The Andhra Agric. J 61(3):684-691, 2014

Optimum Crop Mix for Farmers of Kadapa District, Andhra Pradesh

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ABSTRACT

The present study "Optimum crop mix for farmers of Kadapa district, Andhra Pradesh" was undertaken to examine the possibilities and prospects of increasing income through rational allocation of resources under different capital and technological environments. The study was carried out through collection of data by adopting interview method and linear programming technique was used to develop optimum plans for small and large farmers of the study area. The results of the study brought out that there was sub-optimal allocation of resources in the existing plans of small and large farms. The optimal plans indicated the possibilities of increasing income even under existing technology with limited available owned funds. The income was increased further through relaxation of credit and adoption of recommended technology.

Key words : Crop mix, Farmers, Optimum.

Careful and judicious management of the available but limited resources is essential to satisfy the food requirement of increasing population and economic development of the country. Availability of per capita land is declining day by day so it is essential to have the optimum use of land and other farm resources, for crop production and hence planning in agriculture is very important.

MATERIAL AND METHODS

The district of Kadapa which is one of the agriculturally advanced districts in Andhra Pradesh was purposively selected for the present study. Out of three revenue divisions in the Kadapa district, Jammalamadugu revenue division having similar cropping pattern, soil, climate and other general conditions of the district was purposively selected for the study. From the above selected revenue division, four mandals *viz*., Mylavaram, Proddatur, Mydukur and Duvvur were selected at random. All the villages in the selected mandals based on the gross cropped area were arranged in the descending order and the first two villages from each mandal were selected for a detailed study. Thus, number of farmers selected from each village is sixteen and the total number of farmers selected for the purpose of present study was 128. The data on technical coefficients and factor and product prices were collected from the selected respondents for the agricultural year 2010-11 by survey method.

Linear programming model of the following form was used as an analytical tool to explore the possibilities of optimizing net farm returns, considering only crop activities.

$$\text{Maximise } Z = \sum_{j=1}^{n} C_j X_j$$

j= 1 to n activities
Subject to following constraints

1. $\sum_{j=1}^{n} a_{ij} X_j \geq b_i$ (i = 1, …….K)

2. $\sum_{j=1}^{n} a_{ij} X_j \leq b_i$ (i = K+1,……. m)

3. $\sum_{j=1}^{n} a_{ij} X_j = b_i$ (i = m+1, ……. v)

4. $X_j, b_i \geq 0$ (non negativity constraint)

where,
Z= is the objective function to be maximized in the year.
C_j= is the value or price of j^{th} activity during *kharif* and *rabi* seasons of the year.

X_j =is the unit of j^{th} production activity during *kharif* and *rabi* seasons of the year.

a_{ij} = amount of i^{th} resource required by j^{th} activity

b_i = quantity of i^{th} resource.

With the help of above model, following four optimum plans (models) were developed for both small and large farms.

Model 1: Optimum farm plan with existing technology and owned funds.

Model 2: Optimum farm plan with existing technology and relaxed borrowing.

Model 3: Optimum farm plan with recommended technology and owned funds

Model 4: Optimum farm plan with recommended technology and relaxed borrowing.

Each of these four models was designed separately for small (S_1, S_2, S_3, and S_4) and large (L_1, L_2, L_3, and L_4) farmers category.

RESULTS AND DISCUSSION

Existing Cropping Pattern for Small and Large Farmers

The existing production programme of both small and large farmers included groundnut on dry land in *kharif* season. Groundnut occupied 0.08 hectare on small farms and 0.16 hectare on large farms accounting for 32.00 and 39.02 per cent of the total *kharif* dry land respectively. An extent of uncultivated dry land on small and large farms was 0.17 and 0.25 hectare respectively.

