

RESEARCH PAPER

Trends in Input-Output Relation and Structural Changes in Input Cost of Major Crops in West Bengal

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ABSTRACT

The structural change of input cost refers to the change in the intensity of labour and capital (seed, fertilizers, pesticides, machineries etc.) used in agriculture. An attempt has been made to analyse the structural changes of input cost along with the trends in input-output relation of the three major crops (paddy, jute and potato) in West Bengal during 1999-00 to 2019-20 by using data of the Cost of Cultivation of Principal crops in India, Directorate of Economics & Statistics (DES), Ministry of Agriculture and Farmers Welfare, Government of India. It is found that the structural intensity of input cost shifts towards a more capital-intensive direction during 1999-00 to 2009-10, but then the situation is reversed to more labour-intensive in terms of input cost during 2009-10 to 2019-20. To investigate the reasons, the study found that the higher labour cost is the main reason for this. Though the physical unit of labour per hectare decreased during the second phase (2009-10 to 2019-20), the high wage rate increased the share of labour cost and the total cost of cultivation. In the trend of the input-output relation of the state's agricultural production, the study observed a decline in the input-output ratio (profitability from cultivation) for the crop paddy and jute, but it increased for the potato. The higher growth of input cost over output price during reference periods is the main reason for the decline in profitability of the crops in West Bengal.

HIGHLIGHTS

- ① There is structural shift of input cost of three major crops (paddy, jute and potato) from labour intensity to capital-intensity during first phase (1999-00 to 2009-10) but during second phase (2009-10 to 2019-20), there is shift from capital intensity to labour-intensity.
- ② The input output ratio (profitability) of crops paddy and jute declines, but it increases for the crop potato during the reference periods.

Keywords: CAGR, Capital-Intensive, Cost of Cultivation, Input-Output Relation, Labour-Intensive

West Bengal adopted new techniques of production since mid-1980s to increase agricultural production in crop production. The state ranked first in rice (13.36 % of total production in India) and jute (81.68 % of the total production of India) production and second highest in potato (25.87 % of the total production of India) production among the states of India (Government of India, 2022). In the structural dimension of the Indian economy, the agrarian sector is the most labour-intensive and absorbs the more labour than the manufacturing and the service sectors. In the process of economic development, the

labour share in each sector will decline (Basu *et al.* 2021) and will shift towards more capital-intensive techniques for an economy. The decline of labour share for an economy also affects the structure of agricultural input. As a result, the structure of agricultural input changes, and would like to employ of more capital in production.

The costs for the input in agricultural production

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called the cost of cultivation incurred by the farmers with an expectation of a positive return, further lead to driven investment to another production and maintain the production cycle in agriculture. The rate of growth of any crop production mainly depends on the parallel growth of profitability over the cost of cultivation (Rahman and Bee, 2019). The net earnings are determined by the amount of input-output from agriculture and also vary by the input and output relation. Henceforth it is imperative to understand both the pattern of structural changes of inputs and profitability in agriculture. An attempt has been made to examine the structural changes of input combination in the production system and the input-output relation in agriculture of West Bengal.

METHODOLOGY

This study is based on secondary data i.e., various Government reports, existing literature etc. To examine the structural change of input combinations in production system this study used the cost of cultivation data of three major crops paddy, jute, and potato taken from the Cost of Cultivation of Principal crops in India, Directorate of Economics & Statistics (DES), Ministry of Agriculture and Farmers' Welfare, Government of India, for the years 1999-2000, 2009-10 and 2019-20.

To show the growth rate of input costs and output prices of three major crops (paddy, jute and potato), the compound annual growth rate (CAGR) has been calculated by using the following formula:

CAGR in percentage =

$$\left(\left(\frac{\text{End Year Value}}{\text{Beginning Year Value}} \right)^{1/n} - 1 \right) \times 100$$

To show the profitability i.e., the output return per one rupee investment on input. The input-output ratio (I-O ratio) has been calculated by using the following formula:

$$\text{I-O Ratio} = \frac{\sum \text{Total Output Value}}{\sum \text{Total Input Cost}}$$

Thus I-O ratio is actually indicating the return from cultivation from per unit of investment as input cost. Higher the value of I-O ratio implies the higher return from the cultivation process.

Again, the study also decomposes the total cost C_2 into paid-out cost and total imputed cost to compare the I-O ratio and its trend between cost C_2 and paid-out cost of the three major crops, where, the paid-out cost indicates the actual cost borne in terms of money value by the farmers and the imputed cost is the farmers own assets' opportunity cost actually incurred by farmers.

