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Research Article

Decomposition analysis of income difference between border strip irrigation and flood irrigation in cultivation of chickpea in Malaprabha command area of Karnataka

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SUMMARY : The present study was conducted in the Malaprabha command area as many scientific irrigation methods were implemented by the RKVY project. The required data were collected from the 35 farmers each practicing border strip method of irrigation (scientific) and flood methods of irrigation (traditional) in the cultivation of chickpea. The study revealed that the adopters of scientific irrigation technology produced 16.89 per cent higher income from border strip method of irrigation than flood irrigation. The increase in the income was further decomposed into different sources of change such as adoption of scientific irrigation technology and changed input levels. The scientific irrigation technology alone could contribute 9.37 per cent increase in income, while the contribution of change in input levels was also found to be positive (7.52 %). Amongst the various inputs, seed (-0.04 %), fertiliser (-1.01 %) and cost of irrigation (-3.67 %) contributed negatively whereas human labour (6.35%), bullock and machine labour (5.72 %) and FYM (0.17 %) contributed positively to the income.

KEY WORDS :
Border strip method of irrigation, Decomposition analysis, Flood irrigation

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BACKGROUND AND OBJECTIVES

Chickpea is an important pulse crop in India and it is rich source of high quality protein. Chickpea is an important legume that plays a significant role in the food and nutritional security of people in the developing countries to protein intake, particularly for vegetarian population. Further, being a leguminous crop it contributes towards soil fertility by fixing atmospheric nitrogen into the soil. This property has an added benefit to farmers by saving external applications of nitrogenous fertilizers and in turn reduces cost of production and thus, is an environment friendly crop.

There are two different water management practices being practiced by peasants in cultivation of chickpea in the Malaprabha command area, such as flood and border strip method of irrigation. Out of these two first one is traditional and other one is scientific. Flood irrigation is an ancient method of irrigation, where generally half water is lost through evaporation, run off, infiltration in uncultivated areas, transpiration through the leaves of weeds, anaerobic conditions in the soil and around root zone and deep percolation below the root zone that is unavailable to the plants. So much of canal water is being wasted by the farmers by following such traditional method of irrigation. Thus, to overcome these problems of flood irrigation, the adoption of scientific water management technology (border strip method of irrigation) assumes greater attention.

Malaprabha command comprises the area of a dam across the river Malaprabha, near Navilutheertha in Belgaum district with a irrigation potential of 2,20,028 hectares in the areas of Belgaum, Bagalkot, Gadag and Dharwad districts. Cumulative financial and physical progress upto the end of March 2011 were Rs. 1172.36 crores and 2,13,537 ha, respectively.

Water is the elixir of life. Every drop of water needs to be used optimally. The water use should aim at securing the maximum crop production per unit of water, income and sustaining soil health. Thus, the present paper aimed to analyse the income difference between border strip method of irrigation and flood method of irrigation in cultivation of chickpea.

RESOURCES AND METHODS

The present study was conducted in Malaprabha Command Area of Karnataka. All the villages covered by the project entitled enhancing water use productivity in Malaprabha command area of Northern Karnataka" under RKVY were purposively selected for the study. The seven villages selected were Hebsur, Kumargoppa, Kanakikoppa, Guralikatti, Hunasikatti, Mugnur and Naragund.

The major traditional irrigation method followed by the farmers in the cultivation of chickpea in the study area was flood method whereas; scientific method was border strip method of irrigation which was recommended by the project officials. Thus, from each village five farmers practicing each methods were selected randomly, thus, the total sample size was 70 and irrigation method wise sample size was 35.

Output decomposition model :

Before going to the decomposition analysis of the income difference of chickpea crop between the border strip method of irrigation and flood irrigation one must ensure whether there is structural break or not in the production relations between border strip method of irrigation and flood method of irrigation. To identify the structural break, if any, in the production relations with the adoption of scientific irrigation method, output elasticities were estimated by ordinary least square method by fitting a log linear regression separately for farmers following border strip irrigation method and flood irrigation method. The pooled regression was run in combination with farmers following border strip and flood irrigation methods including dummy variable for farmers following border strip irrigation method. The dummy variable was quantified as one for farmers following border strip irrigation method and zero for farmers following flood irrigation method.

