

Stabilization of Farm Income and Employment Under Water Scarcity Conditions

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Abstract The present study was carried out in a village Naga-Ki- Dhani in Jaipur district of Rajasthan. Four optimum crop plans which the farmers can adopt to stabilize their farm income and employment during the drought year were developed with the help of linear programming technique. The results of optimum plans showed that use of improved varieties of crops developed specifically for water scarcity conditions, would certainly increase the farm income. The employment opportunities under optimum plans developed with cash borrowing did not increase significantly over the plans with existing resource supply. However, working capital available with the farmers during drought year would not allow full use of whatever little irrigation water available in the open wells. Hence, it is suggested that credit in adequate amounts should be made available to the farmers during drought years.

Key words Linear programming, Optimum plan, Cropping intensity

The agriculture of Rajasthan, where irrigation facilities are comparatively scarce, depends primarily on rainfall. Drought and famine have assumed more or less a well established cyclical pattern of recurrence in the state. During drought year, farmers face great difficulties. Pandey and Upadhyay (1970) observed that drought situation results in substantial loss of production and productivity, employment of labour in general and employment of hired labour in particular, and fall in income. Bharara (1980) noticed that in arid zone of Rajasthan, on an average, crop loss per cultivating household varied from 35% in an average year to 52% in mild drought year to 82% in drought year to 100% in severe drought year as compared with no loss in a good/surplus year. Naidu (1985) found that the acreage of cereals declined by 16% and production by 31% during the drought year (1982-83) compared to preceding year in the state of Andhra Pradesh. Patel *et al.* (1987) observed that only about 25% of the total casual labourers could get full employment during the drought year (i.e. 1987), relative to 60% during the normal year (i.e. 1986). It is thus necessary that farmers of the drought prone areas of the country in general and of Rajasthan in particular adopt crops and cropping patterns which can help them in withstanding to some extent the vagaries of the monsoon and can provide them with some income and employment even in the event of failure of rainfall. This study is an attempt in this direction.

Materials and Methods

The present study was conducted in village Naga-Ki-Dhani in Jaipur district of Rajasthan. Twenty five farmers in proportion to their number in each size group were selected randomly for the study. Out of these 25 farmers, 11 were from small (0-2 ha), 8 from semi-medium (2-4 ha) and 6 from medium (4-10 ha) groups. Since, there was no farmer in the sample village having holding size of 10 ha and above, hence no farmer was selected in large group.

Linear programming technique was used as an analytical tool in the present study. The specific model used in the study is based on the models developed by Sirohi and Gangwar (1968), Verma (1972) and Sirohi *et al.* (1980). The model used in the study included in all, 46 activities (processes) and 57 resource constraints. Following four optimum crop plans were developed for each of the three size groups of farms.

- P₀ = Existing plan.
- P₁ = Optimum plan with existing resource supply.
- P₂ = Optimum plan with existing resource supply and maximum area restriction on important crops.
- P₃ = Optimum plan with cash borrowing.

Table 1 Existing and optimum crop plans (in ha)