RESULTS AND DISCUSSION

Trends in the Costs of Cultivation

Under Commission for Agricultural Costs & Prices (CACP), all the physical input costs are incorporated for the total operational costs along with some fixed costs consisting of the imputed cost like the rental value of own land, cost for leased in, land revenue taxes or cesses, depreciation of equipment of the farming and the interest on fixed capital used in the production. The operational cost consists of the labour costs (including human and animal labour) and the capital costs (total operational costs other than human and animal labour). All the cost components (physical input costs + imputed costs) compositely are called the C_2 in the cost of cultivation approach given by Commission for Agricultural Costs & Prices (CACP).

Table 1 shows the trends of CAGR of the various input cost of the paddy crop. The CAGR of total cost of paddy increases from 6.45 percent during 1999-00 to 2009-10 to 8.21 percent during 2009-10 to 2019-20. By comparing the total operational cost with the total fixed cost of the paddy, it is found that the CAGR of total operational cost of paddy (7.93 percent) is higher than the CAGR of the total fixed cost, (5.68 percent) during 1999-00 to 2019-20. One of the important reasons behind the lower growth rate of the fixed cost is the lower growth rate of the rental value of owned land during the periods for the crop paddy. The rental value of owned land is the imputed value of rent for the land for cultivation, which contributes to the major part of the fixed cost for cultivation. However, over periods, the share of the rental value of land decreases because the preference for crop cultivation has shifted from food grains to cash crops for higher profit, leading to decrease the share of food grains crops like paddy. Table 1 also shows that all cost components increased from 1999-00 to 2019-20, along with the

Table 1: Compound Annual Growth Rate (CAGR) of Input Cost of Paddy (Per Hectare) during 1999-00 to 2019-20

Cost Structures	Cost Component (Per Hectare)	Years			CAGR (%)		
		1999-00 (%)	2009-10 (%)	2019-20 (%)	1999-00 to 2009-10	2009-10 to 2019-20	1999-00 to 2019-20
Labour Cost (₹)	Human Labour	8453.64 (41.44)	16106.16 (42.26)	42807.14 (51.03)	6.66	10.27	8.45
	Animal Labour	1410.44 (6.91)	1729.88 (4.54)	1852.20 (2.21)	2.06	0.69	1.37
Capital Cost (₹)	Machine Labour	436.88 (2.14)	1403.84 (3.68)	7059.49 (8.42)	12.38	17.53	14.93
	Seed	732.15 (3.59)	1030.89 (2.70)	2539.75 (3.03)	3.48	9.44	6.42
	Fertilizer and Manure	1747.96 (8.57)	3189.55 (8.37)	6228.83 (7.43)	6.20	6.92	6.56
	Insecticides	208.84 (1.02)	401.74 (1.05)	1168.25 (1.39)	6.76	11.27	8.99
	Irrigation Charges	827.96 (4.06)	1963.15 (5.15)	1885.15 (2.25)	9.02	-0.40	4.20
	Miscellaneous	11.05 (0.05)	20.88 (0.05)	68.66 (0.08)	6.57	12.64	9.56
	Interest on Working Capital	291.48 (1.43)	550.19 (1.44)	1322.37 (1.58)	6.56	9.17	7.85
Total Operational Cost (₹)		14120.40 (69.22)	26396.28 (69.26)	64931.84 (77.40)	6.46	9.42	7.93
Rental Value of Owned Land (₹)		5105.88 (25.03)	9122.38 (23.94)	15721.14 (18.74)	5.98	5.59	5.78
Rent Paid for Leased-in-Land (₹)		58.11 (0.28)	1120.85 (2.94)	1271.91 (1.52)	34.44	1.27	16.68
Land Revenue, Taxes, Cesses (₹)		15.2 (0.07)	40.13 (0.10)	0.16 (0.00)	10.20	-42.45	-20.36
Depreciation on Implements & Farm Building (₹)		246.30 (1.21)	544.58 (1.43)	740.45 (0.88)	8.26	3.12	5.66
Interest on Fixed Capital (₹)		852.75 (4.18)	887.33 (2.33)	1220.5 (1.46)	0.40	3.24	1.81
Total Fixed Costs (₹)		6278.24 (30.78)	11715.27 (30.74)	18954.16 (22.60)	6.44	4.93	5.68
Total Cost (C ₂) (₹)		20398.64 (100.00)	38111.55 (100.00)	83886.00 (100.00)	6.45	8.21	7.33

Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI.

operational cost except the cost of animal labour and irrigation charges. Among the total operational costs, the growth rate of machine labour is much higher (with a CAGR of 14.93 percent) during the above-mentioned periods as farmers substituted animal labour by machine labour. Comparing the two decades, 1999-00 to 2009-10 and 2009-10 to 2019-20, it is found that all the costs have increased, having a positive percentage of CAGR except the cost of irrigation charges. During 1999-00 to 2009-10, the growth rate of the cost of irrigation charges of paddy increased at CAGR 9.02 percent, whereas in the period 2009-10 to 2019-20, the cost declined. The result may be due to the adoption of modern irrigation facilities like solar energy and for using subsidized agricultural equipment's / machineries etc.

