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Though the prime-movers were mainly acquired for agriculture, maximum use of energy hours for agriculture was found only in the small sized farms. On the medium and big farms, processing services and industrial production activity accounted for maximum hours of use. On an average, per farm energy hours use in agriculture accounted for 40.3 per cent and the rest was almost equally shared by production and processing. The labour days utilized on an average ISL farm was maximum in agriculture. The linkage of employment in agriculture and processing was greater than that of agriculture and production. Now we conclude from the ratios of percentages of constituent variables of interlinked activities, that with a very low percentage of inter-sectoral linkage of capital, production and also processing resulted in much better linkages of energy hours use and labour employment under existing situations on the MES farms studied. Various ratios of variables computed with regard to an average MES farm show that production emerged to be the first among the three interlinked activities to consume maximum energy per labour day worked. In agriculture capital investment per labour day was extremely high, compared with that in the other two related activities. Similarly, the use of energy hour in agriculture proved to be very costly in view of the capital investment, which was comparatively very low in production and processing. But labour employment rate per hour of energy was higher in agriculture than it was in the other two linked activities. However, the employment ratio per rupee of capital investment in processing was the maximum followed by production and agriculture.

MEASURING BACKWARD LINKAGE EFFECTS OF VERKA MILK PROCESSING PLANT, AMRITSAR (A CASE STUDY)

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The theory of inter-industry linkage is associated with the name of Hirschman.¹ According to him, any particular investment project may have both forward linkage (*i.e.*, it may encourage investment in subsequent stages of production) and backward linkage (*i.e.*, it may encourage investment in earlier stages of production). The task is to find the projects with the greatest total linkage. The projects with greatest linkage vary from country to country and from time to time and can be discussed only by empirical study of input-output analysis. To Hirschman, iron and steel industry has the highest combined linkage score. In the case of subsistence agriculture the food processing industry, in which milk processing is one, had backward linkage effect to the extent of 61 per cent and forward linkage effect to the extent of 15 per cent.²

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1. A. O. Hirschman: *The Strategy of Economic Development*, Yale University Press, New Haven, 1959.

2. T. Watanabe and H. B. Chenery, "International Comparisons of the Structure of Production", Cleveland Meeting of Econometrics Society, December 27, 1956, p. 11 (*Econometrica*, Vol. 26, No. 4, October 1958, pp. 487-521).

OBJECTIVES

The present study attempts to assess the backward linkage effects of the Milk Processing Plant at Verka (district Amritsar) on dairy cattle, area under fodders, the quantity of milk sold and shifts in the net income resulting from diversification of sources of income. The main objectives of this study are: (i) to examine the changes in the number of cattle, area under fodders and the quantity of milk sold; (ii) to analyse the shifts in the net income of the farmers resulting from diversification of sources of income; and (iii) to find out the backward linkage coefficient.

MATERIAL AND METHOD

The study was confined to Mitha Majha* area of the district. Seven villages within a radius of 20 km. from the plant were randomly selected. These villages were Talwandi Dogra, Meharbanpur, Malikpur, Raipur Kalan, Ramdivali Hindua, Bhaini Gillan and Thande. Then a list of persons (both cultivators and non-cultivators) having dairy farming as their occupation was made. These were grouped into five categories, viz., landless and marginal, small, medium, large and big with holdings below 2.50 acres, 2.50-5, 5-15, 15-25 and above 25 acres. Twenty per cent of the farmers were selected at random. In all, 112 farmers—44 landless and marginal, 17 small, 32 medium, 11 large and 8 big—were selected. Stratified random sampling technique was used for this study. Relevant details about different aspects of the study were collected through a schedule canvassed to each person. The reference period of the study was 1963-64, the year of establishment of the plant and 1971-72 to 1974-75.

DATA PROCESSING AND ANALYSIS

Budgeting technique was applied to estimate the returns to fixed factors in the case of fodder crops. Similarly, the net income from milk sold to the plant was estimated. Earnings from direct and indirect employment were pooled together in respect of different categories of farmers. Backward linkage coefficient was estimated by dividing the net increase in income (in 1974-75 over 1963-64) with the total amount of income received from milk sold to the plant.

(i) Effect on Milk Cattle

The data given in Table I show that the average number of cattle increased from 79.5 to 158.6 per cent on different farms. The increase was maximum in the case of large farmers and minimum in the case of big farmers. This was due to the fact that some of the large farmers were operating dairy units on a large scale which yielded economies of scale. Big farmers, however, reported less increase in the number of cattle as they mostly kept milch cattle for domestic purposes.

* Mitha Majha area is the area where underground water is fit for irrigation.