The existing production programme of small and large farmers included paddy, groundnut, turmeric, chillies, onion, tomato, brinjal, redgram and cotton on *kharif* irrigated land. Paddy which is the main food crop in the study area occupied the largest area of 0.47hectare (55.95 per cent) and 1.00 hectare (47.39 per cent) on small and large farms respectively. Groundnut was grown on 0.09 and 0.11 hectare on small and large farms respectively. Turmeric and chillies which are the important commercial crops in the study area occupied 0.07 and 0.06 hectare on small farms accounting for 8.34 and 7.14 per cent of *kharif* irrigated land respectively. Large farmers allocated 0.22 hectare (10.43 per cent) and 0.08 hectare (3.79 per cent) for the production of turmeric and chillies respectively. Cotton, another commercial crop was grown on 0.12 hectare (5.69 per cent) by the large farmers. The existing plan of small farmers included only one vegetable enterprise during *kharif* i.e., onion. It occupied 0.05 hectare (5.95 per cent). However, the current production programme followed by large farmers included three vegetable crops namely onion, tomato and brinjal during *kharif* season on irrigated land. Large farmers allocated an extent of 0.10, 0.08 and 0.10 hectare for the production of onion, tomato and brinjal accounting for 4.74, 3.79 and 4.74 per cent of the *kharif* irrigated land respectively. Redgram occupied 0.09 hectare on large farms. The extent of uncultivated *kharif* irrigated land on small and large farms was 0.10 and 0.21 hectare accounting for 11.90 and 9.95 per cent respectively.

Groundnut and bengalgram were the predominant enterprises in the existing plan on dry land in *rabi* season. The *rabi* dry land utilized for groundnut and bengalgram was 0.12 and 0.08 hectare respectively on large farms while 0.08 hectare occupied by the bengalgram on small farms. Larger proportion of dry land was kept fallow on both the size groups.

On *rabi* irrigated land, small and large farmers grew food crops, pulses, oil seeds and vegetables. One third of the *rabi* irrigated land was occupied by paddy on small farms. Oil seed crops *viz*., groundnut and sesamum occupied 0.14 and 0.06 hectare accounting for 16.67 and 7.14 per cent respectively. Blackgram, a pulse crop was grown on 0.08 hectare (9.52 per cent) on *rabi* irrigated land by the small farmers. Small farmers allocated 0.04 hectare each for chillies, tomato and brinjal. Like on small farms, on large farms too paddy occupied 0.55 hectare (26.06 per cent). Blackgram an important pulse crop of the study area was grown on 0.30 hectare (14.22 per cent). Groundnut, sesamum and sunflower the important oil seed crops of the study area occupied 0.23 hectare (10.90 per cent), 0.19 hectare (9.00 per cent) and 0.15 hectare (7.11 per cent) respectively on *rabi* irrigated land of large farmers. Chillies, tomato and brinjal were the other crops grown by the large farmers on *rabi* irrigated land accounting for 5.69, 3.32 and 3.79 per cent respectively. Redgram which was grown by large farmers alone and turmeric grew by small and large farmers on *kharif* irrigated land continued to occupy the *rabi* irrigated land to the same extent. The cropping intensity in the

Table 1. Cropping pattern for small farmers under different optimal plans.

