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Chickpea production in Ahmednagar district of Maharashtra: a technological gap analysis

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ABSTRACT

The study was undertaken in Ahmednagar district of Maharashtra state by selecting 60 sample farmers during 2002-03. The data on input use and production of demonstration plots and farmers' field of chickpea were analyzed by using Cobb-Douglas production function and decomposition analysis. The results revealed that the per ha use of most important inputs was minimum on sample farms than the demonstration plots. The B:C ratio of 1.19 for chickpea indicated that profitability in its cultivation. Production function analysis indicated scope in the use of human labour, bullock labour, nitrogen and phosphorous with curtailment in the use of manures in chickpea cultivation. The decomposition analysis of yield gaps showed that 52.99% of the potential farm yield in chickpea was left untapped by the sample farmers. Therefore, there is a scope to raise chickpea production at least by 53%.

Key words: Chickpea, Decomposition analysis, Technology adoption index

Chickpea (Cicer arietinum L.) is the most important pulse crop in India with production of 6.33 million tonnes. Among states, MP (2.41 mt), Maharashtra (0.92 mt), and UP (0.50 mt) contribute maximum to the total production. In recent years, Maharashtra has seen positive trends in area, production and yield of chickpea. The state has tremendous potential in expanding chickpea area and production, provided that improved production technologies are made available to farmers. Keeping this in mind, a study was conducted to assess the technology gap in one of the major chickpea producing districts of Maharashtra.

MATERIALS AND METHODS

Ahmednagar district falls under Scarcity Zone of western Maharashtra where chickpea is cultivated in *rabi* season on large scale. Therefore, it was selected purposely for the study. Based on the area under chickpea, five villages were selected from Kopergaon tahsil. From each village, 12 farmers were selected randomly. In all, 60 sample farmers were sampled and information was collected during 2002-03. The trial plots of chickpea taken by the Mahatma Phule Krishi Vidyapeeth, Rahuri on the farmer's fields were considered as the demonstration plots for comparison. The technology adoption score of each component of crop production technology was computed and Technology Adoption Index (TAI) was worked out as per the formula of Kiresur *et al.* (2001):

$$TAI = (Ai/Mi)\,C\,100$$

Where, Ai = Average adoption score registered by the farmer for particular component

Mi = Maximum adoption score registered for the particular component

The yield gap was worked out as the difference between the demonstration plot yield and the actual farmer's yield. The following Cobb-Douglas type of production function was used for the purpose (Gaddi *et al.* 2002):

$$Y = a_0 H^{a1} B^{a2} M^{a3} N^{a4} P^{a5} e^{u}$$

Where,

Y = Output of main produce in quintals per ha

a_0 = Intercept

H = Per ha use of human labour in man days

B = Per ha use of bullock in pair days

M = Per ha use of manure in quintals

N = Nitrogen (kg) per ha

P = Phosphorus (kg) per ha

e^u = Error term

a_1 to a_5 are the elasticities of production.

To examine the structural break in production relations on the farmer's fields and the demonstration plots, the above equation was estimated by the ordinary least square (OLS) technique separately for the sample farmer's fields and demonstration plots as follows.

$$\text{Log } Y_1 = \text{Log } a_0 + a_1 \text{Log } H_1 + a_2 \text{Log } B_1 + a_3 \text{Log } M_1 + a_4 \text{Log } N_1 + a_5 \text{Log } P_1 + U_1 \quad \ldots\ldots\ldots(1)$$

$$\text{Log } Y_2 = \text{Log } b_0 + b_1 \text{Log } H_2 + b_2 \text{Log } B_2 + b_3 \text{Log } M_2 + b_4 \text{Log } N_2 + b_5 \text{Log } P_2 + U_2 \quad \ldots\ldots\ldots(2)$$

Where, Y_1 and Y_2 are the yield levels on the farmer's fields and the demonstration plots. The inputs have the symbol as stated above along with associated coefficients. The combination of different resources to yield gap was estimated with the Decomposition model Bisaliah (1997). The following functional forms specified an Eq^n (1) and (2) above mentioned were used.

$$\text{Log}(Y_2/Y_1) = [\text{Log}(b_0/a_0)] + [(b_1-a_1)\text{Log } H_1 + (b_2-a_2)\text{Log } B_1 + (b_3-a_3)\text{Log } M_1 + (b_4-a_4)\text{Log } N1 + (b_5-a_5)\text{Log } P_1] + [b_1 \text{Log}(H_2/H_1) + b_2 \text{Log}(B_2/B_1) + b_3 \text{Log}(M_2/M_1) + b_4 \text{Log}(N_2/N_1) + b_5 \text{Log}(P_2/P_1)] + [U_2-U_1]$$

This equation involves decomposing the yield gap. The summation of the 1st and 2nd bold bracketed term on the right hand side of equation represents the yield gap, attributable to the difference in the cultural practices. The 3rd term represents the yield gap attributable to the difference in the input use (input gaps) between demonstration plots and the farmers fields. The last term takes the care of the random disturbance. In addition, constraint analysis for the adoption of improved production technologies in chickpea was also carried out.