Table 2 shows the trends of structural changes of various inputs of the total cost of cultivation of jute in West Bengal. The table shows that the total cost of jute cultivation increases with a CAGR of 9.07 percent from 1999-00 to 2019-20. Comparing the two decadal periods, the result is the same as paddy,

i.e., the CAGR of the total cost of cultivation of jute during 2009-10 to 2019-20 is higher than the CAGR of the periods 1999-00 to 2009-10. Between the total operational cost and total fixed cost of the jute, it is found quite the same result as noticed for the crop paddy. From table 2, it is found that the operational cost of jute increases with a CAGR of 9.51 per cent during 1999-00 to 2019-20, which is relatively higher than the fixed cost, which increases with the CAGR of 8.06 per cent during 1999-00 to 2019-20. During the periods 1999-00 to 2019-20, all the operational cost components have increased except the cost of animal labour. The growth rate of operational cost of machine labour is highest (with CAGR 18.46 percent) among the other operational cost combinations during the above-mentioned periods. The result is similar like the cost composition of the crop paddy. The main reason is that the animal labour is substituted by the machine labour due to the modernisation in agriculture over the years.

Table 3 depicts the trends of structural changes of various inputs of the total cost of cultivation of potato in West Bengal. It is found that the total

Table 2: Compound Annual Growth Rate (CAGR) of Input Cost of Jute (Per Hectare) during 1999-00 to 2019-20

Cost Structures	Cost Component (Per Hectare)	Years			CAGR (%)		
		1999-00 (%)	2009-10 (%)	2019-20 (%)	1999-00 to 2009-10	2009-10 to 2019-20	1999-00 to 2019-20
Labour Costs (₹)	Human Labour	8512.09 (45.54)	17864.69 (43.73)	58009.75 (54.63)	7.70	12.50	10.07
	Animal Labour	1401.37 (7.50)	2101.07 (5.14)	442.30 (0.42)	4.13	-14.43	-5.60
Capital Costs (₹)	Machine Labour	294.92 (1.58)	1278.27 (3.13)	8739.19 (8.23)	15.80	21.20	18.46
	Seed	384.96 (2.06)	705.45 (1.73)	1072.58 (1.01)	6.24	4.28	5.26
	Fertilizer and Manure	1169.88 (6.26)	2445.57 (5.99)	5307.80 (5.00)	7.65	8.06	7.85
	Insecticides	249.29 (1.33)	185.94 (0.46)	585.66 (0.55)	-2.89	12.16	4.36
	Irrigation Charges	260.63 (1.39)	1257.08 (3.08)	1241.46 (1.17)	17.04	-0.12	8.12
	Miscellaneous	0.00 (0.00)	6.91 (0.02)	9.44 (0.01)	-*	3.17	-*
	Interest on Working Capital	259.79 (1.39)	544.24 (1.33)	1720.66 (1.62)	7.68	12.20	9.91
	Operational Cost (₹)	12532.92 (67.05)	26389.22 (64.60)	77128.84 (72.64)	7.73	11.32	9.51
Rental Value of Owned Land (₹)		5111.15 (27.35)	13054.63 (31.95)	27197.56 (25.62)	9.83	7.62	8.72
Rent Paid for Leased-in-Land (₹)		26.9 (0.14)	12.89 (0.03)	1072.68 (1.01)	-7.09	55.60	20.24
Land Revenue, Taxes, Cesses (₹)		9.47 (0.05)	35.85 (0.09)	0.01 (0.00)	14.24	-55.89	-29.01
Depreciation on Implements & Farm Building (₹)		302.4 (1.62)	403.13 (0.99)	211.79 (0.20)	2.92	-6.23	-1.77
Interest on Fixed Capital (₹)		709.09 (3.79)	955.3 (2.34)	566.24 (0.53)	3.03	-5.10	-1.12
Fixed Costs (₹)		6159.01 (32.95)	14461.80 (35.40)	29048.28 (27.36)	8.91	7.22	8.06
Total Cost (C ₂) (₹)		18691.93 (100.00)	40851.02 (100.00)	106177.12 (100.00)	8.13	10.02	9.07

Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI.

