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Impact of Input-Output Prices on Profitability of Pulses in Karnataka

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ABSTRACT

The effectiveness of price incentives in driving agricultural growth hinges on the sensitivity of crop output and input prices with changes impacting both demand and supply. Appropriate cost estimation in agriculture profoundly affects productivity, income and policy decisions which are crucial for sustainable agricultural development and supporting farmers' livelihoods. The study compared pulse cultivation costs using cost accounting and survey method by employing the translog cost function to analyse the impact of input-output prices on crop profitability during 2019-20. The findings revealed that the cost of cultivation (Cost C_3) estimated using the cost accounting method was lower in red gram and bengal gram by 31.42 and 25.86 per cent compared to survey method. Similarly, the cost of production (Cost A_2+FL) revealed percentage difference of 26.38 and 23.89 per cent for redgram and bengal gram between the two methods. The difference between input and output prices during the study period notably affected redgram profitability. Own and cross-price elasticities varied across crops due to substitutes and technological advancements, with the negative net effect in redgram (-0.13) and positive in bengal gram (0.66). Rising human labour, fertilizer and machinery expenses outpaced output prices impacting crop profitability in redgram. The study strongly emphasizes the intervention of policy makers including the Government of India to explicitly look into the increase in cost of important productive factors before announcing Minimum Support Price (MSP) and there is a strong need for reviewing the present methodology adopted by CACP in arriving at MSP looking into the crops profitability.

Keywords : Cost of cultivation, Cost of production, Cost accounting method, Survey method, Own and Cross price elasticity, Translog cost function

AGRICULTURE plays a vital role in India's economy, serving as the primary source of livelihood for almost 58 per cent population. In India, agricultural sector is receiving substantial government support in terms of subsidies that have fostered its development. Karnataka state has the per-capita income of Rs.3.01 lakhs, surpassing the national average by 77 per cent (Anonymous, 2022). Agriculture sector is projected to achieve a growth rate of 5.5 per cent during 2022-23 in comparison to 8.7 per cent witnessed during 2021-22. Karnataka's economy stands as the fifth-largest among all Indian states, with a Gross Domestic Product (GDP) of Rs.20.5 trillion (US$ 260 billion) and a per capita GDP of Rs.3,05,000 (US$ 3,800). Agricultural growth has been supported by favourable monsoons, significant budget allocation and subsidies (Anonymous, 2021). Pulses plays an important role for sustainable crop growth with nitrogen fixation and resilience in adverse conditions, serve as India's crucial and affordable dietary protein source, especially for the impoverished and vegetarian majority (Shalendra *et al.*, 2013). Karnataka is one among the important pulses growing states in India and are grown in an area of 27.90 lakh ha during 2021-22. The important pulses grown in Karnataka are pigeon pea, chickpea, green gram, horse gram and black gram. More than 60 per cent of the area under total pulses in Karnataka is covered by pigeon pea and chickpea (Anonymous, 2021). The red gram stands first in area (1719 thousand hectare), second in production (1144.85 thousand tonnes) while bengal gram stands fifth in area (712 thousand hectare) and sixth in production (490.57 thousand tonnes). With stagnant production of pulses, increasing dependence on imports and limited global supply of *kharif* pulses, it was decided to boost the efforts under the ongoing National Food Security Mission by focusing on five key pulse crops *viz.,* redgram, bengal gram, green gram, black gram and lentil in major pulses growing states of the country.

The demand for pulses is growing considerably in recent year, but high fluctuations in supply and therefore prices of pulses, leading to recurring shortages in their availability. Both price and non-price factors influence supply response in agriculture. The price factors are having a significant influence on supply (Rahman, 2015). Price factors comprise of inputs and output prices that determine the cost of production and profit, (Reddy, 2009; Sadasivam, 1993 and Tuteja, 2006). Both the supply function and supply response are measures of incentives. Understanding the factors that influence the supply response of a crop is essential for policy. Agricultural price policy in the form of Minimum Support Price (MSP), subsidies for inputs, investments in yield increasing technology and infrastructure such as roads and irrigation and direct market procurement are influencing the supply responses especially for pulses. The production responsiveness of farmers to changing demand is conditioned on the economic incentives to grow a particular crop.

