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Economic Analysis of Yield Gap in Chick Pea

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ABSTRACT

The pulses are richsource of proteins, also a rich source of green and dry fodder for livestock production. Therefore, pulses are important in cropping system of Maharashtra. Due to their protein richness, pulses are the integral part of the Indian people. Chickpea has the richest, cheapest and easiest source of best quality proteins and fats. Chickpea is also a good source of vitamins and minerals like potassium and phosphorus. In this study an attempts has been made to study Economic analysis of yield gap in chick pea. The study was based on both primary as well as secondary data collected from Bhandara district of Maharashtra. The Primary data of 90 chick pea growers were collected from six villages from two tehsils of Bhandara District viz. Bhandara and Pauni and from these 45 and 45 samples were selected purposively. The secondary data on area, production and productivity was pertained to the periods 1991-92 to 2020-21 collected from various government publications. The present study revealed that, area, production and productivity of chick pea had increased in Bhandara district over the period of time. The yield gap analysis shows that the overall yield gap I i.e. difference between potential yield and farmers yield worked out to be 283 kg/ha and yield gap II i.e. difference between potential farm yield and farmers yield was 210 kg/ha. The highest total yield gap was recorded in small farmers (375 kg/ha), while lowest in large farmers (176 kg/ha) in yield gap I. Magnitude and Direction of yield gap shows that the yield gap is increased at increasing rate. The path analysis measured the direct and indirect effect of input gaps on yield gap explained that the total effect of seed (0.98) was found to be highest in large farmers, while seed (0.98), fertilizer (0.98) and plant protection (0.93) found to be highest in small size group of farmers.

Keywords: Chick Pea, Garrett's ranking, Growth, Legume, Path analysis

Pulses are the edible seeds of plant in the legume family. Pulses grow in pods and come in a variety of shapes, size and colours. The pulses are rich source of proteins, also a rich source of green and dry fodder for livestock production. Therefore, pulses are important in cropping system. Due to their protein richness, pulses are the integral part of the Indian people.

Chick pea or chana is a very important pulse crop in the world after peas and beans. The chickpea (*Cicer arientinum L.*) belongs to Febaceae family. Indian name "Chana" has most probably derived from Sanskrit word "Chanakah". Chick pea iscommonly known by various names in different states of India such as, chana, harbhara, chhole, bengal Chick pea, etc. Chana is used as an edible seed and is also used for making flour throughout the globe. Chickpea also enriches the soilby nitrogen fixation through its root nodules. Chick pea is one of the major pulse crops grown in India. Chickpea has the richest, cheapest

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and easiest source of best quality proteins and fats. Chickpea is also a good source of vitamins and minerals like potassium and phosphorus.

Chickpea was cultivated in India on an area of 112 lakh hectares which harvested 116.2 lakh tonnes with a productivity 1036 kg/ha in the year 2020-21. The major producing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka and Andhra Pradesh. In Maharashtra during 2020-21 area under Chick pea cultivation was 2594.30 (00 ha) with annual production of 2865.90 (00 tones) with an average productivity of 1047.0 kg/ha. In Bhandara district during 2020-21 area under Chick pea cultivation was 189.38(00 ha) with annual production of 158.85 (00 tones) with an average productivity of 838.76 kg/ha. (www.mahagri.gov.in).

MATERIALS AND METHODS

Selection of samples and collection of data: The present study was based on both primary as well as secondary data collected from the Chick growers of Bhandara District. The primary data on input used, their costs and returns received from chick pea was collected from 90 potential growers of Bhandara district pertained for the year 2021-22 and secondary data of area, production and productivity was collected from Statistical survey of Maharashtra, Epitome of Government of Maharashtra and Different government websites. The secondary data was collected for last 30 years i.e. from 1991-92 to 2020-21. The entire period of the study was split up into two sub periods i.e. period I (1991-92 to 2005-06) and Period II (2006-07 to 2020-21).

Statistical analysis

Following statistical tools has been carried out for the present study.