Note: * As the value of miscellaneous component of initial year (1999-00) is zero, the calculation of CAGR is not possible during 1999-00 to 2009-10

Table 3: Compound Annual Growth Rate (CAGR) of Input Cost of Potato (Per Hectare) during 1999-00 to 2019-20

Cost Structures	Cost Component (Per Hectare)	Years			CAGR (%)		
		1999-00 (%)	2009-10 (%)	2019-20 (%)	1999-00 to 2009-10	2009-10 to 2019-20	1999-00 to 2019-20
Labour Costs (₹)	Human Labour	13444.04 (27.61)	16056.31 (18.06)	51716.62 (24.34)	1.79	12.41	6.97
	Animal Labour	1188.92 (2.44)	1711.58 (1.92)	1184.73 (0.56)	3.71	-3.61	-0.02
Capital Costs (₹)	Machine Labour	1383.52 (2.84)	2584.96 (2.91)	9503.20 (4.47)	6.45	13.90	10.11
	Seed	11314.25 (23.24)	30343.55 (34.12)	35255.62 (16.59)	10.37	1.51	5.85
	Fertilizer and Manure	6715.95 (13.79)	10608.94 (11.93)	32620.30 (15.35)	4.68	11.89	8.22
	Insecticides	733.91 (1.51)	955.89 (1.07)	4438.53 (2.09)	2.68	16.60	9.42
	Irrigation Charges	2752.20 (5.65)	3497.86 (3.93)	2292.83 (1.08)	2.43	-4.14	-0.91
	Miscellaneous	28.45 (0.06)	40.58 (0.05)	518.92 (0.24)	3.62	29.03	15.62
	Interest on Working Capital	993.73 (2.04)	1799.27 (2.02)	3274.74 (1.54)	6.12	6.17	6.14
	Operational Cost (₹)	38554.97 (79.19)	67598.94 (76.02)	140805.49 (66.26)	5.78	7.61	6.69
Rental Value of Owned Land (₹)		9427.88 (19.36)	12198.59 (13.72)	70031.19 (32.95)	2.61	19.10	10.55
Rent Paid for Leased-in-Land (₹)		0.00 (0.00)	8112.69 (9.12)	0.00 (0.00)	—	—	—
Land Revenue, Taxes, Cesses (₹)		23.21 (0.05)	22.85 (0.03)	0.21 (0.00)	-0.16	-37.43	-20.96
Depreciation on Implements & Farm Building (₹)		135.70 (0.28)	248.50 (0.28)	861.19 (0.41)	6.24	13.23	9.68
Interest on Fixed Capital (₹)		543.93 (1.12)	738.78 (0.83)	813.25 (0.38)	3.11	0.97	2.03
Fixed Costs (₹)		10130.72 (20.81)	21321.41 (23.98)	71705.84 (33.74)	7.73	12.89	10.28
Total Cost (C ₂) (₹)		48685.69 (100.00)	88920.35 (100.00)	212511.33 (100.00)	6.21	9.10	7.65

Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI

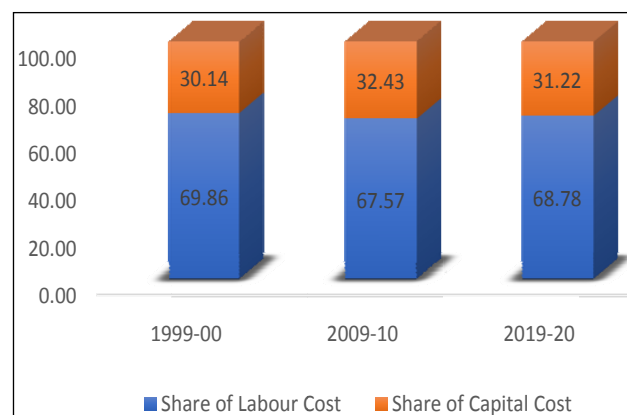
cost of potato cultivation increases with a CAGR of 7.65 percent during 1999-00 to 2019-20. The CAGR (9.10 percent) of total cost of cultivation of potato increases faster during 2009-10 to 2019-20 than the preceding periods 1999-00 to 2009-10 (with a CAGR of 6.21 percent). It is found from the table 3 that the CAGR of fixed cost (10.28 per cent) of potatoes is higher than the growth of operational cost (increases with a CAGR of 6.69 per cent) during the period 1999-00 to 2019-20. This is because of the higher growth rate of the rental value of owned land during the periods for the crop potato. Over the periods, the demand for land for cash crop cultivation increases, leading to increase the rental value for the crop potato (opposite of the crop paddy and jute). From 1999-00 to 2019-20, all the operational cost components have increased except the cost of animal labour and irrigation charges. With the development of agricultural technology over the periods, the animal labour is substituted by the machine labour. The irrigation cost of potato also declines over the reference periods 1999-00 to 2019-20, as found above for the other two crops, paddy and jute.

