with pigeonpea gave negative net returns with less than unity benefit-cost ratio. This may have resulted from severe pod borer (*Heliothis armigera*) attack which drastically reduced pigeonpea yields as well as the yields of the main crop.

During field visits, farmers perceived that CSV 15 and CSH 16 performed better than PSV 16 and S 35 as these cultivars met the criteria for good quality and yield of grain and stover. Encouraged by the enthusiasm and response of farmers, improved cultivars were supplied to 546 farmers in 12 villages for the 2004 rainy season to allow for the scale-up of the project. Farmers are also keen to participate in collective marketing, dealing directly with poultry feed manufacturers for the grain to be produced in the 2004 rainy season.

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