Crop	Existing		S_1		S_2		S_3		S_4	
	Area (ha)	Per cent	Area (ha)	Per cent	Area (ha)	Per cent	Area (ha)	Per cent	Area (ha)	Per cent
***Kharif* dry land**										
Groundnut	0.08	32.00	-	-	0.25	100.00	-	-	0.25	100.00
Fallow	0.17	68.00	0.25	100.00	-	-	0.25	100.00	-	-
Total	0.25	100.00	0.25	100.00	0.25	100.00	0.25	100.00	0.25	100.00
***Kharif* irrigated land**										
Paddy	0.47	55.95	0.42	50.00	0.40	47.62	0.29	34.52	0.37	44.05
Groundnut	0.09	10.72	-	-	0.03	3.57	-	-	-	-
Turmeric	0.07	8.34	-	-	0.06	7.14	-	-	0.14	16.66
Chillies	0.06	7.14	0.11	13.09	0.20	23.81	0.11	13.10	0.20	23.81
Onion	0.05	5.95	-	-	0.15	17.86	-	-	0.13	15.48
Fallow	0.10	11.90	0.31	36.91	-	-	0.44	52.38	-	-
Total	0.84	100.00	0.84	100.00	0.84	100.00	0.84	100.00	0.84	100.00
***Rabi* dry land**										
Bengalgram	0.08	32.00	0.25	100.00	0.25	100.00	0.25	100.00	0.25	100.00
Fallow	0.17	68.00	-	-	-	-	-	-	-	-
Total	0.25	100.00	0.25	100.00	0.25	100.00	0.25	100.00	0.25	100.00
***Rabi* irrigated land**										
Paddy	0.28	33.33	0.08	9.52	0.10	11.90	0.21	25.00	0.13	15.48
Blackgram	0.08	9.52	0.26	30.95	0.38	45.25	0.53	63.10	0.47	55.95
Groundnut	0.14	16.67	-	-	-	-	-	-	-	-
Sesamum	0.06	7.14	-	-	-	-	-	-	-	-
Chillies	0.04	4.76	0.10	11.91	0.10	11.90	0.10	11.90	0.10	11.91
Tomato	0.04	4.76	0.20	23.81	-	-	-	-	-	-
Brinjal	0.04	4.76	0.20	23.81	0.20	23.81	-	-	-	-
Turmeric	0.07	8.34	-	-	0.06	7.14	-	-	0.14	16.66
Fallow	0.09	10.72	-	-	-	-	-	-	-	-
Total	0.84	100.00	0.84	100.00	0.84	100.00	0.84	100.00	0.84	100.00
Cropping Intensity (%)	151.37		148.62		200.00		136.69		200.00	
Net Farm Returns (Rs.)	53065.00		86750.80		113170.80		89998.45		131426.60	
Net farm Returns per hectare of Cultivated area (Rs.)	48683.48		79587.88		103826.42		82567.38		120574.86	

existing plan was higher on large farms (169.04 per cent) than on small farms (151.37 per cent) (Tables 1 & 2).

Cropping Pattern of Small Farmers Under Different Optimum Plans

The optimum model S_1 (Table 1) developed at the existing technology without borrowing suggested complete fallow of *kharif* dry land. Groundnut crop found in the existing plan was eliminated in this optimum model. The optimum model suggested to reduce the area for the production of paddy from 0.47 hectare in the existing plan to 0.42 hectare on *kharif* irrigated land. Groundnut, turmeric and onion which were in the existing plan were eliminated. However, the area under chillies increased from 0.06 hectare in the existing plan to 0.11 hectare in the model S_1. The remaining 0.31 hectare (36.91 per cent) of *kharif* irrigated land was kept fallow. In *rabi* the results of the model indicated allocation of the entire dry land (0.25 hectare) for the production of bengalgram. The model also suggested to increase area under production of blackgram, chillies, tomato and brinjal over the current plan on *rabi* irrigated land. The allocation of land for blackgram, chillies, tomato and brinjal was 0.26 hectare, 0.10 hectare, 0.20 hectare and 0.20 hectare respectively. The area under paddy declined from 0.28 hectare in the existing plan to 0.08 hectare. This plan did not favour the inclusion of groundnut and sesamum in the production pattern on *rabi* irrigated land. Resource optimization led to decrease in the cropping intensity from 151.37 per cent in the existing plan to 148.62 per cent.