Structural Changes in Input cost

The changes in input prices or changes in the use of physical units of input over the periods lead to changes in the structural composition of the input cost. With the economic development, there is happened a structural shift in input composition in agricultural sector from labour-intensive to capital-intensive technology. In this section, the study analyses structural changes of input for the three major crops (paddy, jute and potato) production in West Bengal. The labour or capital intensity is measured in terms of the percentage share of labour and capital costs to the total operational cost of crop cultivation.

Fig. 1 depicts the structural changes of input intensity of paddy during 1999-00, 2009-10 and 2019-20. The share of labour cost constituted more than 60 per cent of the total operational cost of cultivation of paddy crops in West Bengal during the study periods. That indicates that the paddy crop production is very labour-intensive. During the periods from 1999-00 to 2009-10, a shift is found toward capital-intensive production method

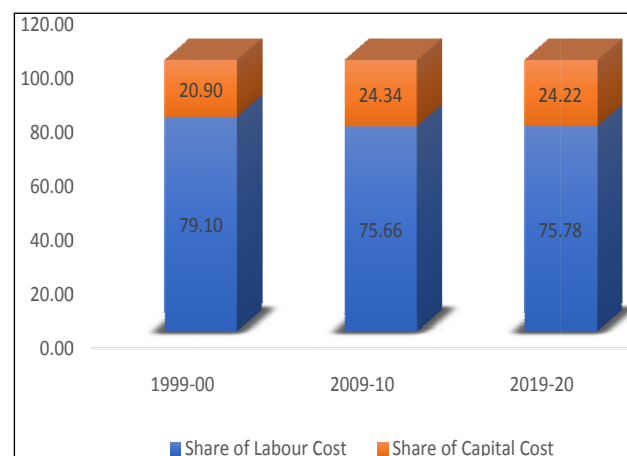
that indicates a decline in the percentage share of labour cost in total operational cost. From 2009-10 to 2019-20, the intensity shifted to reverse, and again the share of labour cost increased. The result is against the fundamental hypothesis of economic development: as per the progression of economic development, the production techniques shifted from labour-intensive to capital intensive.



Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI

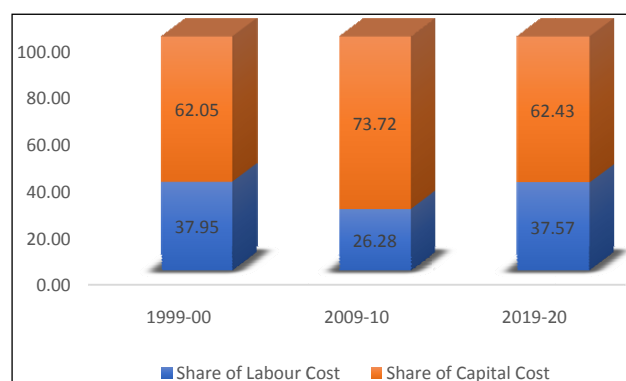
Fig. 1: Structural Changes of Input Cost of Paddy during the Year from 1999-00 to 2019-20

The pattern of structural changes is also the same for the crop- jute in West Bengal. Fig. 2 and 3 show the pattern of the structural intensity of input in terms of the input cost of the jute and potato, respectively. The jute is very much labour intensive in nature, and the share of the labour cost is more than 75 per cent of the total operational cost, that is more labour-intensive than the paddy crop.



Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI

Fig. 2: Structural Changes of Input Cost of Jute during the Year from 1999-00 to 2019-20



Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI

Fig. 3: Structural Changes of Input Cost of Potato during the Year from 1999-00 to 2019-20

During the periods 1999-00 to 2009-10, the share of the labour cost in total operational cost of jute decreases, and the share of capital cost increases. But during the period 2009-10 to 2019-20, the percentage share of labour cost in total operational of jute increases to some extent, but the share of capital cost reduces. The production of potato crops is highly capital intensive (capital cost constituted more than 60 percent of the operational cost). The pattern of changes in the structural composition of the potato crop is also observed to be the same as that of two other crops, i.e., during the first decade, the share of labour cost declines, and the share of capital cost increases. However, the result is reversed for the decade 2009-10 to 2019-20.