For identifying the structural break in production of chickpea with the introduction of border strip method of irrigation (new technology), the Cob-Douglas (1928) type of production function was used. Production function with technology dummy variable was fitted for identifying structural break in production relations between the border strip method of irrigation and flood irrigation method. Production function with one for border strip method of irrigation and zero for flood irrigation was estimated.

The following log linear estimable forms of equations were used for examining the structural break in production relation.

$$\ln y_1 = \ln A_1 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + U_i \quad ......(1)$$

$$\ln y_2 = \ln A_2 + b'_1 \ln X_1 + b'_2 \ln X_2 + b'_3 \ln X_3 + b'_4 \ln X_4 + b'_5 \ln X_5 + b'_6 \ln X_6 + U_i. \quad ......(2)$$

$$\ln y_3 = \ln A_3 + b''_1 \ln X_1 + b''_2 \ln X_2 + b''_3 \ln X_3 + b''_4 \ln X_4 + b''_5 \ln X_5 + b''_6 \ln X_6 + e_3 d + U_i \quad ......(3)$$

where,

Y = Gross return in rupees/hectare

a = Intercept

x_1 = Seed cost/ hectare

x_2 = Fertiliser cost/ hectare

x_3 = Human labour cost/ hectare

x_4 = Bullock labour and machine labour cost/ hectare

x_5 = Cost of irrigation/ hectare

x_6 = FYM cost/ha

e_i = Error term

b_i = Elasticity co-efficients of respective inputs and summation of these gives returns to scale.

Equations 1, 2 and 3 represent farmers following flood irrigation method, farmers following border strip irrigation method and pooled regression function with farmers following border strip irrigation method as dummy variables, respectively.

$b_1, b_2, b_3, b_4, b_5, b_6, b_1', b'_2, b'_3, b'_4, b'_5, b'_6, b''_1, b''_2, b''_3, b''_4, b''_5, b''_6$, represent individual output/income elasticity of respective input variable in equation (1), (2) and (3) 'd' in equation (3) represent dummy variable. If the regression co-efficient of dummy variables is significant, then there is structural break in production relations with the adoption of scientific irrigation method (BSI).

For any production function, the total change in income is affected by the change in the factors of production and in the parameters that define the function. This total change in per hectare output/income is decomposed to reflect on adoption of border strip irrigation method. The output decomposition model developed by Bisaliah (1977) was used in the study, which is depicted below.

The output decomposition equation used in this study can be written as :

$$\ln Y\ SIM - \ln Y\ TIM = [\text{intercept SIM} - \text{intercept TIM}] + [(b_1' - b_1) \times \ln X_1\ TIM + ... + (b_6' - b_6) \times \ln X_6\ TIM] + [\{(b_1'(\ln X_1\ SIM - \ln X_1\ TIM + ... + (b_6'(\ln X_6\ SIM - \ln X_6\ TIM)\}] \quad ....(4)$$

The decomposition equation (4) is approximately a measure of percentage change in output/income with the adoption of border strip irrigation method. The first bracketed expression of the right hand side is the measure of percentage change in output/income due to shift in scale parameter (A) of the production function. The second bracketed expression is the difference between output elasticities each weighted by natural logarithms of the volume of that input used under non- adopter category, a measure of change in output/income due to shift in slope parameters (output elasticities) of the production function. The third bracketed expression is the sum of the natural logarithms of the ratio of each input of adopters to non-adopters, each weighted by the output elasticity of that input. This expression is a measure of change in output due to change in the per hectare quantities of seed, fertilisers, human labour, bullock and machine labour, cost of irrigation and cost of farm yard manure.

OBSERVATIONS AND ANALYSIS

The finding of the study as well as relevant discussion have been summarized under following heads:

Structural break in the production relation of chickpea cultivation under border strip and flood method of irrigation (BSI) :

To identify the structural break in chickpea production relation with the introduction of border strip method of irrigation (BSI) method as new technology, direct estimates of Cobb-Douglas type of production function presented in the Table 1 are used.

