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An Optimal Cropping Pattern in Karanja Command Area of Bidar District, Karnataka

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Abstract: ***Karanja dam is a medium irrigation project built in Byalhalli village of Bhalki taluka, Bidar District, Karnataka, has a Gross Command Area of 48,968 hectares. The dam is built under drought relief program of Government of Karnataka. The dam has two main canals, Karanja Right Bank Canal (KRBC), Karanja Left Bank Canal (KLBC) and Fore Shore Lift Irrigation Scheme (FSLI). Two Linear Programming Models were formulated and run, one for KRBC and another for KLBC&FSLI combined. Managerial constraints were also included in the model keeping in view of the local food consumption. The model was subjected to land and water constraints. The crop season was divided into three categories: Kharif which spreads from June to September, Rabi from September to February and biseasonal from July to March. Linear Programming Model was solved in LINGO VII version software. The net returns obtained from the existing cropping pattern were 2311.4 million rupees and when optimal cropping model was adopted the returns were 3877.8 million rupees an increase of rupees 1900.95 million rupees. The model showed when existing cropping pattern was adopted, thenet returns per hectare as Rs:47, 200, while in optimal cropping pattern, the net returns per hectare were Rs:79,200 an increase of Rs:32,000 (67 %).***

Keywords: command area, Right bank canal, left bank canal, linear programming, optimal values, crop water requirement

1. Introduction

Agriculture plays an important role in the growth of Indian economy as on today 58 percent of population either wholly or significantly depends on agriculture and allied activities for their livelihood. The contribution to Gross Domestic Products GDP by agriculture sector was about 70 percent once has declined over the years and it is at 18 percent at present while other sectors like services have increased. Nevertheless, the importance of agriculture in the country like India is not likely to decline due to concern for food security, employment, rural poverty and availability of goods as wages.(Vijay2012)[1]

India has gradually improved its status in world agriculture through step wise progress starting from green revolution. The food grains production has increased from 50.8 Million Tonnes during 1950-51 to 259.32 Million Tonnes by 2012 (Harender & Sharma 2013)[2]. Besides, significant achievements have been made in the field of milk production through white revolution, fish through blue revolution, pulses and oil seeds through technology mission and yellow revolution, India still needs to grow more food grains to meet the needs of its growing population as it is increasing at the rate of 1.8 percent per annum. The population increase, improved purchasing power associated with economic growth will enhance not only the demand of cereal foods but also the demand for other nutritious foods. According to a recent estimate, India will need about 260-264 Million Tonnes of food grains, 130-135 Tonnes of milk, 151-193 Million Tons of vegetables for a population of 1.35 billion by 2022 A.D. the expanding demands for agriculture commodities together with limited availability of farm resources needs careful exploration of production possibilities and ways of increasing the efficiency of resources on various sizes of farms (Paroda & Praduman 2000). [3]

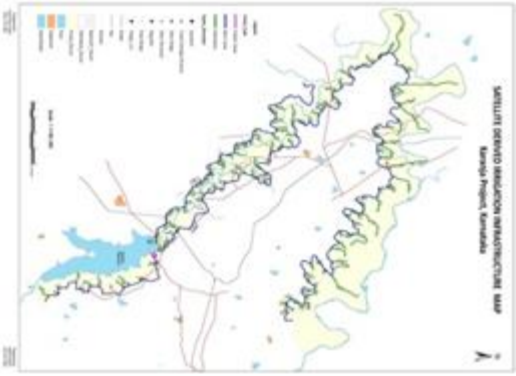
The present agriculture resources base comprising of a large segment of farming community does not permit farmers to derive full benefits of improved technology. If scarce farm resources are not enhanced, the improved techniques may not turn out to be economical and effective in increasing farm production. These limited farm resources, thus to be increased in selective manner so that capital formation in agriculture is not only accelerated but rationalized in a manner that investments are according to the marginal productivity of resources. The rationalized use of resources on farm can be achieved by determining optimal enterprise mix, resulting in increased farm returns and employment. The preset study is an attempt to analyze possibilities and prospects of increasing the net farm income by rational resource allocation through optimum production pattern using linear programming model.