RESULTS AND DISCUSSION

Resource use structure in chickpea cultivation: The per hectare use of human labour on demonstration plot and by the sample cultivators was 60 and 49 man days (Table 1). The per cent gap observed in utilization of human labour between demonstration plot and sample cultivators was 18.33%. The per hectare use of bullock labour was 12 and 7.52 pair days on the demonstration plot and by the sample cultivators. The per hectare use of seed was 100 and 61.64 kg, depicting the >38% gap. In case of manures, the per hectare utilization was 15 and 10.20 tonnes on demonstration plot and sample farms. There was a wide gap of 93.19% in the utilization of manure by sample farmers. The use of nitrogen and phosphorus was 25 and 50 kg/ha on demonstration plots while their application in the sample farms was found to be 27.38 and 17.23 kg/ha, nearly 10% gap as compared to demonstration plots. In case of phosphorus, a gap of about 66% was observed between farmers' fields and demonstration plots. The yield obtained on demonstration plots was 2270 kg/ha while it was 1067 kg/ha on the sample farms. The productivity gap observed was nearly 53 %. It was noticed that the per ha use of important inputs by sample farmers varied remarkably and their use was found much less than that on demonstration plots.

Production function estimates: The Cobb-Douglas type production function was fitted to the observations for the estimation of elasticities of important variables contributing to the yield of chickpea. The analysis of variance in respect of the production function showed significant variance indicating the overall significance of the estimated production function. The value of coefficient of multiple determination

Table 1. Per ha resource use utilization in chickpea cultivation in Ahmednagar district of Maharashtra

Resource	Unit	Demonstration plot	Sample Farms	% gap
Human labour	Mandays	60	49	-18.33
Bullock labour	Pairdays	12	7.52	-37.33
Seed	Kg	100	61.74	-38.26
Manures	Kg	15,000	1021	-93.19
Nitrogen	Kg	25	27.38	+9.52
Phosphorus	Kg	50	17.23	-65.54
Potash	Kg	0	8.31	--
Productivity	Kg	2270	1067	-52.99

Table 2. Cobb-Douglas production estimates for chickpea in Ahmednagar district of Maharashtra

Particulars	Demonstration plot	Sample farmers
Human labour (X_1)	0.0700	0.2880*
	(0.060)	(0.147)
Bullock Labour (X_2)	0.2230*	0.5230***
	(0.115)	(0.144)
Manure (X_3)	0.0480**	-0.0060
	(0.017)	(0.039)
Nitrogen (X_4)	0.1200	0.0780*
	(0.105)	(0.042)
Phosphorus (X_5)	0.140**	0.0090
	(0.052)	(0.044)
Intercept (a)	0.7500	0.0090
Coefficient of multiple determination (R^2)	0.87	0.63
Number of observation (N)	30	60
D.F.	24	54
'F' value	32.12*	18.38*

(Figures in the parenthesis indicate the standard errors of respective regression coefficients)
'*', '**', and '***' indicate significance level at 10, 5, and 1%, respectively

(R^2) in demonstration plots was 0.87, which suggested that the five resource variables included in the production function had jointly explained as high as 87% of the total variation in the chickpea production on demonstration plots. It was important to note that the regression coefficients of variables *viz.*, bullock labour (X_2), manure (X_3) and phosphorus (X_5) which indicated their positive association with the output on the demonstration plots were turned out to be significant at 10 and 5% levels, indicating their importance in raising the output. It is also observed that for the sample farms, the production elasticities of human labour, bullock labour and nitrogen were 0.288, 0.523 and 0.078.