Reasons for Structural Changes of Input Intensity

Some questions have been raised regarding structural changes in the intensity of input use in agricultural production. The percentage share of labour cost in total operational cost declined during the periods 1999-00 to 2009-10, and it again increased during the periods 2009-10 to 2019-20 for all three crops: paddy, jute and potato. So, what are the reasons behind these structural changes? The human labour cost may be increased by two ways: by increasing physical unit of human labour per hectare at a given wage rate or by increasing wage rate of human labour at given unit of human labour per hectare. Incorporating the table 4, it is found that the physical unit of human labour used per hectare of paddy and jute production increases from 1166.66 and 1312.22 man-hour during 1999-00 to 1245.19 and 1514.94 man-hour during 2009-10 and after that decreases to 993.79 and 1288.61 man-hour respectively during 2019-20. However, for the crop potato, it decreases throughout the reference periods. The Animal labour unit used per hectare gradually decreases throughout the duration for all the crops. The paradoxical situation is found in the sense that the share of labour cost per hectare decreases, but the actual physical unit of labour per hectare increases and vice versa for paddy and jute. But for potato, the percentage share of labour cost per hectare decreases at first (during 1999-00 to 2009-10) and then increases (during 2009-10 to

Table 4: CAGR of Physical Quantity Unit of Labour Use (Man hours. / Pair hours.) Per Hectare Crop Cultivation

Crop	Cost of Labour Components	Years			CAGR (%)		
		1999-00	2009-10	2019-20	1999-00 to 2009-10	2009-10 to 2019-20	1999-00 to 2019-20
Paddy	Human Labour (Man hrs.)	1166.66	1245.19	993.79	0.65	-2.23	-0.80
	Animal Labour (Pair hrs.)	131.83	79.42	17.53	-4.94	-14.02	-9.60
Jute	Human Labour (Man hrs.)	1312.22	1514.97	1288.61	1.45	-1.61	-0.09
	Animal Labour (Pair hrs.)	145.35	113.74	4.76	-2.42	-27.19	-15.71
Potato	Human Labour (Man hrs.)	1732.53	1263.41	1252.4	-3.11	-0.09	-1.61
	Animal Labour (Pair hrs.)	107.51	78.74	14.92	-3.07	-15.32	-9.40

Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI.

2019-20), while the actual labour used per hectare decreases throughout the years. To answer these questions, the cost of labour used per hour for crop cultivation has been analysed, as shown in table 5. Here, it is observed that the rate of growth (in CAGR) of the cost of labour used per hour (both the ₹ / man-hour and ₹ / pair-hour) increased at a very high rate during 2009-10 from 2019-20 for all major crops. The high growth rate of labour cost per hour (both the ₹ / man-hour and ₹ / pair-hour) leads to an increase in the share of labour cost per hectare in total operational cost, even after the physical unit of labour used per hectare is reduced, and so there is again a structural shift in favour of labour-intensive technology in agriculture in terms of the share of the cost of production. In a study (Srivastava *et al.* 2017), also argued the same type of result that the cost of labour is the one of the important sole factor that increase the total input cost in the cultivations.

Trends in Input-Output Ratio

The input-output ratio is defined as the amount of return received from per rupee investment in crop production that is the synonym of profitability from crop cultivation. Over the periods, both the value of input and output changes, but the changes do not occur in a parallel way. Hence, the relation between input and output also changes during the periods. This section depicts the pattern of changes of input-output relation of three major crops over the years in West Bengal.

Table 6 shows the input-output ratio and their trends during 1999-00 to 2019-20 of the crop paddy. During the reference periods, the total paid-out cost (with a CAGR of 8.50 percent) is rising at much faster rate than the total imputed cost (with a CAGR of 6.37 percent). The percentage share of imputed cost is also declining whereas the percentage share of paid-out cost is increasing during the periods

Table 5: CAGR of Rate/Price of Labour Per Hour Uses for Crop Cultivation

Crop	Cost of Labour Components	Years			CAGR (%)		
		1999-00	2009-10	2019-20	1999-00 to 2009-10	2009-10 to 2019-20	1999-00 to 2019-20
Paddy	Human Labour (₹ / Man hrs.)	7.25	12.93	43.07	5.96	12.79	9.32
	Animal Labour (₹ / Pair hrs.)	10.7	21.78	105.66	7.37	17.11	12.13
Jute	Human Labour (₹ / Man hrs.)	6.49	11.79	45.02	6.15	14.34	10.17
	Animal Labour (₹ / Pair hrs.)	9.64	18.47	93.00	6.72	17.54	12.00
Potato	Human Labour (₹ / Man hrs.)	7.76	12.71	41.29	5.06	12.50	8.72
	Animal Labour (₹ / Pair hrs.)	11.06	21.74	79.38	6.99	13.83	10.36

Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI.