2. Study Area

Karanja dam is built across river Karanja, which is a tributary of Manjira, located in village Byalhalli of Bhalki Taluka, Bidar District. The salient features of the dam are given below. The dam lies between the coordinate 17°49′45" N and 77°19′47"E. The dam is built under drought relief program, Government of Karnataka.(KNNL) [5]

Table 1.1: Total Annual Utilization of Water at Head of Main Canals at Karanja Dam Site

Sub Area	Canal	Total Annual Utilization of Water at Head of Main Canals in Million Cub metre.
1	Right Bank Canal	175.35
2	Left Bank Canal	16.958
3	Fore Shore Lift Irrigation Scheme	16.958



Karanja Map

3. Model Formulation

The planned irrigable area under the project is 48977 Hectares and proposed cropping pattern is shown in the table 1.2. The entire irrigable area is subdivided into three sub areas given in Table 1.1, which gives total water utilization under each sub area Table 1.3 gives monthly requirement of water for each crop MCM (Million Cubic Metre) per Hectare. and net returns. The monthly water requirement of various crops are calculated from climatological data by Karnataka Neeravari Nilgam Ltd, Bidar.In the model field application efficiency is 70 percent, conveyance loss 20 percent and distribution losses 15 percent. The monthly water requirements of crops available are considered and used in Linear Programming. The *Kharif* season spreads from June to October, *Rabi* from October to February and two seasonal crops are spread over from July to March. Two separate Linear Programming (LPs) are run, one for KRBC and other for KLBC and FSLI combined.

The objective function is Maximize for K.R.B.C.

$$Z = \sum_{j=1}^{n} C_j x_j$$

Subject to

i) Total Crop Water Requirement under KRBC

$\sum_{j=1}^{n} W_j x_j \le$ Total water available for utilization under KRBC

ii) Area Constraint

$\sum_{j=1}^{n} x_j \le$ Total Area of *Kharif* crops

$\sum_{j=1}^{n} C_j x_j \ge$ Minimum Area for affinity for crops

iii) Area Constraint for *Rabi* crops

$\sum_{j=1}^{n} x_j \le$ Rabi Area

$\sum_{j=1}^{n} x_j \ge$ Minimum Area of affinity crops

iv) *Biseasonal* Area

$\sum_{j=1}^{n} x_j \le$ Area of *Biseasonal* Crops ,

The Linear Programming Model for KLBC and FSLI Scheme is as below :

Maximize $Z = \sum_{j=1}^{n} C_j x_j$

Subjected to

Crop Water Requirement under KLBC

i) $\sum_{j=1}^{n} W_j x_j \le$ Total allowable for utilization under KLBC

ii) $\sum_{j=1}^{n} x_j \le$ *Kharif* crops area

$\sum_{j=1}^{n} x_j \le$ Minimum area for crops affinity

iii) $\sum_{j=1}^{n} x_j \le$ *Rabi* Crops

a) $\sum_{j=1}^{n} x_j \ge$ Minimum area affinity crops

iv) Biseasonal Crops

$\sum_{j=1}^{n} x_j \le$ Area of *biseason* crops

$C_j \ge 0,\ x_j \ge 0$

Table 1.2: Cropping pattern, water requirement, Net returns from existing practice

Crop Index	Crop	Area Under K.R.B.C.(ha)	Area Under K.L.B.C.(ha)	Area under F.S.L.I (ha.)	Total Area (ha)	Total Return in lakh rupees	Net Returns in Rs: lakh/ Ha	GIR (MCM/Ha)
X1	Hybrid jowar	6782.4	655.58	655.58	8093.56	1194.375	0.1476	0.0000
X2	Local jowar	850.0	80.935	80.935	1011.87	325.728	0.3219	0.0378
X3	Sunflower	7717.21	714.255	714.255	9145.72	3378.375	0.3694	0.0380
X4	Navane	3731.13	360.165	360.165	4451.46	13.5525	0.00304	0.3050
X5	Kharif Pulses	9153.82	886.25	886.25	10929.32	3762.72	0.3443	0.0000
X6	Rabi Jowar	2464.4	188.172	188.172	2840.75	857.39	0.3018	0.5213
X7	Rabi Wheat	5438.87	437.05	437.05	6312.97	3605.9	0.5712	0.4480
X8	Rabi Pulses	3731.13	360.165	360.165	4451.46	3471.925	0.7800	0.3820
X9	Hybrid cotton	679.86	64.75	64.75	809.36	1551.000	1.9163	0.6327
X10	Sugarcane	271.13	26.305	26.305	323.74	461.5	1.4255	1.5869
X11	Lime	101.17	10.115	10.115	121.4	555.0	4.5717	0.6997
X12	Garden Plant	202.34	20.23	20.23	242.8	1165.0	4.7982	0.6324
X13	Grapes	202.34	20.23	20.23	242.8	2973.75	12.2477	0.6998
	Total	41325.8	3824.21	3824.21	48977.21	23316.255		