Different sources of yield gap: The decomposition analysis of yield gaps showed that the 52.99% of the potential farm yield of chickpea left untapped by the sample farmers (Table 3). Among different sources of yield gap, input use

Table 3. Decomposition analysis of yield gaps in chickpea production (%) in Ahmednagar district of Maharashtra

Sources of difference	Chickpea
Total difference in output	52.99
Source of contribution-	
1. Difference in cultural practices	24.35
2. Input use gaps-	
i) Human labour	0.86
ii) Bullock labour	2.59
iii) Manure	6.70
iv) Nitrogen	-1.58
v) Phosphorus	20.07
Due to all inputs	28.64
Total estimated gap from all sources	52.99

Table 4. Technology adoption index (TAI) for chickpea

Technology	Average adoption score registered by sample farmers	Technology adoption index (TAI) %
Seed rate		
Recommended	4.50	50.00
Above recommended	2.30	25.56
Below recommended	2.20	24.44
Sowing time		
Timely	2.30	25.56
Early	2.10	23.33
Late	4.60	51.11
Seed treatment		
Yes	8.50	94.44
No	0.50	5.56
No. of irrigation		
One	7.50	83.33
Two	0.80	8.89
Three	0.70	7.78
Manure		
Recommended	0.40	4.44
Above recommended	0.60	6.67
Below recommended	4.70	52.22
No application	3.30	36.67
Nitrogen		
Recommended	0.45	5.00
Above recommended	1.82	20.22
Below recommended	6.18	68.67
No application	0.55	6.11
Phosphorus		
Recommended	0.30	3.33
Above recommended	0.50	5.56
Below recommended	5.90	65.56
No application	2.30	25.56
Spraying		
One	7.60	84.44
Two	0.90	10.00
No spraying	0.50	5.56

(Maximum technology score for each component is 9)

Table 5. Constraints in the adoption of improved production technologies in chickpea

Particulars (N= 60)	Frequency	%
Variety		
Unaware about recommended variety	15	25.00
Non availability in time	9	15.00
High cost of seed	32	53.33
Seed rate		
Unaware about the recommendation	22	36.66
More seed rate for better plant population	9	15.00
Less rate due to high cost of seed	31	51.67
Seed treatment		
Unaware about recommendation	22	33.67
Unavailability of seed treatment culture	20	33.33
Costly and time consuming	10	30.00
FYM		
Unaware about recommendation	12	20.00
Non availability	16	26.67
Available quantity used for other crops	12	20.00
High cost	23	38.33
Fertilizer		
Unaware about recommendation	30	50.00
Uncertainty about irrigation/rains	13	21.66
Cost	20	33.33
Plant protection		
Chemical control		
Unaware about recommendation	26	43.33
Non availability	12	20.00
Cost	22	36.67
Biological control		
Unaware about recommendation	30	50.00
Application is not easy	14	23.33
Unavailability of labour in time	7	11.67
Cost	9	15.00

(29%) turned out to be the major contributor followed by cultural practices (24.33%) in farmers' fields. This implied that by adopting the recommended cultivation practices and without incurring extra expenditure on required inputs, the yield can be increased by 24% in chickpea. Thus, the deviation from the recommended package of practices on farmers' fields adversely affected the yield performance of chickpea. Efforts on the part of the extension agencies to pursue the farmers to accept and adopt the recommended technology are urgently required. Limited use of human labour, bullock labour, manure and phosphorus on farmers' fields compared to the demonstration plots explained the major portion. Thus, by applying appropriate quantities of human labour, bullock labour and recommended doses of manure and phosphorus on farmers' fields, the yield gap can be reduced by 29%. The regression coefficient of nitrogen turned out to be negative (-1.58) which indicated that there was excess use of nitrogen on demonstration plots.

Technology adoption index (TAI): The maximum technology score considered for this analysis was nine (Table 4). The TAI was highest for recommended seed rate (50%), late sowing (51.11%) and seed treatment (94.44%). In case of irrigation, TAI varied from 7.78 to 83.33%. The maximum TAI was observed in manure application for the below recommended level (52.22 %). In nitrogen application, TAI ranged from 5.00 to 68.67% whereas in phosphorus, it ranged from 3.33 to 65.56 %. The maximum (84.44 %) TAI was found for one spraying as plant protection measure. Therefore, it is advised that the farmers should follow timely sowing and apply the manure as per the recommendation for realizing the potential yield of chickpea.

Constraint analysis: Among various constraints in realizing potential yield at farmers' fields, high cost of seed

was the foremost as 53% farmers did not have access to the seeds of the improved varieties while 51% farmers indicated that they did not use recommended seed rate (Table 5). Unawareness about recommendations regarding seed treatment (33%), fertilizer dose (50%), and use of chemical pesticides (43%) and biological agents (50%) were the other major constraints reported by the sample farmers.

The study concluded that the per hectare use of human labour, bullock labour, seed, manure and phosphorus was less than adequate in chickpea cultivation in Ahmednagar district of Maharashtra. The average productivity of chickpea was 1067 kg /ha on sample farms. The decomposition analysis of yield gap showed that 53% of the potential yield of chickpea left untapped by sample farmers. The major factors responsible for yield gap are low input use (29%) and cultural practices (24%). The non-adoption of improved technology is mainly due to high cost of inputs and unawareness regarding recommendations of the improved production technologies.

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