In case of new technology (BSI), the calculated 'F' value 63.94 was greater than the 'F' critical value (3.528) at one per cent for 6 and 28 degrees of freedom, the R^2 value 0.931 was statistically significant. The intercept value was 8.836. The regression co-efficient for bullock and machine labour (0.277) and cost of irrigation were found to be significant at one per cent level of significance, fertilizer (0.228) and human labour (-0.248) were significant at five per cent level of significance, whereas seed (0.018) and FYM (0.048) were found to be non-significant.

In case of traditional technology (flood method of irrigation), the calculated 'F' value 68.40 was greater than the 'F' critical value (3.528) at one per cent for 6 and 28 degrees of freedom, the R^2 value 0.936 was statistically significant. The intercept value was 4.264. The regression co-efficient for cost of irrigation (0.217) was found to be significant at one per cent level of significance, seed (0.241) and fertilizer (0.342) were significant at five per cent level of significance, whereas human labour (-0.030), bullock and machine labour (0.119) and FYM (-0.007) were found to be non-significant.

In case of pooled chickpea production function with border strip method of irrigation as dummy variable was used for identifying structural break if any in production relation with the introduction of border strip method of irrigation as a new technology. The regression co-efficient for dummy variable (0.242) was significant at one per cent level of significance and also calculated 'F' value (96.62) was greater than 'F' critical value (2.953) at one per cent for 7 and 62 degrees of freedom, so R^2 value 0.916 was statistically significant. The regression co-efficients for fertilizer (-0.374), bullock and machine labour (0.449) and regression co-efficient for dummy variable (0.242) was significant at one per cent level of significance whereas the regression co-efficients for seed (0.093), human labour (0.376), cost of irrigation (0.060) and FYM (0.015) were found to be non-significant.

Geometric mean levels of returns and cost involved in chickpea cultivation under border strip method and flood of irrigation :

The per hectare geometric mean levels of gross returns and input costs in the chickpea production are presented in

Table 1 : Production function estimates in chickpea cultivation under border strip and flood method of irrigation **(Per ha)**

Sr. No.	Particulars	Parameter	Flood	BSI	Pooled
1.	No. of observations	N	35	35	70
2.	Intercept	a	4.264 (2.820)	8.836 (1.084)	5.183 (1.268)
3.	Seed (Rs.)	X_1	0.241** (0.101)	0.018 (0.052)	0.093 (0.061)
4.	Fertiliser (Rs.)	X_2	0.342** (0.157)	0.228** (0.098)	-0.374*** (0.131)
5.	Human labour (Rs.)	X_3	-0.030 (0.464)	-0.248** (0.111)	0.376 (0230)
6.	Bullock and machine labour (Rs.)	X_4	0.119 (0.230)	0.277*** (0.080)	0.449*** (0.146)
7.	Cost of irrigation (Rs.)	X_5	0.217*** (0.076)	0.084*** (0.029)	0.060 (0.057)
8.	FYM (Rs.)	X_6	-0.007 (0.070)	0.048 (0.029)	0.015 (0.039)
9.	Dummy for BSI method		-	-	0.242*** (0.040)
10.	Co-efficient of multiple determination	R^2	0.936	0.931	0.916
11.	Adjusted R	R^2	0.922	0.917	0.906
12.	F value	F	68.40	63.94	96.62

Note : *, ** and *** indicate significance of values at P=0.05, 0.01 and 0.1, respectively, BSI- Border strip irrigation the Table 2.

It is clear from the table that the gross returns under border strip method of irrigation (Rs. 125056.16) were more compared to flood method of irrigation (Rs. 105621.4). With regard to input costs the border strip method of irrigation involves about 2.04 per cent less seed cost, 4.33 per cent less fertilizer cost, 22.55 per cent less human labour cost and 35.05 per cent less cost of irrigation.