It may be noted that 0.25 hectare of *kharif* dry land that was suggested to be fallow in model S_1 was allotted for the production of groundnut crop in model S_2 and thus resulting in complete utilization of dry land. Groundnut, turmeric and onion which did not find their place in the optimum model S_1 entered the optimum model S_2 with an area of 0.03 hectare, 0.06 hectare and 0.15 hectare respectively on *kharif* irrigated land. The model also suggested to increase the area under the production of chillies from 0.11 hectare in optimum model S_1 to 0.20 hectare. All these changes in the production program resulted in the complete utilization of land resource during *kharif*. There was a marginal decline in the area under the production of paddy from 0.42 hectare in model S_1 to 0.40 hectare in model S_2. The model suggested no change in the crop on *rabi* dry land. Bengalgram occupied the entire dry land during *rabi*. Chillies and brinjal occupied the same extent of land as in model S_1 on *rabi* irrigated land. The model recommended to increase the area for the production of blackgram from 0.26 hectare in the model S_1 to 0.38 hectare. There was a marginal increase in the area for the production of paddy from 0.08 in model S_1 to 0.10 hectare. The allotment of land for turmeric was same as in *kharif*. The intensity of cropping increased from 148.62 per cent in S_1 to 200.00 per cent in model S_2.

The model S_3 suggested to keep the entire dry land and 52.38 per cent of *kharif* irrigated land as fallow because of shortage of capital. As a result, cropping intensity sharply declined from 151.37 per cent in existing plan to 136.69 per cent. The area under paddy declined from 0.40 hectare in model S_2 to 0.29 hectare during *kharif*. The area under chillies remain the same as in model S_1. This optimum model did not favour the inclusion of groundnut, turmeric and onion on *kharif* irrigated land. As in previous optimum plans, the entire dry land during *rabi* was occupied by bengalgram. On *rabi* irrigated land, chillies occupied same extent of area as in previous optimum plans. The optimum model suggested to increase the area for production of paddy and blackgram from 0.10 hectare and 0.38 hectare in model S_2 to 0.21 hectare and 0.53 hectare respectively. It is interesting to note that 88.00 per cent of the *rabi* irrigated land was occupied by paddy and blackgram in the optimum model designed at recommended technology and owned funds.

Programming model under recommended technology with relaxed capital (Model S_4) led to complete utilization of land both in *kharif* and *rabi* seasons under rainfed and irrigated conditions. As a result, the cropping intensity which was 136.69 per cent in model S_3 increased to 200.00 per cent in model S_4. The entire dry land during *kharif* season was put for use by allocating it for groundnut crop (0.25 hectare). Of all the *kharif* crops on irrigated land, paddy, turmeric, chillies and onion found place in the optimum plan S_4 occupying 44.05, 16.66, 23.81 and 15.48 per cent of the total *kharif* area respectively. Groundnut which was occupying 3.57

per cent of the area in model S_2 did not appear in this plan. The increase in the area of turmeric in this plan clearly indicates that cash constraints do limit the extent of area under relatively profitable enterprises. Bengalgram continued to occupy the same area (0.25 hectare) as in the models S_1, S_2 and S_3 on dry land during *rabi* season. About 55.95 per cent of total *rabi* irrigated land was occupied by blackgram followed by paddy 15.48 per cent. The extent of land under chillies was unaltered and it remained the same as in previous optimum models. Turmeric continued in the *rabi* season with the same extent of land as in *kharif*.

Cropping Pattern of Large Farmers Under Different Optimum Plans

Model L_1 (Table 2) suggested to keep the entire dry land fallow. The plan suggested less number of crops on irrigated land during *kharif* and *rabi* seasons as compared to the present plan followed by the large farmers. Among *kharif* crops on irrigated land, the most dominant enterprise in the optimum plan was paddy whose area decreased from 1.00 hectare (47.39 per cent) in the current plan to 0.67 hectare (31.75 per cent). The next important crop which exhibited increase in the area over the existing plan was chillies occupying 14.22 per cent of the total *kharif* irrigated land. Onion utilized about 9.48 per cent of the irrigated land during *kharif* season. There was an increase in the extent of land used for the production of groundnut from 5.21 per cent in the existing plan to 9.00 per cent. Other crops like redgram, turmeric, cotton, tomato and brinjal found in the existing plan were completely drained out from the optimum farm plan. The optimum model suggested to keep 0.75 hectare of *kharif* irrigated land as fallow. During *rabi* on dry land, the optimum plan suggested to grow only groundnut whose area increased from 0.12 hectare in the existing plan to 0.41 hectare and completely eliminated bengalgram. On *rabi* irrigated land, the normative plan recommended to increase the land use for the production of blackgram, groundnut, chillies, tomato and brinjal by 0.41, 0.17, 0.18, 0.13 and 0.12 hectare respectively over the existing plan indicating their relatively higher profitability. However, the area under paddy declined from 0.55 hectare in the existing plan to 0.30 hectare in model L_1. The resource optimization led to decrease in the intensity of cropping from 169.04 per cent in the existing plan to 153.96 per cent.