Table 6: CAGR of Input-Output Ratio of Paddy during 1999-00 to 2019-20

Particulars	Years			CAGR (%)		
	1999-00 (%)	2009-10 (%)	2019-20 (%)	1999-00 to 2009-10	2009-10 to 2019-20	1999-00 to 2019-20
Total Cost (C ₂) of paddy	20398.64 (100.00)	38111.55 (100.00)	83886.00 (100.00)	6.45	8.21	7.33
Total Imputed Cost of paddy	12193.68 (59.78)	20632.35 (54.14)	41923.63 (49.98)	5.40	7.35	6.37
Total Paid out Cost of paddy	8204.96 (40.22)	17479.20 (45.86)	41962.37 (50.02)	7.86	9.15	8.50
Yield of paddy (Quintal/Hectare)	34.80	38.91	41.55	1.12	0.66	0.89
Rate (₹ / Quintal of paddy)	498.80	933.20	1477.66	6.46	4.70	5.58
Total output Value of paddy (₹/Hectare)	20762.30	41143.68	68345.11	7.08	5.21	6.14
I-O Ratio of paddy (Total Cost)	1.02	1.08	0.81	0.59	-2.78	-1.11
I-O Ratio of paddy (Paid Out Cost)	2.53	2.35	1.63	-0.72	-3.62	-2.18

Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI.

1999-00 to 2019-20. The higher share of paid-out costs is largely due to higher market price for key inputs used in crop production. From table 6, it is found that the total output value of paddy grows with a CAGR of 6.14 percent during 1999-00 to 2019-20, while the total cost of paddy (C_2) grows with a CAGR of 7.33 percent during the same periods. Comparing the total cost of cultivation and the total output value of paddy, it is found that the growth rate of total value of paddy grows at a lower rate than the growth rate of the total cost. This indicates the declining trends of profitability from cultivation over the periods. The result is also supported by the calculated input-output (I-O) ratio. The table shows that the I-O ratio declined from 1.02 during 1999-00 to 0.81 during 2019-20, indicating a negative CAGR of -1.11 percent. This is clearly demonstrating that farmers earned ₹ 1.02 from paddy cultivation by investing ₹ 1 rupee in paddy production during 1999-00, but in 2019-20, farmers earned only Rs. 0.81, i.e., earns a negative income. When I-O ratio is calculated only from the paid-out cost, it ensures a positive return to farmers but declining over the periods.

Similarly, table 7 shows the input-output ratio and their trends during 1999-00 to 2019-20 for the crop jute. During the reference periods, the total paid-out cost (with a CAGR of 10.76 percent) has grown

at a faster rate than the total imputed cost (with a CAGR of 7.68 percent) and the share of imputed cost in total cost is declining while it is increasing for the paid-out cost of jute cultivation. It is found that the growth rate of the total cost is higher than the growth rate of the total output value, indicating that during the reference periods, the profitability of jute cultivation declined, and the farmers now earn lower return than before. The I-O ratio (based on total cost) also declined from 1.10 during 1999-00 to 1.07 during 2019-20, indicating a negative CAGR of -0.16 percent during the same periods. This demonstrates that on 1 rupee investment in jute production, it returns ₹ 1.10 during 1999-00, whereas during 2019-20, it earns only ₹ 1.07, i.e., the declining trend is observed. The I-O ratio (based on paid-out cost) also declines during the same periods with a CAGR of -1.68 percent.

The input-output ratio and their trends during 1999-00 to 2019-20 of potato has been shown in table 8 in West Bengal. During the reference periods, the total imputed cost grows (with a CAGR of 9.47 percent) faster than the total paid-out cost (with a CAGR of 6.26 percent) that is opposite to above mentioned two crops, paddy and jute. It is found that the share of imputed cost of potato is increasing (from 36.40 percent to 50.96 percent) whereas the share of paid-out cost of potato cultivation is decreasing

Table 7: Changing Pattern of Input-Output Relation of Jute from 1999-00 to 2019-20

Particulars	Years			CAGR (%)		
	1999-2000 (%)	2009-10 (%)	2019-20 (%)	1999-00 to 2009-10	2009-10 to 2019-20	1999-00 to 2019-20
Total Cost (C_2)	18691.93 (100.00)	40851.02 (100.00)	106177.12 (100.00)	8.13	10.02	9.07
Total Imputed cost	11456.59 (61.29)	24950.76 (61.08)	50333.67 (47.41)	8.09	7.27	7.68
Total Paid out Cost	7235.35 (38.71)	15900.26 (38.92)	55843.45 (52.59)	8.19	13.39	10.76
Yield (Quintal/Hectare)	22.25	25.81	28.50	1.50	0.99	1.24
Rate (₹ / Quintal)	830.40	1853.39	3669.34	8.36	7.07	7.71
Total Output Value (₹ /Hectare)	20581.11	52389.25	113287.10	9.79	8.02	8.90
I-O Ratio (Total Cost)	1.10	1.28	1.07	1.54	-1.82	-0.16
I-O Ratio (Paid Out Cost)	2.84	3.29	2.03	1.48	-4.73	-1.68

Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI.