Cost of cultivation surveys play a vital role in generating data on crop cost structures, primarily serving individuals, administrators, policy planners and organizations for decision-making while the individuals use for research purposes (Swamy *et al.*, 2020). Planning and adopting a standardized methodology for the survey is essential to efficiently and precisely obtain the required information, considering the changing global landscape and the impact of technological advancements and prevailing prices on production. The structural changes in costs can be attributed to variations in the quantity and quality of inputs resulting from technological advancements, as well as the prevailing prices in the market (Anonymous, 2017). Estimation of cost is widely regarded as the most reliable basis for recording transactions in farming, as it allows for objective measurement and relies on observable facts (Vinayakumar *et al.,* 2008). Accurate estimates of incurred costs, returns and net income from farming are crucial for formulating appropriate farm policies and assessing the impact of policy measures on cultivators' well-being. To estimate the cost of cultivation, consist of two approaches *i.e.,* cost accounting and survey method. The Comprehensive Scheme for studying the Cost of Cultivation (CoC) and Cost of Production (CoP) of principal crops initiated in 1970-71 by the Government of India through the Commission for Agricultural Costs and Prices (CACP) using cost accounting method serves as a rich information on the cost and the output of various crops on a temporal basis (Rao, 2001 and Sen & Bhatia, 2004). The cost of cultivation/ production estimates being generated with the data collected under the scheme and are used as an important input by CACP while recommending MSP of various crops (Nawn, 2013 and Surjit, 2017). Contrastingly, the Karnataka Agriculture Price Commission (KAPC) was established in 2014-15 employs a distinct approach focused on market stabilization, collective farmer empowerment and agricultural infrastructure enhancement through the survey method (Anonymous, 2020). Despite both using varied data collection methodologies, discrepancies emerge in the estimation of cost of cultivation and production for different crops. While both institutions employ the same calculation method but their divergent methodologies yield varied cost estimates. This study aims to analyse the variations in cost estimates between the cost accounting and survey method exploring differences in cost concepts to provide insight into the discrepancies observed in cost estimations. The assessment of the impact of factor and product prices on crop profitability aims to comprehend how variations in input costs (factors) and output prices (products) influence the financial performance of pulse production in Karnataka. This evaluation yields crucial insights for informed decision-making in crop selection, pricing strategies, and resource allocation, fostering agricultural improvement and ensuring crop profitability. Empowering farmers and policymakers with essential insights, it aids in decisions on crop selection, resource allocation and pricing strategies. This information plays a pivotal role in facilitating financial decisions, enabling the provision of credit, crop insurance and establishment of Minimum Support Price (MSP), as well as identifying regional advantages in crop production (Chand, 2003; Chintapalli and Tang, 2022). These efforts aim to enhance farmers' productivity and income, ultimately contributing to the overall growth and development of the farming community.

METHODOLOGY

Data Collection

The study is based on data gathered from secondary sources obtained from the official websites of the Commission for Agricultural Costs and Prices (CACP), Ministry of Agriculture and Farmers Welfare, Government of India (GoI) and Karnataka Agricultural Price Commission (KAPC), Department of Agriculture, Government of Karnataka (GoK). The data pertains to cost of cultivation and cost of production were calculated using a combination of comprehensive plot-level summary data from CACP and extensive data from KAPC, for the period 2019-20. The crops included in the study were classified into major crop groups, adhering to the standardized categorization system implemented by the Directorate of Economics and Statistics (DES), Karnataka (Kumar and Gajanana, 2023). The major crop groups selected for the research encompass pulse crops (redgram and bengal gram).

Analytical Techniques

The collected data were analysed by working out the cost of cultivation and cost of production on per hectare and per quintal basis for pulse crops in both the methods. The present study employed various techniques to assess different cost concepts for the cost of cultivation and cost of production using cost accounting and survey methods of cost estimation during the period 2019-20. The various cost components including fixed, variable and total cost were computed for the selected crops. In order to determine MSP, CACP considers two approaches for calculating the cost of production before announcement of MSP. The first method involves considering all variable costs (A_2) and adding family labour (FL) to it. The second method includes adding the cost of imputed rent and interest on owned land to A_2+FL (referred to as Cost C_2 or Swaminathan recommendation).

Cost of Cultivation and Cost of Production

The term Cost of Cultivation (CoC) and Cost of Production (CoP) is used for the purpose of cost concept study. However, distinction can be made between them (Agarwal *et al*., 2018 and Meena *et al*., 2016).

Cost of Cultivation : It includes operational costs, material costs and other costs in crop production. The operational costs include cost of hiring human labour, machine power, bullock charges at the prevailing rate at that particular period in the study area.

Cost of Production : Cost of production is worked out as cost per unit of production.

$$\text{Cost of production (per quintal)} = \frac{\text{Cost of cultivation/(Rs./ha)}}{\text{Cost of main product/(q./ha)}}$$

The Structure of Different Costs and their Components

Cost A_1 includes,

(i) Value of hired human labour

(ii) Value of hired bullock labour

(iii) Value of owned bullock labour
(iv) Value of owned machine labour
(v) Value of hired machine labour
(vi) Hired machinery charges
(vii) Value of seed (both farms produced & purchased)
(viii) Value of insecticides and pesticides
(ix) Value of manure (owned and purchased)
(x) Value of fertilizers
(xi) Irrigation charges
(xii) Depreciation on implements and farm buildings
(xiii) Land revenue cesses and other taxes
(xiv) Interest on working capital
(xv) Miscellaneous expenses

Cost A_2 = Cost A_1 + rent paid for leased in-land

Cost B_1 = Cost A_1 + interest on value of owned fixed capital assets (excluding land)

Cost B_2 = Cost B_1 + rental value of owned land and rent paid for leased-in land

Cost C_1 = Cost B_1 + imputed value of family labour

Cost C_2 = Cost B_2 + imputed value of family labour

Cost C_3 = Cost C_2* + value of management input at 10 per cent of total cost (C_2*)

Translog Cost Function

For minimization of total cost, *C*, subject to a production function, there exists a corresponding minimum cost function, *C**, which may be written as per Equation (1):

$$C^* = f\,(Q, p_i, \dots\dots\dots, p_n) \quad \text{..........................(1)}$$