Estimation of Compound growth rates

The growth rates in area, production and productivity was studied by estimating compound growth rate at different periods.

The growth was estimated by using following exponential model.

$$Y = a.bt$$

Where,

Y = Area / Production / productivity

a = Intercept

b = Regression coefficient

t = Time variable

From the estimated function the compound growth is worked out by

$$CGR\ (r) = [Antilog\ (log\ b - 1)] \times 100$$

Degree of instability

The degree of instability in area, production and productivity of Chick pea of different period was measured by using coefficient of variation and coefficient of instability.

$$Coefficient\ of\ variation\ (CV) = \frac{\sigma}{\bar{x}} \times 100$$

Where, σ = Standard Deviation = $\sqrt{\frac{\sum X - \bar{X}}{n}}$

Coefficient of instability was worked out by using coppocks instability index.

$$V\ log = \frac{\sum \left(\log \frac{X_{t+1}}{X_t} \ldots\ldots m \right)^2}{N}$$

$$The\ Instability\ Index = [Antilog\ (\sqrt{vlog}) - 1] \times 100$$

Where

X_t = Area / Production / productivity of Chick pea

N = Number of years

M = Arithmetic mean of the differences between the log of X_t and X_{t-1}, X_{t-2} etc.

$V\ log$ = Arithmetic Variance of series

Analysis of Yield Gap in Chick pea

Yield Gap I: It is the difference between potential yield and actual yield. (i.e. Yp-Ya)

Yield Gap II: It is the difference between potential farm yield and actual yield. (i.e. Yd-Ya)The magnitude and direction of yield gap will be studied by fitting quadratic function.

$$Y = a + bT + CT^2$$

Where,

Y = Yield Gap

T = Time

So, about existing of acceleration or deceleration with a specified time period is based on the sign and statistical significance of the estimation of c in the quadratic trend function.

Factors responsible for the yield gap

The factor contributing towards yield gap studied using path analysis. Path coefficient analysis technique was carried out to estimate direct and indirect contribution of input gap (x) is to yield gap (Y).

A path coefficient is the ratio of the standard deviation of the effect or it is a standardized partial regression coefficient (Deway and Lu,1959). In the present investigation, the effect of difference actual utilization of key inputs and human labour (pd), bullock labour (Pd), seed (Kgs), Plant nutrients (₹) and plant protection (Rs) between the farmers and field demonstration plot independent variable (xi) were used. The path coefficients across different categories of farm will be studied by solving the following simultaneous equations.

$$ry_1 = P_{y1} + r_{12}P_{y2} + r_{13}P_{y3} + r_{14}P_{y4} + r_{15}P_{y5} \quad \ldots(1)$$

$$ry_2 = r_{21}P_{y1} + P_{y2} + r_{23}P_{y3} + r_{24}P_{y4} + r_{25}Py_{25} \quad \ldots(2)$$

$$r_{y3} = r_{31}P_{y1} + r_{32}P_{y2} + P_{y3} + r_{34}P_{y4} + r_{35}P_{y5} \quad \ldots(3)$$

$$r_{y4} = r_{41}P_{y1} + r_{42}P_{y2} + r_{43}P_{y3} + P_{y4} + r_{45}P_{y5} \quad \ldots(4)$$

$$r_{y5} = r_{51}P_{y1} + r_{52}P_{y2} + r_{53}P_{y3} + r_{54}P_{y4} + P_{y5} \quad \ldots(5)$$

The generalized formula may be written as—

$$r_{yi} = r_{1i}P_{y1} + r_{2i}P_{y2} + r_{3i}P_{y3} + \ldots\ldots + r_{ni}P_{yn} \quad \ldots(6)$$

Where,

i = (1 to 5) is the correlated cause and y is the effect.

$$P_{yi} = bi\frac{di}{dy} \quad \ldots(7)$$

The direct effect are given by the path coefficient (P_{yi}). The indirect effect is given by—

$$\sum_{\substack{i=1 \\ i=j}}^{n} r_{ij}P_{yj}$$

The unexplained variance (residual effect) not accounted for the included.