TABLE I—NUMBER OF MILCH CATTLE, AREA UNDER FODDERS, QUANTITY OF MILK SOLD BY DIFFERENT CATEGORIES OF FARMERS IN THE STUDY AREA: 1963-64, 1971-72 TO 1974-75

Year	Marginal	Small	Medium	Large	Big
Milch animals (number)					
1963-64	0.86	1.36	1.30	1.33	1.67
1971-72	1.40	2.00	1.95	1.89	2.33
1972-73	1.71	2.50	2.50	2.44	2.67
1973-74	1.93	3.00	2.92	3.22	2.83
1974-75	2.07	3.38	3.13	3.44	3.00
Percentage increase over 1963-64	140.70	145.60	131.40	158.60	79.50
Area under fodders (acres)					
1963-64	0.84	1.23	2.29	3.80	4.91
1971-72	1.06	1.54	2.80	4.57	6.10
1972-73	1.10	1.40	3.05	5.48	6.51
1973-74	1.22	1.56	3.06	5.71	5.76
1974-75	1.30	1.63	3.52	5.91	7.31
Percentage increase over 1963-64	57.70	32.50	42.30	55.50	48.70
Milk sold to the plant (quintal)					
1963-64	164.90	303.97	134.32	134.26	109.00
1971-72	759.16	1,047.38	482.26	412.78	366.32
1972-73	960.41	1,567.86	862.25	912.25	617.24
1973-74	1,218.19	1,967.28	1,223.56	1,385.75	750.54
1974-75	1,421.79	2,313.23	1,398.38	1,624.24	917.84
Percentage increase over 1963-64	762.30	661.90	941.20	1,110.00	732.80

(ii) Acreage under Fodders

With the setting up of the plant, a trend towards greater production of milk was observed. Since more milk production requires maintenance of more milch cattle, considerable expansion in the area under fodders took place. The area under fodders increased from 32.5 to 57.7 per cent on different farms. In respect of marginal farmers the increase was maximum whereas it was minimum on the small farms, the reason being that marginal farmers try to increase their incomes by using fixed resources like family labour more intensively. Small farmers, however, did not put more area under fodder probably because they got income from other resources.

(iii) Increase in the Quantity of Milk Sold

Rising number of cattle coupled with rising acreage under fodder crops led to greater sale of milk to the plant. Per farmer quantity sold increased by 7 to 11 times, the increase being maximum in the case of large farmers and minimum in the case of small farmers. This shows that the large farmers were brought into greater contact with the milk plant because they had the financial resources to purchase the cattle and some of them operate dairies on large scale. Small farmers, on the other hand, showed less increase during the period under study.

(iv) Rising Income

As a consequence of diversification induced by the plant, the income of different categories of farmers went up. Figures given in Table II show that during the period the net income from milk, fodders and employment increased considerably on all farms. The average net earnings of marginal, small, medium, large and big farmers increased by 331.10, 365.20, 469.20, 478 and 493 per cent respectively. The increase in income was maximum in the case of big farmers and minimum in the case of marginal farmers.

Similarly, the net income from fodders registered an increase of 543.1 to 728 per cent on different farms in 1974-75 compared to 1963-64. With the development of dairy enterprise, sale of fodders became a profitable proposition and income from this enterprise went up.

Income received from employment in the plant and dairy activities also went up with the establishment of the plant. The average income received from employment increased from Rs. 132.72 to Rs. 466.74, from Rs. 85.92 to Rs. 995.04, from Rs. 93.71 to Rs. 350.00, from nil to Rs. 316.38, and from nil to Rs. 318 in respect of marginal, small, medium, large and big farmers respectively. Marginal and small farmers earned income from working in the plant as well as from the dairy activities whereas medium, large and big farmers received income by working as employees in the plant.

(v) Relative Share of Different Enterprises in the Total Net Income

The relevant details about the relative importance of different activities in the total net income are given in Table III. In respect of marginal

TABLE II—INCOME RECEIVED FROM MILK SALE, FODDERS AND EMPLOYMENT IN THE STUDY AREA:
1963-64, 1971-72 to 1974-75

(Rs.)