Crop	Small farm				Semi-medium farm				Medium farm					
	P ₀	P ₁	P ₂	P ₄	P ₀	P ₁	P ₂	P ₃	P ₄	P ₀	P ₁	P ₂	P ₃	P ₄
Kharif														
Moong Imp. (I)	0.00	0.00	0.60	0.50	0.72	0.00	0.00	1.04	0.79	1.25	0.00	1.75	1.97	2.43
Guar Imp. (I)	0.00	0.80	0.20	0.00	0.00	0.00	0.36	0.00	0.00	0.00	2.62	0.67	0.00	0.00
Cowpea Imp. (UI)	0.00	0.00	0.13	0.00	0.13	0.00	0.44	0.00	0.00	1.39	0.00	2.58	0.00	2.58
Guar Imp. (UI)	0.00	0.00	0.05	0.18	0.05	0.00	0.47	1.86	0.47	0.47	3.44	0.86	344	0.86
Fodder Imp. (I)	0.00	0.00	0.00	0.30	0.08	0.00	0.00	0.60	0.14	0.14	0.08	0.00	0.73	0.27
Hybrid Bajra Ext. (I)	0.16	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00
Local Bajra Ext. (UI)	0.26	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00
Guar Ext. (UI)	0.16	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.87	0.00	0.00	0.00
Chillies Ext. (I)	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
Fodder Ext. (I)	0.13	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	1.04	0.00	0.00	0.00
Pulses Ext. (UI)	0.06	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00
Others Ext. (I)	0.08	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00
Rabi														
Wheat Imp. (I)	0.00	0.00	0.00	0.50	0.20	0.00	0.00	0.00	0.46	0.35	0.00	0.00	0.28	0.28
Barley Imp. (I)	0.00	0.00	0.00	0.30	0.08	0.00	0.00	0.00	0.33	0.90	0.00	0.00	1.69	2.15
Mustard Imp. (I)	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.60	0.14	0.00	0.08	0.73	0.27
Taramira Imp. (I)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dwarf Wheat Ext. (I)	0.14	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00
Local Wheat Ext. (I)	0.30	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.75	0.00	0.00	0.00
Barley Ext. (I)	0.19	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00
Gram Ext. (I)	0.10	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00
Mustard Ext. (I)	0.01	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00
Onion Ext. (I)	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
Taramira Ext. (I)	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00
Carrot Ext. (I)	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zaid														
Melons and other cucurbits Ext. (I)	0.08	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00
Total	1.69	0.99	0.98	1.78	1.78	4.10	2.31	2.31	4.64	4.64	8.92	6.22	8.84	8.84
Cropping intensity (%)	172.45	101.02	100.31	181.63	181.63	126.15	71.08	71.08	142.77	142.77	145.27	101.30	143.97	143.97

† = Irrigated, UI = Unirrigated, Ext = Existing technology, Imp = Improved technology

P₄ = Optimum plan with cash borrowing and maximum area restriction on important crops.

Results and Discussion

Cropping pattern : The cropping patterns as shown in Table 1 indicate significant changes in the existing plans due to optimization. Reallocation of existing resources (P₁) resulted in decrease in number of crops on all the three size groups of farms. Crops are almost absent in *rabi* season, except on small and medium farms where barley and mustard, respectively, occupied minor areas. Absence of crops in *rabi* season is because of lack of cash and not because of lack of irrigation water. Cash requirement of *Kharif* crops is comparatively low and their per rupee profitability is more as compared to *rabi* crops, hence, the available cash supply with the farmers is used in the production of *kharif* crops leaving almost nothing for *rabi* crops.

The cropping intensity which is 172.4, 126.1 and 145.3 % on small, semi-medium and medium farms, respectively, decreased to 101.0, 71.1 and 101.3 % in optimum plans (P₁). Decrease in the cropping intensity is because only crops grown with improved technologies, which required comparatively more cash than crops grown with existing technologies, have come in the optimum plans.

Optimum plan (P₂) are not much different from the optimum plan (P₁). Imposition of maximum area restriction on guar resulted in the transfer of area, under moong and cowpea on all the three size groups of farms. Moong and cowpea are absent in optimum plan (P₁). On small and semi-medium farms, the position of *rabi* season is almost same as in optimum plan (P₁). However, on medium farm, there is a significant increase in the area under mustard (i.e. 0.27 ha) and taramira is a new entrant. The cropping intensity in P₂ is same as in P₁.

The optimum plan P₃ is much different from P₁ and P₂. Increased supply of cash has brought in quite large area under *rabi* crops which are almost absent in P₁ and P₂. Wheat and barley on small farm and wheat, barley and mustard on semi-medium and medium farms have occupied significantly large area.