Table 8: CAGR of Input-Output Ratio of Potato during 1999-00 to 2019-20

Particulars	Years			CAGR (%)		
	1999-00	2009-10	2019-20	1999-00 to 2009-10	2009-10 to 2019-20	1999-00 to 2019-20
Total Cost (C ₂)	48685.69 (100.00)	88920.35 (100.00)	212511.33 (100.00)	6.21	9.10	7.65
Total Imputed cost	17723.34 (36.40)	24752.73 (27.84)	108288.15 (50.96)	3.40	15.90	9.47
Total Paid out Cost	30962.35 (63.60)	64167.62 (72.16)	104223.18 (49.04)	7.56	4.97	6.26
Yield (Quintal/Hectare)	212.38	279.68	269.60	2.79	-0.37	1.20
Rate (₹ / Quintal)	177.57	221.10	1039.03	2.22	16.74	9.24
Total Value (₹ / Hectare)	37711.51	61836.70	280124.77	5.07	16.31	10.55
I-O Ratio (Total Cost)	0.77	0.70	1.32	-1.07	6.60	2.69
I-O Ratio (Paid Out Cost)	1.22	0.96	2.69	-2.31	10.80	4.04

Source: Author's Calculation from Cost of Cultivation of Principal crops in India, DES, MoA&FW, GoI.

(from 63.60 percent to 49.04 percent) during 1999-00 to 2019-20. The main factors responsible for such changes in relation of cost of cultivation are the imputed value of family labour cost and the imputed value of rental cost of own land that are increasing as shown in table 3. The profitability of potato cultivation increases during the reference periods as the growth rate of total value of potato is higher than the growth rate of the total cost. The total output value grows with a CAGR of 10.55 percent, whereas the total cost of cultivation increases with a CAGR of 7.65 percent from the year 1999-00 to 2019-20. The I-O ratio also (based on total cost) increases from 0.77 to 1.32, indicating a positive CAGR of 2.69 percent during the study periods. This demonstrates that by investing 1 rupee on jute production, farmers get returns of ₹ 0.77 during the year 1999-00, whereas during 2019-20, farmers earned ₹ 1.32. So, the upward trends of return are observed from the cultivation of potato. The I-O ratio (based on paid-out cost) also increases during the periods with a CAGR of 2.69 percent. The result is again the reverse of the other two crops, paddy, and jute.

CONCLUSION

The structural change of input cost of three major crops (paddy, jute and potato) has occurred due to changes in share of cost components (labour and capital) in total cost of production during the reference periods (1999-00 to 2019-20) in West Bengal. It is observed that during the first phase

(1999-00 to 2009-10), the percentage share of labour cost in total operational cost declined but the percentage share of the capital cost increases, indicating that input cost of agriculture sector shifts towards the capital-intensive direction. This result follows the fundamental developmental theory as the agricultural sector shifts from labour intensive sector to capital-intensive sector. But during 2009-10 to 2019-20, the dimension of shift is reversed in the sense that the percentage share of labour cost increases, and the share of capital to total cost decreases. To investigate the reason behind such contrary results, the study found that the higher cost of labour is the main reason of reverse shift. Though the physical unit of labour per hectare decreases during the period 2009-10 to 2019-20, the higher wage rate leads to an increase in the share of labour cost along with the total cost of cultivation, that lead to shift of input cost towards labour-intensive direction.

In the trend analysis of input-output relation, there is found declining trend of input-output (I-O) ratio for the crop paddy and jute, indicating that the value of output decreases over input cost during reference periods. The situation is very concerning for the paddy, where the study observed a negative return from cultivation of paddy during 2019-20, indicating that the I-O ratio is below one. The main reason for the declining trends in the I-O ratio or profitability is the slower growth rate of output value compared with the input costs (George & Singh, 1971; Gurjar and Varghese, 2005;

Narayanamoorthy, 2013; Raghavan, 2008; Sharma, 2016; Shinde *et al.* 2024; Shivakumar *et al.* 2020; Srivastava *et al.* 2017). For the crop potato, the trend of I-O ratio fluctuates during the reference period 1999-00 to 2009-20. The trends of I-O ratio of potato decline during the first phase (1999-00 to 2009-10), but it increases during second phase (2009-10 to 2019-20). So, the growth of cost of input increases at a higher rate than the growth of the value of output during the reference periods. As a result, the farmers are facing difficulty in earnings profits from cultivation. Hence, appropriate policies should be undertaken to reduce the cost of cultivation.

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