Table 1.3: Comparative statement of proposed cropping pattern and Optimum Cropping

Crop Index	Crop	Area Under K.R.B.C(ha)	Area Under K.L.B.C. (ha)	Area Under FSLI. (ha)	Total Area (ha)	Optimal Cropping Pattern			Total Area in Hectares
						Area in R.B.C. (ha.)	Area in L.B.C (ha.)	Area in F.S.L.I (ha.)	
X1	Hybrid jowar	6782.4	655.58	655.58	8093.56				
X2	Local jowar	850.0	80.935	80.935	1011.27				
X3	Sunflower	7717.21	714.255	714.255	9147.72		967.18	967.18	1934.36
X4	Navane	3731.13	360.165	360.165	4451.46				
X5	Kharif Pulses	9153.82	886.250	886.25	10926.32	28234.39	1730.0	1730.0	31694.39
X6	Rabi Jowar	2464.4	188.172	188.172	2840.75	6243.37	456.483	456.483	7156.33

X7	Rabi Wheat	5438.87	437.050	437.05	6312.97	2735.27	273.27	273.27	3281.81
X8	Rabi Pulses	3731.13	360.165	360.165	4451.46	2647.61	255.54	255.54	3158.65
X9	Hybrid cotton	679.86	64.750	64.75	809.36				
X10	Sugarcane	271.13	26.305	26.305	323.74				
X11	Lime	101.17	10.115	10.115	121.40				
X12	Garden Plant	202.34	20.230	20.23	242.80				
X13	Grapes	202.34	20.230	20.23	242.80	3600	141.64	141.64	1740.12
	Total	6782.4	3824.21	3824.21	48977.2	41317.48	3824.11	3824.11	48965.70

Table 1.4: Calculation of Net Returns from Optimum Cropping pattern

Sub Areas (Command Areas)	Net Returns from OCP in command area in Million Rupees	Net Returns from existing cropping pattern in Million Rupees	Increase in benefits in Million Rupees	Net Return per Hectare with existing cropping pattern in Rupees	Net Return per Hectare with optimum cropping pattern in Rupees
K.R.B.C.	3265.3	2311.4	1900.95	47200	79200
KL.B.C.	306.8				
F.S.L.I.	306.8				
Total	3877.8				

5. Results and Discussions

The Linear Programming Model is run on Lingo VII version; the results obtained are presented in Table 1.3. Maximum returns are compared with irrigation model and presented in Table 1.2. It was observed from the model that from existing cropping pattern the net returns from the command area was 2311.40 million rupees while adopting optimum cropping pattern the net returns were 3877.8 million rupees, an increase in the income of Rs:1900.95 million (67 percent). The net return per hectare for existing cropping pattern was R:47,200 while the net return per hectare in optimum cropping pattern it was Rs: 79,200. An increase of Rs:32,000 (67 percent).In *Rabi* season the model took only *Kharif* pulses with an area of 31694.39 ha. while in normal practice this value was 10926.32 ha. In Rabi season the model took 7156.33 ha. of Rabi jowar while in normal value was 2840.75 ha. the Rabi wheat was 3281.81 ha. in optimal cropping pattern proposed by the model while in existing pattern the value of acreage for wheat was 6312.97 ha. However the Rabi pulses value got decreased in model to 3156.65 ha. While that of the existing practice the area of *rabi* pulses grown was 4451.46 ha which is decrease in the area of 1292.81 ha. The garden crop which had an acre age of 242.8 ha. was increased in the model to 1740.12 ha. Which is considerable given the value of crop water requirement of these cops. This is because the model has judiciously used the water as per crop water requirement and it could increase the area of garden crops grown.

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Author Profile

Prof. Dileep Kumar Kanna who is working at BKIT, Bhalki has vast teaching experience (approximately 31 years) and has published several papers in the past. At present he is pursuing his Research work in the specified field.

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