The cropping intensity in optimum plan P₃ increased to 181.6, 142.8 and 143.9% on small,

Table 2 Labour utilization and cash requirement in existing and optimum crop plans

Size group	Crop plans				
	P ₀	P ₁	P ₂	P ₃	P ₄
	Labour utilization (in mandays)				
Small	108	49	46	121	90
Semi-medium	241	112	105	240	226
Medium	394	208	189	407	382
	Cash requirement (in Rs)				
Small	794	794	794	2575	2417
Semi-medium	1801	1801	1801	5490	5294
Medium	4872	4872	4872	10222	10035

semi-medium and medium farms, respectively and is almost same as in existing plans.

The crop mix in the P₄ is almost same as in optimum plan P₃, except entrance of cowpea. On small farm mustard has also occupied 0.52 ha area at the cost of wheat and barley.

The cropping intensity in the P₄ is exactly same as in P₃.

Labour utilization : In comparison to existing plans, the labour utilization has decreased drastically in optimum plans P₁ and P₂ (Table 2) because of decrease in the cropping intensity. However, in optimum plans P₃ and P₄ the labour utilization, more or less, is equivalent to that in existing plans. Thus, it is clear that use of improved crop technology (in optimal way) would not be able to generate sufficient employment opportunities unless adequate amount of credit is made available to the farmers operating under the drought conditions.

Cash requirement : The cash requirement for existing and optimum plans P₀, P₁ and P₂ is same as is the cash availability with the farmers (Table 2). Optimum plans P₁ and P₂ have been developed with the existing supply of cash. However, with the provision of borrowing the cash from outside agencies, the cash requirement of the P₃ and P₄ has increased substantially. When requirement is examined along with the optimum cropping patterns, it is clear that farms would not be able to utilize the available limited irrigation water fully even in the drought year, if adequate amount of credit is not made available to them for the purchase of variable inputs.

Returns : Table 3 reveals that use of improved crop technology, developed specially for water scarcity

Table 3 Returns from existing and optimum crop plans (in Rs)

Size group	P0	P1	P2	P3	P4
Gross returns					
Small	4669.05	7605.44	6126.75	12603.50	11355.64
Semi-medium	13406.20	17172.80	15602.20	21750.34	27518.75
Medium	32032.50	44986.90	39537.50	58710.53	51941.95
Returns to fixed farm resources					
Small	2164.07	5809.91	4374.82	8022.76	7367.32
Semi-medium	7555.05	13028.05	11551.00	22143.70	18283.89
Medium	20865.97	35418.07	29541.97	41014.68	34770.23
Family labour income*					
Small	-4906.95 (-45.43)	-2087.11 (-42.59)	-3564.20 (-77.48)	1133.74 (9.37)	44.30 (0.49)
Semi-medium	-291.30 (-1.21)	3375.70 (30.14)	1800.65 (17.15)	14283.35 (59.51)	10227.54 (45.25)
Medium	9488.60 (24.08)	21436.70 (103.06)	15294.60 (80.92)	29819.31 (73.26)	23224.86 (60.80)
Farm investment income**					
Small	-4045.91 (-0.10)	-400.07 (-0.01)	-1835.16 (-0.04)	1812.78 (0.04)	1157.34 (0.03)
Semi-medium	1025.60 (0.01)	6498.60 (0.08)	5021.55 (0.07)	15614.25 (0.20)	11754.44 (0.15)
Medium	12488.95 (0.008)	27041.05 (0.18)	21164.95 (0.14)	32337.66 (0.21)	26393.21 (0.71)

* Figure in parantheses are income per worker per day

** Figure in parantheses are the income per rupee of capital investment

conditions, in optimal way would certainly help the drought stricken farmers in raising their income from the farming business substantially.

Optimum plans P₁ and P₂ show that reallocation of existing resources in optimal direction coupled with improved crop technology have increased the gross returns and returns to fixed farm resources significantly on all the three size groups of farms. Returns to labour and capital have also increased substantially on semi-medium and medium farms. However, on small farms reallocation of resources in improved crop technology would not generate positive returns to these factors.

Reallocation of resources in optimal direction with the provision of cash borrowing, P₃ and P₄ would increase all types of returns on all the size groups of farms. However, on small farms although returns to labour and capital would become positive but continue to be quite low.

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