Where,

Q - Total output

pi - Input prices

The translog version of the cost function is considered as one of the general functions for approximation of production and cost relationship in agriculture. The price elasticity of factor demand simulates the response of input used to the changes in its prices. These elasticities were estimated by fitting the translog (transcendental logarithmic) cost function (Kumar *et al.,* 2010 and Srivastava *et al*., 2017). The translog functional form captures many of the attributes of a cost function that are implied by the economic theory. The logarithmic Taylor series expansion of this function can be written as equation (2):

$$in\ c(w,y) = \alpha_0 + \textstyle\sum_{i-1}^{N} \alpha_i\, ln\, w_i + \alpha_y\, ln\, y + \tfrac{1}{2} \textstyle\sum_{i-1}^{N} \textstyle\sum_{j-1}^{N} \alpha_{ij}\, ln\, w_i\, ln\, w_j + \tfrac{1}{2}\, \alpha_{yy} (ln\, y)^2 + \textstyle\sum_{i-1}^{N} \alpha_{ij}\, ln\, w_i\, ln\, y \quad \text{.........(2)}$$

Where,

ln c (w, y) - Cost of producing a certain level of output *y* using inputs *w*

w - Vector of prices for the inputs to production

y - Single output

N - Total number of inputs

α - Parameters of the function

(where *wi* represents the quantity of input *i* used and ln denotes the natural logarithm)

α_0 - Constant term

α_i - Cost elasticity of input *i* with respect to its own quantity

α_y - Cost elasticity of output *y*

α_{ij} - Cross-elasticity of costs between inputs *i* and *j*

α_{yy} - Curvature of the cost function with respect to output *y*

α_{iy} - Cross-elasticity of costs between input *i* and output *y*

Shepherd's lemma

First derivative of equation with respect to logarithms of the input factor prices are equal to the respective input share in the total cost. While it is possible to include terms to account for technological progress, the specification used here assumes that cost is independent of time. Using Shepherd's lemma, the derived demand equations are,

$$S_i = a_i + a_{iy} lny + \textstyle\sum_{j=1}^{N} a_{ij} lnw_j \quad \text{................(3)}$$

Where,

$S_i = \frac{w_i x_i}{c}$ is the cost share of the i[th] nput

The cost function is assumed to be continuous, so Young's Theorem concerning symmetry of the second derivatives restricts,

Homogeneity of the first degree implies,

$$\sum_{i=1}^{N} \alpha_i = 1, \sum_{j=1}^{N} \alpha_{ij} = 0, \sum_{i=1}^{N} \alpha_{iy} = 0 \text{ for all } i \text{ and } j$$

It is also possible to impose constant ret to scale - equivalent to imposing homogeneity in y-and details of this procedure can be found in Diewert and Wales (1987). The global concavity can also be imposed on this specification by forcing the matrix (a_{ij}) to be negative semi definite.

The elasticities of substitution are given by,

$$\sigma_{ii} = \frac{\alpha_{ii} + s_i^{\,2} - s_i}{s_i^{\,2}}$$

$$\sigma_{ij} = \frac{\alpha_{ij} + s_i s_j}{s_i s_j} \quad j \neq j$$

The price elasticities (own and cross) are given by,

$$\eta_{ij} - \sigma_{ij} s_j$$

Results and Discussion

The comparison of cost of cultivation of redgram and bengal gram using cost accounting method and survey method is presented in Table 1 and Table 2, respectively. There was a notable percentage difference in various cost components between both the methods. The total labour cost according to the survey method was Rs.23,360 per hectare higher than the cost accounting method (Rs.22,022/ha) with a percentage difference of 5.73 per cent over cost accounting method in redgram. Among the different labour components, the cost of human labour was comparatively higher in both the methods compared to machine and bullock labour. The total cost for inputs was lower in cost accounting method (Rs.6,536/ha) compared to survey method (Rs.13,134/ha) with a percentage change of 50.24 per cent over cost accounting method. Off the different input costs, the survey method reported a higher cost with respect to manure, seeds, fertilizers and plant protection chemicals. The total variable cost in survey method was Rs.40,034 per hectare which is higher than cost accounting method with Rs.30,947 per hectare. This was mainly due to higher expenditure incurred on plant protection chemicals, Farm Yard Manure (FYM) and seeds in survey method over cost accounting method. Similar results observed were also with respect to fixed costs with a percentage difference of 39.42 per cent. The survey method reported Rs.20,204 per hectare compared to Rs.12,240 per hectare in cost accounting method. The total cost of cultivation was higher in survey method (Rs.60,238/ha) compared to cost accounting method (Rs.43,187/ha) with a percentage difference of 28.31per cent in survey method over cost accounting method.