Constraint Analysis

The constraint in the Chick pea production was analyzed by using Garrett's ranking technique. The ranks given by each respondent was converted into percent position by using formula.

$$Percent\ position = \frac{100 \times \left(R_{ij} - 0.5\right)}{N_j}$$

Where

R_{ij} = Rank given for i factor by j individual.

N_j = Number of factors ranked by j individual.

The estimated percent positions were converted into scores using Garrett's table. The mean of scores was estimated for each constraint and these means score was arranged in a descending order. The constraint with highest mean score value was considered as the most important and ranked as one and remaining mean scores have given rank in descending order.

RESULTS AND DISCUSSION

Growth Performance, Variation and Instability in Chick pea

Growth in area, production and productivity

In this study, the compound growth rates in area, production and productivity of chick pea were estimated using exponential function with time normalization on area, production and productivity. The growth, variation and Instability in area, production and productivity in chick pea pertaining to two periods and overall is discussed and presented in Table 1.

It is seen from Table 1 that, In period I, the production and productivity of chick pea in Bhandara district was increased by 4.39 and 2.04 per cent per annum respectively while the growth in area was stagnant. In period II, the area and production of chick pea

Table 1: Growth, Variation and Instability in Chick pea

Particulars	CGR			Coefficient of variation			Coppock Instability index		
	P-I	P- II	Overall	P-I	P- II	Overall	P-I	P- II	Overall
Area	2.35	5.59***	6.23	28.07	36.94	62.23	26.26	26.06	29.41
Production	4.39*	6.69**	9.04	33.76	47.30	84.57	29.05	37.53	38.26
Productivity	2.04*	1.09	2.65	19.66	33.26	38.51	17.10	32.83	27.83

Note: ***, ** and * denotes significant at 1%, 5% and 10% level of significance.

was positive and increased by 5.59 per cent and 6.69 per cent per annum respectively. At overall level, area, production and productivity of chick pea in Bhandara district was increased by 6.23 per cent, 9.04 per cent, and 2.65 per cent per annum respectively.

Coefficient of variation and Instability in area, production and productivity of chick pea

In order to know the instability in area, production and productivity of chick pea, fluctuation measured with the help of coefficient of variation. The results are presented in Table 1 and discussed as under for the period with fifteen years breakage and overall also. Fluctuation in area, production and productivity due to the uncontrollable factors like climatic conditions can cause upward bias in coefficient of variation. As seen from Table 1, that the coefficient of variation in area for overall period was 62.23 per cent, there was highest variation as compared to period I and period II (i.e. 28.07 per cent and 36.94 per cent respectively). During period II Bhandara district recorded high variation (i.e. 36.94 per cent) as compared to period I. It is cleared that this district exhibited less variation in first period and highest variation in area during overall period of study. As revealed from Table 1 the district witnessed very high instability of production as indicated by highest coefficient of variation of 84.57 per cent for overall period. Among periods under study the period II has highest coefficient of variation (i.e. 47.30 per cent) in production. While during the first period it was 33.76 per cent. Table 1 reveals that, the productivity of Chick pea over the entire period shows highest coefficient of variation of 38.51 per cent. During first period the coefficient of variation of 19.66 per cent while in second period, the coefficient of variation witnessed 33.26 per cent. From above it is clear that the instability in Chick pea was increased during overall period and productivity were increased over period at time. At overall level coefficient of variation was 84.57 per cent per annum.

From Table 1 that the instability index of area under Chick pea for overall was 29.41 per cent. During first period instability index was 26.26 per cent and second period the instability in area was comparatively low (i.e. 26.06 per cent) which means that there was instability in area under Chick pea. Above table present instability index for production for the overall period was 38.26 per cent. During first period the instability index was 29.05 per cent while in second period the instability index witnessed 37.53 per cent. It is also revealed from Table that the instability index of productivity for overall period was 27.83 per cent during first period instability index was 17.10 per cent while in second period instability index was highest (i.e. 32.83 per cent).