The results of model L_2 indicated the allocation of 0.41 hectare of *kharif* dry land for the production of groundnut enterprise. It is important to note that turmeric, tomato and brinjal crops which did not find their place in model L_1 entered model L_2 with an area of 0.35, 0.25 and 0.20 hectare respectively and thus resulting in complete utilization of irrigated land during *kharif* season. Chillies and onion occupied the same area as in model L_1. The area under paddy increased by 0.12 hectare and groundnut declined by 0.17 hectare over the optimum plan L_1. No drastic change in the crops was indicated by optimum model L_2 on *rabi* dry and irrigated lands. Paddy, groundnut, chillies and brinjal occupied the same area as in optimum plan L_1 on *rabi* irrigated land. The area under blackgram declined by 0.15 hectare over model L_1. Turmeric continued to occupy the same area as in *kharif*. The optimization with sufficient funds both owned and borrowed resulted in increase in the cropping intensity from 153.96 per cent in the model L_1 to 200.00 per cent in the model L_2.

The normative plan L_3 indicated to reduce land use for paddy and onion from 0.79 and 0.20 hectare in the optimum model L_2 to 0.50 and 0.01 hectare respectively during *kharif* season. There was a greater increase in the area for the production of groundnut from 0.02 hectare in model L_2 to 0.40 hectare. Chillies continued to occupy the same extent of area as in the previous optimum plans. This optimum plan did not favour the inclusion of redgram, turmeric, tomato and brinjal on *kharif* irrigated land. All these changes led to keep 0.90 hectare of *kharif* irrigated land fallow. The reason for large area of land fallow was inadequacy of capital to implement recommended technology which is highly capital intensive. During *rabi*, this plan suggested to allot the entire dry land for the production of bengalgram. Groundnut crop which was present in the previous optimum plan was completely eliminated. About 71.56 per cent of the *rabi* irrigated land was occupied by blackgram. This might be due to less requirement of capital and irrigation water. Paddy and chillies continued to occupy the same extent of area as in previous optimum models. The intensity of cropping declined

Table 2. Cropping pattern for large farmers under different optimal plans.