Similarly, in bengal gram, the labour cost was found higher in survey method (Rs.25,264/ha), compared to cost accounting method (Rs.18,523/ha). The percentage difference in survey method over cost accounting method was 26.68 per cent. These differences could be attributed to higher expenditure incurred on human labour followed by machine labour and animal labour. In case of inputs, survey method showed significantly higher total input costs, especially in manures, fertilizers and plant protection chemicals, which may vary across different geographical locations. The total variable cost in the survey method (Rs.41,521/ha**)** was higher compared to cost accounting method (Rs.28,252/ha). These differences were mainly due to discrepancies in both labour and input costs. In overall, survey method reported a much higher total cost of Rs.54,567 per hectare as compared to Rs.42,296 per hectare in cost accounting method. The similar results are in line with the study conducted by Swamy *et al.* (2020) on the comparative estimation of cost of cultivation of crops reported that among different inputs, highest growth rate was found in machine labour mainly due to a shortage of labour and the increased use of machinery in agriculture. The challenging financial situation of

TABLE 1

Comparison of cost of cultivation for redgram using cost accounting and survey method

(Rs. /ha)

Particulars	Cost accounting Method		Survey Method		Absolute difference	% difference
	Mean	Standard Error	Mean	Standard Error		
Labour	**22022**		**23360**		**-1337.95**	**-5.73**
Human Labour (Rs.)	9369	554.38	11289	180.54	-1919.94	-17.01
Human Labour (hrs.)	295	17.98	436	0.81	-140.89	-32.31
Animal Labour (Rs.)	6217	551.12	3181	53.27	3035.47	95.42
Animal Labour (hrs.)	33	2.14	25	0.04	8.97	36.63
Machine Labour (Rs.)	6436	375.68	8890	57.21	-2453.47	-27.60
Machine Labour (hrs.)	28	2.41	15	0.05	12.92	86.74
Inputs	**6536**		**13134**		**-6597.87**	**-50.24**
Manure (FYM) (Rs.)	138	63.82	2925	8.60	-2787.76	-95.30
Manure (FYM) (q)	1	0.33	1	0.11	-0.40	-35.57
Seeds (Rs.)	978	60.13	1138	158.85	-160.67	-14.12
Seeds (Kgs.)	13	0.36	12	0.06	0.73	5.94
Fertilizer (Rs.)	3345	158.49	3356	40.45	-11.11	-0.33
Fertilizer (Kgs.)	89	4.47	148	2.03	-59.25	-40.00
Plant protection chemical (Rs.)	2076	149.45	5714	30.26	-3638.34	-63.67
Interest on working capital	2142		2737		-595.19	-21.75
Miscellaneous cost/ Marketing expenses (Rs.)	247	19.42	803	12.49	-556.06	-69.24
Irrigation charges	0	0.00	0	0.00	0.00	
Variable Cost (Rs.)	**30947**	911.46	**40034**	275.17	**-9087.07**	**-22.70**
Crop Insurance (Rs.)	0	0.00	840	3.46	-839.80	-100.00
Land Revenue (Rs.)	11	0.55	49	2.20	-38.28	-77.50
Depreciation (Rs.)	2417	395.82	117	2.25	2300.50	1969.08
Rental value of land (Rs.)	8699	539.10	16953	156.40	-8253.71	-48.69
Interest on fixed capital	1113		2245		-1132.10	-50.43
Fixed Cost (Rs.)	**12240**	615.38	**20204**	42.05	**-7963.40**	**-39.42**
Total Cost (Rs.)	**43187**	1299.36	**60238**	317.15	**-17050.47**	**-28.31**
Output						
Main Product (Rs.)	34200	2236.56	67812	612.77	-33612.11	-49.57
Main Product (q)	7	0.41	11	0.10	-4.15	-36.91
By-Product (Rs.)	1534	95.78	0	29.10	1533.73	
Return						
Gross return (Rs.)	35733	2354.87	67812	625.07	-32078.38	-47.31
Net returns (Rs.)	-7454		7574		-15027.92	-198.42
Cost of Production (Rs. /q)	6091		5360		731.17	13.64

Note: *Interest on working capital - Cost Accounting method (crop growth period) & Survey method (7.5%)
*Interest on fixed capital - Cost Accounting method (10%) & Survey method (12.5%)

TABLE 2

Comparison of cost of cultivation for bengal gram using cost accounting and survey method

(Rs. /ha)