Yield Gaps in Chick pea production

The study was undertaken with the overall objective of estimating the magnitude of yield gaps and factor contributing to yield gap in chick pea production. The results obtained are presented in Table 2.

It could be observed from the Table 2, that there is a wide gap in the Chick pea productivity between the research station, the potential farm (demonstration plots) and the sample farmer fields. The magnitude of yield gap I worked out to be 283 kg/ha which observed relatively higher size of yield gap II 210 kg/ha. The higher magnitude of yield gap II may be attributed to the significant experimental difference and partly to the non-transferable component of technology like cultural practices between the demonstration plot and the research stations. Farm size group wise analysis observed that the highest in magnitude of yield gap was recorded on the small farm (375 kg/ha) and medium farms (265 kg/ha) while the lowest magnitude was notice on large farm

(176 kg/ha) and in yield gap II it has been noticed that highest magnitude noticed on small farm (302 kg/ha), medium farm (192 kg/ha) and the lowest in large size farm (103 kg/ha).

Table 2: Chick pea yield levels realized and estimated yield gap under different field situation

Particulars	Yield (Kg/ha)
Potential yield	2500
Potential farm yield	2427
Actual yield	
Small farmers	2125
Medium farmers	2235
Large farmers	2324
0verall	2217
Yield gap I	
Small farmers	375
Medium farmers	265
Large farmers	176
0verall	283
Yield gap II	
Small farmers	302
Medium farmers	192
Large farmers	103
0verall	210

Farm size group wise analysis showed that the small and medium farmers obtained relatively better yield levels than large farmers. This resulted comparatively higher yield levels and narrower yield gap on medium and small farmers than on their medium counterparts. Due to knowledge of new technology and proper cultural practices should manage their farms better resulted in higher yield levels on the other hand comparatively lower yield level realized on large farms. (Hence the hypothesis of this study i.e. The yield gap exit in sample area is true and accepted.)

Table 3: Magnitude and direction of yield gap for Chick pea

		Coefficient		
Sl. No.	**Intercept**	**X**	**X^2**	**R^2**
1	3.50	-0.03	0.01	0.40

From Table 3, the analysis of yield gap II for Chick pea shows that the quadratic function fitted for yield gap data for Bhandara district had R^2 value is positive. This indicates that yield gaps for Chick pea is showing acceleration andincreased i.e. yield gap is increased at increasing rate.

Factor Contributing to the Yield Gap of Chick pea

The direct and indirect effects measured both in terms of correlation coefficient and percentage of input use gaps on yield gaps are presented in Table 4, which represents the information on yield gap which were the result of gap in the quantity of input used and a composite variable that included all other factor affecting yield gap not included in the model. These could be differences in the climatic conditions, various cultural and crop management practices between the farmers and demonstration plots. Results of correlation coefficient between the yield gap and input use gaps revealed that the total effect of seed and fertilizer were found to be highest (0.98) in small farmers. Plant protection (0.93) in small farmers. On overall category of farmers machine labour, seed, manure and plant protection were found to be equal and highest total effect. In large category of farmers seed was found to be the most important variable conditioning yield gap as indicated by its correlation coefficient (0.98) and it explained direct and indirect effect 93.88 per cent and 6.12 per cent of total effect respectively.

In medium category of farmers seed was found to be the most important variable conditioning yield gap as indicated by its correlation coefficient (0.98) and it explained direct and indirect effect 69.39 per cent and 30.61 per cent of total effect respectively. The positive correlation between the input use gaps and the yield gap indicated a direct association between the input use differences and yield gap. The findings of the study clearly demonstrated the possibility of reducing the yield gap by reducing the input use gaps. In addition to this, the farmers ability to use higher level of input need to be considered and there is a need to educate farmersabout the benefits of using the recommended level of inputs.

Constraints responsible for yield gap in Chick pea production

All the selected Chick pea cultivators were interviewed for the constraints they face for production of Chick pea. The constraint in the Chick pea production was analysed by using Garrett's ranking technique.