Crop	Existing		L_1		L_2		L_3		L_4	
	Area (ha)	Per cent	Area (ha)	Per cent	Area (ha)	Per cent	Area (ha)	Per cent	Area (ha)	Per cent
					***Kharif* dry land**					
Groundnut	0.16	39.02	-	-	0.41	100.00	-	-	0.41	100.00
Fallow	0.25	60.98	0.41	100.00	-	-	0.41	100.00	-	-
Total	0.41	100.00	0.41	100.00	0.41	100.00	0.41	100.00	0.41	100.00
					***Kharif* irrigated land**					
Paddy	1.00	47.39	0.67	31.75	0.79	37.44	0.50	23.70	0.61	28.90
Redgram	0.09	4.27	-	-	-	-	-	-	-	-
Groundnut	0.11	5.21	0.19	9.00	0.02	0.95	0.40	18.96	0.40	18.96
Tumeric	0.22	10.43	-	-	0.35	16.58	-	-	0.40	18.96
Cotton	0.12	5.69	-	-	-	-	-	-	-	-
Chillies	0.08	3.79	0.30	14.22	0.30	14.22	0.30	14.22	0.30	14.22
Onion	0.10	4.74	0.20	9.48	0.20	9.48	0.01	0.47	0.20	9.48
Tomato	0.08	3.79	-	-	0.25	11.85	-	-	-	-
Brinjal	0.10	4.74	-	-	0.20	9.48	-	-	0.20	9.48
Fallow	0.21	9.95	0.75	35.55	-	-	0.90	42.65	-	-
Total	2.11	100.00	2.11	100.00	2.11	100.00	2.11	100.00	2.11	100.00
					***Rabi* dry land**					
Groundnut	0.12	29.27	0.41	100.00	0.41	100.00	-	-	-	-
Bengalgram	0.08	19.51	-	-	-	-	0.41	100.00	0.41	100.00
Fallow	0.21	51.22	-	-	-	-	-	-	-	-
Total	0.41	100.00	0.41	100.00	0.41	100.00	0.41	100.00	0.41	100.00
					***Rabi* irrigated land**					
Paddy	0.55	26.06	0.30	14.22	0.30	14.22	0.30	14.22	0.30	14.22
Blackgram	0.30	14.22	0.71	33.64	0.56	26.54	1.51	71.56	1.11	52.60
Groundnut	0.23	10.09	0.40	18.96	0.40	18.96	-	-	-	-
Sesamum	0.19	9.00	-	-	-	-	-	-	-	-
Sunflower	0.15	7.11	-	-	-	-		-	-	-
Chillies	0.12	5.69	0.30	14.22	0.30	14.22	0.30	14.22	0.30	14.22
Tomato	0.07	3.32	0.20	9.48	-	-	-	-	-	-
Brinjal	0.08	3.79	0.20	9.48	0.20	9.48	-	-	-	-
Turmeric	0.22	10.43	-	-	0.35	16.58	-	-	0.40	18.96
Redgram	0.09	4.27	-	-	-	-	-	-	-	-
Fallow	0.11	5.21	-	-	-	-	-	-	-	-
Total	2.11	100.00	2.11	100.00	2.11	100.00	2.11	100.00	2.11	100.00
Cropping Intensity (%)	169.04		153.96		200.00		148.01		200.00	
Net Farm Returns (Rs.)	101018.00		172247.00		196923.00		217823.20		277976.60	
Net farm Returns per hectare of Cultivated area (Rs.)	40086.50		68351.98		78144.04		102310.79		110308.17	

from 200.00 per cent in the model L_2 to 148.01 per cent.

It may be noted that 0.41 hectare of dry land that was suggested to be fallow in the model L_3 was allotted for groundnut crop and thus resulting in complete utilization of *kharif* dry land in model L_4. On *kharif* irrigated land, the optimum plan suggested to grow fewer crops as compared to existing plan. The programme recommended to cultivate chillies, onion and brinjal with the same area as in model L_2 during kahrif season on irrigated land. This model favoured inclusion of turmeric which did not find place in the models L_1 and L_3. It occupied 0.40 hectare of *kharif* irrigated land. The land allocated for the production of groundnut was the same as in model L_3. This plan also recommended to increase the area for the production of paddy from 0.50 hectare in model L_3 to 0.61 hectare. It is important to note that redgram, cotton and tomato did not enter model L_4. The optimum plan recommended the allocation of 0.41 hectare of *rabi* dry land for the production of bengalgram. Paddy and chillies continued to occupy the same area as in previous optimum models L_1, L_2 and L_3 on *rabi* irrigated land. But the area under blackgram declined from 1.51 hectare in model L_3 to 1.11 hectare. Turmeric continued to occupy the same extent of land as in *kharif* season. These findings are in conformity with the findings of Rajeswari *et al*. (2011), Varalakshmi *et al*. (2011) and Mahendran *et al*. (2006).