Table 2 : Geometric mean levels of returns and cost involved in the cultivation of chickpea under border strip and flood method of irrigation (Per ha)

Sr. No.	Particulars	Flood	BSI	Difference (%)
1.	No of observation	35	35	
2.	Seed (Rs.)	39164.20	38363.40	-2.04
3.	Fertiliser (Rs.)	1104.06	1056.25	-4.33
4.	Human labour (Rs.)	13428.25	10399.88	-22.55
5.	Bullock and machine labour (Rs.)	7062.70	8678.54	22.88
6.	Cost of irrigation (Rs.)	1776.97	1154.11	-35.05
7.	FYM (Rs.)	405.56	419.60	3.46
8.	Gross returns (Rs.)	105621.4	125056.16	18.40

Note: BSI- Border strip irrigation

Decomposition analysis of total change in per hectare income between border strip and flood method of irrigation in cultivation of chickpea :

The total change in income received from chickpea production due to adoption of border strip method of irrigation technology was decomposed using decomposition equation (4) developed by Bisaliah (1977) provided in methodology, using the production function parameters (estimates) from Table 1 and geometric mean levels of returns and cost of inputs from Table 2. The results of output decomposition analysis are presented in Table 3.

A perusal of Table 3 revealed that the adopters of border strip method of irrigation technology produced 16.89 per cent higher income from chickpea production than the flood method of irrigation. The increase in the income was further decomposed into different sources of change such as adoption of border strip method of irrigation technology and all other inputs. The border strip method of irrigation technology alone could contribute 9.37 per cent increase in income, while the contribution of change in input levels was also found to be positive (7.52%). Amongst the various inputs, seed (-0.04 %), fertilizer (-1.01%) and cost of irrigation (-3.67%) contributed negatively whereas human labour (6.35 %), bullock and machine labour (5.72 %) and FYM (0.17%) contributed positively to the income. Reddy (1980); Reddy and Clyma (1981); Shatanawi and Strelkoff (1984) have also worked on border irrigation and the results coincide with the present investigation.

Table 3: Decomposition analysis of total change in per hectare income between border strip and flood method of irrigation in cultivation of chickpea (Per ha)

Sr. No.	Particulars	Flood+ BSI
	Total change in the measured income	18.40
1.	Technology component	9.37
	Neutral component	457.25
	Non - neutral	-447.87
	Seed (Rs.)	-235.57
	Fertilisers (Rs.)	-79.85
	Human labour (Rs.)	-207.12
	Bullock and machine labour (Rs.)	139.88
	Cost of irrigation (Rs.)	-98.90
	FYM (Rs.)	33.69
2.	Input contribution	7.52
	Seed (Rs.)	-0.04
	Fertilisers (Rs.)	-1.01
	Human labour (Rs.)	6.35
	Bullock and machine labour (Rs.)	5.72
	cost of irrigation (Rs.)	-3.67
	FYM (Rs.)	0.17
	Total estimated difference in the income	16.89

Note: BSI- Border strip irrigation

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REFERENCES

Bisaliah, S. (1977). Decomposition analysis of output change under new production technology in wheat farming – some implications to returns on investment. *Indian J. Agric. Econ.*, **32**(3): 193-201.

Cobb, C.W. and Douglas, P.H. (1928). A theory of production. Supplement, Papers and Proceedings of the Fortieth Annual Meeting of the American Economic Association. *American Econ. Rev.*, **18**(1):139–165.

Gaddi, G.M., Mundinamani, S.M. and Patil, S.A. (2002). Yield gaps, constraints and potential in chickpea production in North Karnataka - An econometric analysis. *Indian J. Agric. Econ.*, **57**(4): 722-734.

Kumar, Vinod (2001). Decomposition analysis of output change under new production technology in dairy farming. *Indian J. Anim. Sci.*, **71**(10): 966-969.

Mohan, H.P. (2009). Impact of IPM technology on chickpea and paddy production in Haveri district- an economic analysis. M.Sc. (Ag.) Thesis, University of Agricultural Sciences Dharwad, KARNATAKA (INDIA).

Reddy, J.M. (1980). Irrigation system improvement by simulation and optimization. Ph.D. diss. Fort Collins, Colorado State University, COLO.

Reddy, J.M. and Clyma, W. (1981). Optimal design of border irrigation systems. *J. Irrig. & Drain. Div. ASCE*, **107**(3): 289-306.

Shatanawi, M.R. and Strelkoff, T. (1984). Management contours for border irrigation. *J. Irrig. & Drain. Engg., ASCE*, **110**(4): 393-399.

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