Table 4: Direct and indirect effects of input use on yield gap in Chick pea

Sl. No.	Particulars	Small	Medium	Large	Overall
(A)					
1	Direct effect of human labour	-0.07 (-7.95)	0.14 (14.58)	0.84 (86.60)	-0.15 (-15.46)
2	Indirect effect of human labour	0.95 (107.95)	0.82 (85.42)	0.13 (13.40)	1.12 (115.46)
3	Total effect of human labour	0.88 (100.00)	0.96 (100.00)	0.97 (100.00)	0.97 (100.00)
(B)					
1	Direct effect of bullock labour	0.04 (5.41)	0.57 (59.38)	-0.05 (-6.09)	-0.04 (-4.25)
2	Indirect effect of bullock labour	0.70 (94.59)	0.39 (40.62)	0.87 (106.09)	0.98 (104.25)
3	Total effect of bullock labour	0.74 (100.00)	0.96 (100.00)	0.82 (100.00)	0.94 (100.00)
(C)					
1	Direct effect of machine labour	0.06 (6.98)	-0.14 (-14.89)	-0.37 (-38.94)	0.08 (8.08)
2	Indirect effect of machinelabour	0.80 (93.02)	1.08 (114.89)	1.32 (138.94)	0.91 (91.92)
3	Total effect of machine labour	0.86 (100.00)	0.94 (100.00)	0.95 (100.00)	0.99 (100.00)
(D)					
1	Direct effect of seed	0.43 (43.88)	0.68 (69.39)	0.92 (93.88)	0.81 (81.82)
2	Indirect effect of seed	0.55 (56.12)	0.30 (30.61)	0.06 (6.12)	0.18 (18.18)
3	Total effect of seed	0.98 (100.00)	0.98 (100.00)	0.98 (100.00)	0.99 (100.00)
(E)					
1	Direct effect of fertilizer	0.39 (39.80)	-0.10 (-29.41)	0.02 (2.08)	-0.05 (-5.21)
2	Indirect effect of fertilizer	0.59 (60.20)	0.44 (129.41)	0.94 (97.92)	1.01 (105.21)
3	Total effect of fertilizer	0.98 (100.00)	0.34 (100.00)	0.96 (100.00)	0.96 (100.00)
(F)					
1	Direct effect of manure	0.10 (11.11)	-0.14 (-15.05)	-0.43 (-44.33)	0.16 (16.16)
2	Indirect effect of manure	0.80 (88.89)	1.07 (115.05)	1.40 (144.33)	0.83 (83.84)
3	Total effect of manure	0.90 (100.00)	0.93 (100.00)	0.97 (100.00)	0.99 (100.00)
(G)					
1	Direct effect of plant protection	0.07 (7.53)	-0.09 (-9.47)	0.05 (5.21)	0.18 (18.18)
2	Indirect effect of plantprotection	0.86 (92.47)	1.04 (109.47)	0.91 (94.79)	0.81 (81.82)
3	Total effect of plant protection	0.93 (100.00)	0.95 (100.00)	0.96 (100.00)	0.99 (100.00)

The information regarding the important constraints faced by cultivators is presented in Table 5.

The farmers have various constraints like shortage of labour, irregular supply of electricity, inadequate supply of fertilizers, high cost of improved variety and infestation of pest and diseases etc. which was analysed with the help of ranking technique. The overall results are presented in the following Table 5.

Table 5 revealed that, there were eight main problems of Chick pea producers from that High wage rate was major problem after that shortage of labours ranks second, there were no storge facility for farmers. Problem of infestation of pest and diseases ranks fourth, inadequate supply of fertilizer ranks fifth, problem of high cost of machinery ranks sixth, also high cost of seeds was major problem of chick pea cultivators.