Net Farm Income of Small and Large Farmers Under Different Optimum models

On an average, small farmers realized Rs. 53,065.00 from their current production programme (Table 3). Model S_1 offered scope for augmenting net farm returns of Rs. 86,750.80, an increase of 63.48 per cent (Rs. 33,685.80) over the existing situation. The results of the plan at existing technology with relaxed borrowing (Model S_2) indicated the prospects of raising the net farm returns to Rs. 1,13,170.80 recording a raise of 113.26 per cent (Rs. 60,105.80) over the existing returns and 30.45 per cent (Rs. 26,420.00) over model S_1. The net farm returns in model S_3 (recommended technology at the existing level of funds) were higher by Rs. 36,933.45 (69.60 per cent) over the existing plan. This, however represented an increase of Rs. 3,248.65 (3.74 per cent) over model S_1 and a decrease of Rs. 23,172.35 (20.47 per cent) over model S_2. Provision of adequate capital coupled with recommended technology (Model S_4) indicated prospects of further augmenting net farm returns by Rs. 78,361.60 (147.67 per cent) than what they were getting in their current plan. The net farm returns increased by Rs. 44,675.80 (51.49 per cent), Rs. 18,256.80 (16.13 per cent) and Rs. 41,428.15 (46.03 per cent) over models S_1, S_2 and S_3 respectively.

The net farm returns under model L_1 (existing technology with owned funds) were Rs. 1,72,247.00 as against the present net farm returns of Rs. 1,01,018.00 which accounts for 70.51 per cent increase in income over the existing plan (Table 4). This indicates the scope to increase the net farm returns by mere reallocation of resources even with the existing technology. The model L_2 in which borrowing was relaxed under existing technology had paved the way for better reallocation of resources than model L_1. It resulted in augmenting the net farm income from Rs. 1,72,247.00 in model

Table 3. Net farm returns of small and large farmers under different optimum models.

(in Rupees)

Category/ model	Existing plan	Model-1	Change over E-plan	Model -2	Change over E-plan	Model-3	Change over E-plan	Model-4	Change over E-plan
Small farmers	53065.00	86750.80	33685.80 (63.48)	113170.80	60105.80 (113.26)	89998.45	36933.45 (69.60)	131426.60	78361.60 (147.67)
Large farmers	10108.00	172247.00	71229.00 (70.51)	196923.00	95905.00 (94.93)	217823.20	116805.20 (115.62)	277976.60	176958.60 (175.17)

Note: Figures in parentheses indicate percentages

L_1 to Rs. 1,96,923.00 in model L_2 which was higher by 14.32 per cent and 94.93 per cent over model L_1 and existing plan respectively. Further, increment of net farm returns was achieved over the existing plan with the help of model L_3 which was designed at recommended technology with available funds. This model increased the net farm returns by Rs. 1,16,805.02 (115.62 per cent) over the existing production pattern even with some fallow land. Model L_4 (recommended technology with relaxed borrowing) results suggested possibilities of raising the net farm returns to Rs. 2,77,976.60 registering an increase of 175.17 per cent over the existing level of income. This represented an increase of Rs. 1,05,729.60 (61.38 per cent), Rs.81,053.60 (41.16 per cent) and Rs. 60,153.40 (27.61 per cent) over models L_1, L_2 and L_3 respectively. These results are in agreement with the findings of Gajanana and Sharma (1990), Deoghare (1997), Rajeswari *et al*. (2011) and Varalakshmi *et al*. (2011)

CONCLUSIONS

From the preceding discussion, it can be inferred that there existed mal-allocation of resources in the existing plan. The process of optimization under different capital and technology environment resulted in improvement in the net farm returns of small and large farms. However, increase in income in the optimization model designed at recommended technology with relaxed borrowing resulted in higher returns as compared to that of other models on both the size groups. There is greater scope to enhance the farm income on large farms than on small farms under different capital and technological environments.

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(Received on 29.04.2013 and revised on 29.06.2013)