Particulars	Cost accounting Method		Survey Method		Absolute difference	% difference
	Mean	Standard Error	Mean	Standard Error		
Labour	**18523**		**25264**		**-6740.96**	**-26.68**
Human Labour (Rs.)	10250	633.99	14632	184.91	-4382.10	-29.95
Human Labour (hrs.)	330	20.20	557	0.86	-226.72	-40.72
Animal Labour (Rs.)	2825	439.64	2978	62.41	-152.54	-5.12
Animal Labour (hrs.)	13	1.62	21	0.07	-7.72	-36.87
Machine Labour (Rs.)	5447	330.31	7654	55.26	-2206.32	-28.83
Machine Labour (hrs.)	36	4.55	14	0.05	22.59	162.44
Inputs	**7629**		**12437**		**-4808.21**	**-38.66**
Manure (FYM) (Rs.)	0	0.00	3977	72.44	-3977.14	-100.00
Manure (FYM) (q)	0	0.00	2	0.61	-1.63	-100.00
Seeds (Rs.)	3361	133.27	3239	222.30	122.16	3.77
Seeds (Kgs.)	66	2.43	61	0.08	4.65	7.62
Fertilizer (Rs.)	2663	160.53	3413	38.94	-749.73	-21.97
Fertilizer (Kgs.)	61	3.78	156	2.51	-95.35	-60.95
Plant protection chemical (Rs.)	1604	133.49	1808	22.94	-203.50	-11.26
Interest on working capital	1961		2828	44.72	-866.19	-30.63
Miscellaneous cost/ Marketing expenses (Rs.)	138	11.35	993	5.12	-855.14	-86.14
Irrigation charges	1	1.23	0.00	0.00	1.23	0.00
Variable Cost (Rs.)	**28252**	**980.82**	**41521**	**440.04**	**-13269.27**	**-31.96**
Crop Insurance (Rs.)	0	0.00	605	2.60	-605.15	-100.00
Land Revenue (Rs.)	8	1.27	49	1.89	-41.54	-84.10
Depreciation (Rs.)	4744	992.17	213	3.11	4531.32	2131.70
Rental value of land (Rs.)	8016	404.86	10730	160.87	-2713.98	-25.29
Interest on fixed capital	1277		1450		-172.85	-11.92
Fixed Cost (Rs.)	**14044**	992.96	**13046**	66.72	**997.80**	**7.65**
Total Cost (Rs.)	**42296**	1625.06	**54567**	506.73	**-12271.47**	**-22.49**
Output						
Main Product (Rs.)	32903	1657.78	42918	642.73	-10014.72	-23.33
Main Product (q)	8	0.39	11	0.14	-3.02	-27.32
By-Product (Rs.)	1587	62.50	0	0.00	1586.66	0.00
Return						
Gross return (Rs.)	34490	1720.28	42918	642.73	-8428.06	-19.64
Net returns (Rs.)	-7805		-11649		3843.42	-32.99
Cost of Production (Rs. /q)	5271		4942		328.74	6.65

Note: *Interest on working capital - Cost Accounting method (crop growth period) & Survey method (7.5%)
*Interest on fixed capital - Cost Accounting method (10%) & Survey method (12.5%)

many farmers, who heavily rely on borrowed funds to embrace modern technology for higher productivity. However, agriculture remains highly vulnerable to unfavourable weather and climatic factors, emphasizing the need for robust cost estimation methods to aid farmers in decision-making (Table 2).

It is evident from Table 3 and Table 4, that the cost of cultivation of redgram considering cost C_3 was higher in survey method (Rs.69273.63/ha) compared to cost accounting method (Rs.47506.22/ha). The percentage difference in cost of cultivation of redgram between both the methods was 23.89 per cent. Similarly, the cost of cultivation considering cost A_2+FL was higher in survey method Rs.57153.27 per hectare compared to Rs.42074.71 per hectare in cost accounting method. In bengal gram the cost of cultivation computed considering cost C_3 was higher in survey method (Rs.62752.03/ha) compared to cost accounting method (Rs.46525.06/ha). The percentage difference in cost of cultivation between both the methods was 16.46 per cent. Similarly, the cost of cultivation considering cost A_2+FL was higher in survey method (Rs.52512.25/ha) compared to cost accounting method (Rs.41018.78/ha). Notably, the utilization of manure, fertilizers, and plant protection plant protection

TABLE 3

Comparison of cost of cultivation and cost of production between cost accounting method and survey method for redgram

Redgram	Cost of Cultivation (Rs. /ha)				Cost of Production (Rs. /q)			
	Cost accounting Method	Survey method	Absolute difference	% difference	Cost accounting Method	Survey method	Absolute difference	% difference
Cost A_1	28455.65	37310.29	-8854.64	-23.73	4013.37	3319.86	693.50	20.89
Cost A_2	37154.86	54263.21	-17108.35	-31.53	5240.30	4828.33	411.97	8.53
Cost B_1	28698.49	38275.84	-9577.35	-25.02	4047.62	3405.78	641.84	18.85
Cost B_2	38267.62	57347.88	-19080.26	-33.27	5397.24	5102.81	294.44	5.77
Cost C_1	33618.34	41165.91	-7547.56	-18.33	4741.51	3662.94	1078.58	29.45
Cost C_2	43187.47	60237.94	-17050.47	-28.31	6091.14	5359.96	731.17	13.64
Cost C_3	47506.22	69273.63	-21767.41	-31.42	6700.25	6163.96	536.29	8.70
Cost A_2+FL	42074.71	57153.27	-15078.56	-26.38	5934.19	5085.49	848.70	16.69