Table 5: Constraints responsible for yield gap in chick pea production

Sl. No.	Particulars	Score	Rank
1	Shortage of Labours	59.02	2
2	High wage rate	66.47	1
3	High cost of machinery	43.71	6
4	No storage facility	56.91	3
5	Infestation of pest and diseases	48.56	4
6	High cost of seeds	39.32	8
7	Irregular supply of electricity	42.91	7
8	Inadequate supply of fertilizers	46.20	5

CONCLUSION

It is concluded from the study that, the area, production and productivity of chick pea in Bhandara district was increased over the period of study. The yield gap analysis showed that, the overall yield gap I i.e. difference between potential yield and farmers yield was worked out to be 283 kg/ha and yield gap II i.e. difference between potential farm yield and farmers yield was 210 kg/ha. Magnitude and Direction of yield gap shows that the yield gap is increased at increasing rate. High wages rate, irregular supply of electricity, shortage of labours, deficiency of storage facility, high cost of improved variety, inadequate supply of fertilizers etc. are the major constraints in chick production.

REFERENCES

Bisht, A. and Kumar, A. 2018. Growth and Instability analysis of pulses production inIndia, *Int. J. of Agri. Sci.*, **10**(14): 6722-6724.

Bhokare, K.R., Thorat, B.S., Raykar, S.S., Patil, R.R. and Ingale, S.N. 2017. Performance of chickpea production in Amravati district of Maharashtra, *J. Pharmacognosy and Phytochem.*, **6**(6): 62-64.

Bondar, U.S., Mohalkar, S.S. and Shrote, R.V. 2018. Production performance of chickpea in Maharashtra, *J. Pharmacognasy and Phytochem.*, **7**(4): 2784-2787.

Kumari, M. and Singh, R.G. 2017. Status problem and prospects of chickpea production in Bihar: A situation Analysis. *Int. J. curr. Microbial. App. Sci.*, **6**(8): 3553-3563.

Mazher A., Mahmood, I., Bashir, A., Mahmood, T., Mahmood, M.A. and Hassan, S. 2017. Economics of chickpea production and empirical investigation of its yield determinants in low intensity zones of Punjab, *Pak. J. of Agril. Res.*, **55**(2): 409-416.

Patil, R.S., Deshmukh, R.G., Deshmukh, P.S. and Jahagirdar, S.W. 2016. Performance of growth and instability of chickpea in India, Asia. *J. of Agril. Ext. Eco. and Socio.*, **14**(2): 1-5.

Rimal, S. and Kumar, S. 2015. Yield gap analysis of major pulses in India. *J. Inst. Agri. Anim. Sci.*, **33**(34): 213-219.

Sharma, K.L. 2010. Studied correlation and path analysis in Indian Mustard. *Ann. Agric. Res. New series*, **31**(34): 127-128.

Singh, A., Kushwaha, R.R., Supriya, Singh, V.K. and Maurya, S.K. 2020. An economic analysis of production and marketing of chickpea in Banda district of Bundelkhand zone in Uttar Pradesh. *J. of Pharma. and Phytochem.*, **9**(4): 245- 249.

Singh, R., Singh, G.P., Mishra, S.K., Singh, S.P., Shahi, B.P., Mohil, K. and Vishen, G.S. 2019. Cost and income analysis of gram pulse crop cultivation in Azamgarh District of eastern Uttar Pradesh. *J. of Pharma. and Phytochem.*, **5**: 170-172.

Venkatramana, P., Madhuprasad, V.C. and Anand, T.N. 2005. Yield gaps and constraints in gram cultivation. A case study of Kolar dist. In Karnataka, Mysore. *J. of Agric. Sci.*, **39**(2): 262-267.

Wable, A.A. and Tambe, P.C. 2017. Resource productivity and resource use efficiency of Chickpea production in Ahmednagar district of Maha. *Trends in Biosci.*, **10**(14):8709-8711.

Warade, S., Desmukh, R., Tiwari, V. and Alexander, S. 2010. Yield gap analysis in cotton of Akola District. *J. of Soc. and Econ. Dev.*, **12**(1).

Yadav, S.K., Kumar, P.R., Yadav, S. and Kant, K. 2005. A critical overview of chickpea seed technological research, *Seed Res.*, **33**(1): 1-15.