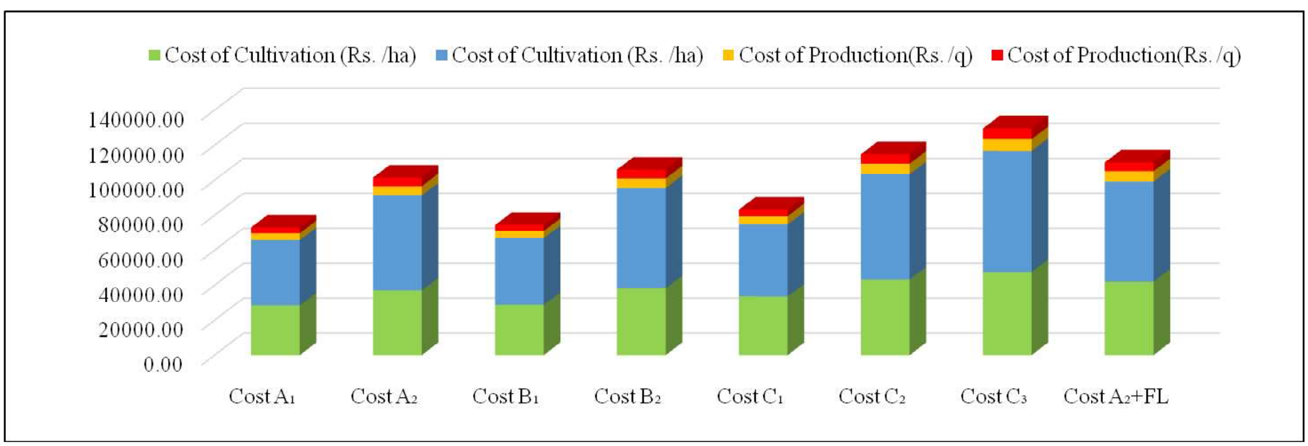

Fig. 1: Comparison of cost differences in redgram using cost accounting and survey method

TABLE 4

Comparison of cost of cultivation and cost of production between cost accounting method and survey method for bengal gram

Bengal gram	Cost of Cultivation (Rs. /ha)				Cost of Production (Rs. /q)			
	Cost accounting Method	Survey method	Absolute difference	% difference	Cost accounting Method	Survey method	Absolute difference	% difference
Cost A_1	27730.56	37972.50	-10241.94	-26.97	3455.87	3439.26	16.61	0.48
Cost A_2	35746.08	48702.01	-12955.92	-26.60	4454.78	4411.05	43.73	0.99
Cost B_1	28205.73	38686.04	-10480.31	-27.09	3515.08	3503.88	11.20	0.32
Cost B_2	37022.81	50756.73	-13733.92	-27.06	4613.89	4597.16	16.74	0.36
Cost C_1	33478.43	42496.29	-9017.86	-21.22	4172.18	3848.99	323.19	8.40
Cost C_2	42295.51	54566.98	-12271.47	-22.49	5270.99	4942.26	328.74	6.65
Cost C_3	46525.06	62752.03	-16226.97	-25.86	5798.09	5683.60	114.50	2.01
Cost A_2+FL	41018.78	52512.25	-11493.47	-21.89	5111.88	4756.16	355.73	7.48

chemicals emerges as the principal variable components contributing to the increased costs observed in the survey method.

The cost of production considering cost C_3 as well A_2+FL was higher in cost accounting method compared to survey method in both redgram and bengal gram. The percentage difference in cost of production for redgram between both the methods considering cost C_3 and A_2+FL was 8.70 and 16.69 per cent, respectively. For bengal gram, the percentage difference in cost of production between both the methods considering cost C_3 and A_2+FL was 2.01 and 7.48 per cent, respectively. The lower cost of production in survey method was mainly due to higher yields from both redgram and bengal gram compared to yield levels obtained in cost accounting method. These findings clearly illustrated that the cost accounting method generally results in lower costs compared to the survey method when estimating the expenses associated with cultivation of redgram and bengal gram.These findings are in line with the study conducted by Kumar and Kumar (2017) and reported that on an average total cost of cultivation (Cost C_2) of redgram was Rs.38,685 per hectare in the study area. The concerned departments may recommend the suitable crop planning in the respective zones (Murali and Khan, 2022). As the increase in cost of production is mainly due to increase in prices of inputs, the government should come out with clear polices that stabilizes the prices of the inputs and encourage the farmers to continue in cultivation of these important crops (Hamsa *et al*., 2017).

Derived Estimates of Own and Cross-price Elasticities of Input Demand for Pulses

The parameters of the share equation were assessed based on the values they yield for the elasticity of factor demand and elasticity of substitution for pulses in Karnataka. Input demand elasticity estimates concerning own and cross prices were calculated for human labour, machine labour and fertilizers and the matrix of input demand elasticity is presented in Table 5 and 6.

The estimates of both own-price elasticities and cross-price elasticities of input demand for redgram and bengal gram production interpreted how changes in the prices of inputs (human labour, fertilizer, and machine labour) and the output affect the demand for these inputs. A positive value indicated that a one per cent increase in the price of human labour resulted in a 0.335 per cent increase in the demand for human labour implying that human labour was an elastic input in redgram cultivation, which means that when the wage for human labour increases, farmers respond by increasing their usage of human labour and readily in

TABLE 5

Derived estimates of own and cross-price elasticities of input demand for redgram

Factor share	Prices of inputs (2019-20)			
	Human labour	Fertiliser	Machine labour	Output
Human labour	0.335	-0.126	-0.223	0.228
Fertiliser	-1.227	-1.163	2.391	0.259
Machine labour	-1.492	1.490	0.105	-0.649

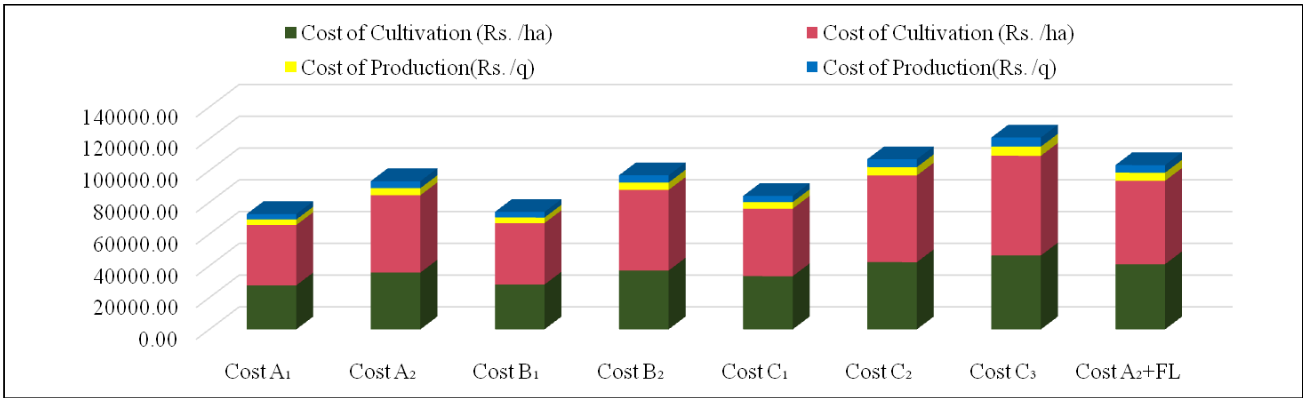

Fig. 2: Comparison of cost differences in bengal gram using cost accounting and survey method

TABLE 6

Derived estimates of own and cross-price elasticities of input demand for bengal gram

Factor share	Prices of inputs (2019-20)			
	Human labour	Fertiliser	Machine labour	Output
Human labour	0.874	-0.211	-0.662	0.395
Fertiliser	-0.372	-0.311	0.682	0.155
Machine labour	-3.141	1.862	1.260	0.279

the production. Similarly, increase in the price of machine labour led to 0.105 per cent increase in the demand for machine labour which was a relatively elastic input and cost increase had a limited impact on its usage. Whereas, negative value indicated that a one per cent increase in the price of fertilizer led to a substantial decrease in the demand for fertilizer by 1.163 per cent in redgram production. Fertilizer was inelastic, showed that in its price increase significantly reduced its usage and farmers were less responsive to changes in fertilizer prices to enhance the yields. The inelastic substitution between labour and machine along with inelastic demand for labour appropriately explained why the share of labour in the cost of cultivation has increased over the years in the study area. The relationship between all three inputs, such as complementarity and substitutability, which can be vital for understanding input allocation and decision-making in redgram cultivation. The substitution relationship was exhibited between human labour with fertilizer and with machine labour indicated that increase in the price of fertilizer and machine labour resulted in the decrease in the demand for human labour. Whereas, machine labour with fertilizer showed complementary relationship which means increase in the price of human labour led to a substantial decrease in the demand for fertiliser in redgram production.

A positive cross-price elasticity with human labour and output was 0.228 per cent which means the cost of human labour was increased, farmers responded by increasing their demand for human labour to produce more output. Similarly, the price of fertilizer led to 0.259 per cent increase in the demand for output of redgram. A negative cross-price elasticity of -0.649 for machine labour was substitutable input in the redgram production meaning that when the cost of machine labour increased, farmers reduced their demand for it and may opted for other inputs to obtain the same output. These results were similar to the study conducted by Choudhary *et al.* (2022) in which authors reported that the factor substitution between technically feasible inputs like labour and machinery was another well-acknowledged method of cost control. Price inelasticity of factors also indicated that policies for controlling input price inflation would be imperative in reducing the cost of cultivation of crops.

The own-price elasticity for bengal gram production revealed that human labour was an elastic and readily substitutable input, while fertilizer was relatively inelastic, machine labour was highly inelastic, indicated its unique importance in the production of bengal gram and the significant impact of changes in machine labour costs. The positive own-price elasticity for human labour and machine labour was 0.874 and 1.260 per cent, respectively indicated that increase in the price of human labour and machine labour led to an increase in the demand for bengal gram. It was mainly due to the positive elasticity where human labour is readily substitutable or that farmers are willing to adjust their labour usage in response to wage rate changes. This may reflect the flexibility in labour usage in response to wage rate changes and the adaptability of labour resources in bengal gram cultivation. Similarly, when the price of machine labour increased, farmers significantly increased their demand for it mainly due to mechanized equipment which played a vital role in enhancing efficiency and productivity in bengal gram. Farmers readily adjusted their usage of machine labour to optimize their production and its substitutability with other inputs when it became cost-effective (Table 6).

The negative own-price elasticity for fertilizer was 0.311 per cent which led to a decrease in the demand for fertilizer and was a relatively inelastic input. The farmers were less responsive to changes in fertilizer prices. Even when fertilizer price rise, the demand for fertilizer decreases, but to a relatively lesser extent. This suggested that fertilizer may be considered an essential input in bengal gram cultivation, and may be reluctant to significantly reduce its usage, regardless of price changes. The positive own-price elasticities for all three inputs (human labour, fertilizer, and machine labour) with respect to output indicated that these inputs were complementary and essential for bengal gram cultivation. Increased prices of these inputs led to higher demand and consequently resulted

TABLE 7

Impact of factor and product prices on profit of redgram

Redgram	Growth in the unit prices of factor/product			Elasticity	Contribution to supply (%)
Factor/Product	2015-16	2019-20	%		
Output	6.02	7.14	0.19	-0.65	-0.12
Labour	31.20	32.27	0.03	0.34	0.01
Fertiliser	37.64	38.97	0.04	-1.16	-0.04
Machine labour	227.15	268.46	0.18	0.10	0.02
Net effect					-0.13

in increased bengal gram output. The elasticity for human labour (0.395%), fertiliser (0.15%) and machine labour (0.279%) suggested that a one per cent increase in the price of all these inputs resulted in a positive increase in the demand for bengal gram. The positive elasticity suggested that all the inputs played a significant role in increasing the yield. As the prices increased, the farmers were chosen to use more inputs to enhance production.

During the period from 2015-16 to 2019-20, the significant changes in factor and product prices impacted the overall profitability of redgram and the respective results are presented in Table 7. The unit price of output was increased from 6.02 to 7.14, representing a substantial growth (0.19%) and displayed a negative elasticity of -0.65. This negative elasticity suggested that despite the increase in output prices, redgram supply decreased by 0.12 per cent, which had an unfavourable effect on profit. Similarly, labour costs (0.03%) experienced a minor increase, with a positive elasticity of 0.34. This small increase in labour cost positively affected labour supply and contributed minimally to profit. Fertilizer price was increased by 0.04 per cent, with the negative elasticity of -1.16 indicated a more significant negative impact on fertilizer supply, resulted in decrease of profit (- 0.04%). Machine labour cost was increased by 0.18 per cent, with positive elasticity (0.10), meaning that the machine labour supply remained relatively stable and had contributed to a positive impact on profit. The net effect, represented by -0.13,highlighted that the influence of these factors and product price changes resulted in a slight decrease in profit for redgram cultivation. The sensitivity of agricultural profitability to changes in input and output prices highlights the need for strategies to mitigate adverse effects and harness positive ones to ensure economic sustainability. In redgram, despite the increase in output prices, the negative elasticity and a slight decrease in supply indicated that market dynamics and other factors may have influenced the overall profitability. Fluctuating demand and supply in the market, possibly influenced by external factors such as consumer preferences, market competition, or weather-related issues, could have limited farmers' ability to fully capitalize on the price increase.

The results for bengal gram cultivation revealed a combination of growth in the factors and product price changes that impacted profitability of crop as represented in the Table 8. The unit prices of output increased by 68 per cent followed by labour (14%), fertiliser (14%) and machine labour (31%) during 2019-20. The positive elasticity was observed for all the factors except for fertiliser (-0.31) with negative elasticity. This has resulted in limited adverse impact on the fertilizer supply. However, the magnitude of this negative contribution to profit was relatively small. However, the increase in output prices, human labour and machine labour costs had a substantial positive impact profit of bengal gram. The net effect was found to be positive *i.e.,* 0.66 indicated that the significant positive impact of higher output and machine labour prices, farmers were likely optimized their labour usage combined with the efficient management of machine labour costs, played a pivotal role in driving the overall increase in profit.

TABLE 8

Impact of factor and product prices on profit of bengal gram

Bengal gram	Growth in the unit prices of factor/product			Elasticity	Contribution to supply (%)
Factor/Product	2015-16	2019-20	%		
Output	5.11	8.56	0.68	0.28	0.19
Labour	27.57	31.34	0.14	0.87	0.12
Fertiliser	39.69	45.05	0.14	-0.31	-0.04
Machine labour	195.27	256.42	0.31	1.26	0.39
Net effect					0.66

The present study analyses the difference between the cost accounting and survey method in terms of cost estimation for selected crops in computing cost of cultivation and production. Among pulses, it becomes apparent that cost accounting method consistently resulted in lower cost compared to survey method across different cost concepts for redgram and bengal gram in the study. The discrepancy was mainly attributed to higher usage of FYM, fertiliser and plant protection chemicals whose usage was higher in survey method compared to cost accounting method. In addition, differences in geographic locations, sample farmers selection bias, variation in input prices led to differences in cost of cultivation as well as production. These differences hold substantial implications for farmers and policymakers, affecting decision-making in crop selection, pricing, profitability and investment in future. Addressing these disparities becomes crucial to ensure accurate cost estimation and informed agricultural decision-making. A strategic price policy, driven by understanding input-output dynamics and technological shifts, particularly in pulses, aids in formulating effective MSP policy. The formulation of MSP policy for pulses relies on understanding their input demand, output supply, and technological shifts. This comprehension of demand elasticity aids in predicting future demand scenarios and determining crop prices. The Government's focus on providing remunerative MSPs aims to enhance production and ensure profitability for farmers. This study provides empirical evidence on factors impacting crop prices, utilizing translog cost model to estimate elasticities, guides policymakers in setting MSPs, ensuring fairness and sustainability in agriculture. Stabilizing crucial input prices like fertilizers, pesticides, labour, and farm machinery becomes imperative to manage production costs. Appropriate cost estimation not only facilitates targeted government subsidies but also supports the effective implementation of output subsidies to increase the growth of agriculture. This approach incentivizes increased production playing a pivotal role in advancing sectors both within the state and the country. Prioritizing the integration of output subsidies with precise cost estimation allows policymakers establish a comprehensive framework for agricultural development and directly link support to output to empower farmers to enhance productivity, efficiency and profitability in the selected crops.

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