Year			Marginal	Small	Medium	Large	Big
Milk sale							
1963-64	..	..	497.73 (74.20)	789.63 (136.79)	338.49 (60.44)	416.51 (60.61)	214.41 (49.05)
1971-72	...	..	1,065.72 (417.54)	1,570.68 (576.16)	756.54 (275.24)	824.35 (227.94)	831.55 (201.47)
1972-73	..	..	1,176.43 (48.20)	2,196.99 (779.93)	1,155.25 (431.13)	1,306.76 (456.13)	1,084.46 (308.62)
1973-74	..	..	1,819.05 (668.00)	2,856.44 (1,082.00)	1,655.36 (572.96)	2,230.39 (762.06)	1,211.92 (412.80)
1974-75	..	..	2,145.69 (995.25)	3,672.60 (1,619.16)	1,927.73 (978.87)	2,407.75 (1,136.97)	1,273.72 (635.49)
Percentage increase over 1963-64	..	..	331.10	365.20	469.20	478.00	493.90
Fodders							
1963-64	..	..	144.24	229.73	503.93	836.50	1,230.86
1971-72	..	..	608.76	931.79	1,752.36	2,409.04	3,020.18
1972-73	..	..	1,093.71	1,346.40	2,833.33	3,846.56	5,593.62
1973-74	..	..	1,134.79	1,438.30	3,260.51	4,789.26	4,971.15
1974-75	..	..	1,194.56	1,588.65	3,791.24	6,104.45	7,914.77
Percentage increase over 1963-64	..	..	728.00	592.90	552.20	629.80	543.10
Employment							
1963-64	..	..	132.72	85.92	93.71	—	—
1971-72	..	..	244.70	545.94	125.42	307.22	—
1972-73	..	..	249.54	603.57	212.51	313.63	305.00
1973-74	..	..	369.62	900.51	337.57	314.56	315.00
1974-75	..	..	466.74	995.04	350.00	316.38	318.00
Percentage increase over 1963-64	..	..	332.00	909.50	256.30	316.38	318.00

Note:— Figures in brackets denote income received from the plant as a result of sale of milk.

TABLE III—RELATIVE IMPORTANCE OF DIFFERENT ENTERPRISES IN THE TOTAL NET INCOME OF DIFFERENT FARMERS IN THE STUDY AREA: 1963-64, 1971-72 TO 1974-75
(per cent)

Year	Fodders	Milk	Employment	Total	Total net income (Rs.)
Marginal					
1963-64	41.08	21.13	37.79	100.00	351.16
1971-72	47.90	32.85	19.25	100.00	1,271.00
1972-73	59.98	26.33	13.69	100.00	1,823.45
1973-74	52.24	30.75	17.01	100.00	2,172.41
1974-75	44.97	37.46	17.57	100.00	2,656.55
Small					
1963-64	50.78	30.23	18.99	100.00	452.44
1971-72	45.37	28.05	26.58	100.00	2,053.89
1972-73	49.32	28.57	22.11	100.00	2,729.90
1973-74	42.05	31.63	26.32	100.00	3,420.81
1974-75	37.80	38.52	23.68	100.00	4,202.85
Medium					
1963-64	76.58	9.18	14.24	100.00	658.08
1971-72	81.39	12.78	5.83	100.00	2,153.02
1972-73	81.49	12.40	6.11	100.00	3,476.97
1973-74	78.17	13.78	8.09	100.00	4,171.04
1974-75	74.05	19.12	16.84	100.00	5,120.13
Large					
1963-64	93.26	6.74	—	100.00	896.91
1971-72	81.82	7.74	10.44	100.00	2,944.20
1972-73	83.33	9.88	6.79	100.00	4,616.32
1973-74	81.65	12.99	5.36	100.00	5,865.88
1974-75	80.77	15.04	4.19	100.00	7,557.80
Big					
1963-64	96.17	3.83	—	100.00	1,279.91
1971-72	93.75	6.25	—	100.00	3,221.65
1972-73	90.11	4.97	4.91	100.00	6,207.24
1973-74	87.23	7.24	5.53	100.00	5,698.94
1974-75	89.25	7.17	3.58	100.00	8,868.26

farmers net income received from fodders and milk production increased whereas the income received from employment became less important over the years. This was due to greater investment in the dairy activities. In the case of small farmers the income from milk and employment increased relatively over the years but the income from the sale of fodder became less important. Medium farmers derived large income from milk production in 1974-75 compared to other sources of income. In respect of large and big farmers, similar trends were noted. Therefore, it may be concluded that the importance of milk production as a source of income increased on all farms whereas the income from other activities varied from farm to farm. There was, however, a marked increase in income in absolute terms.

(vi) *Backward Linkage Coefficient*

Backward linkage coefficient in respect of marginal, small, medium, large and big farmers worked out to 0.051, 0.136, 0.139, 0.532, 1.327 respectively. It was lowest in the case of marginal farmers and highest in the case of big farmers. In the case of marginal farmers it was lowest because of receipt of less additional income from the sale of fodders. The net increase in income in the dairy units by the marginal and small farmers was more because they provided labour to dairy operators on hire. In the case of large and big farmers the income from employment was only from the persons employed in the Verka plant. They were working either as their agents in the villages or as employees of the plant. In the case of large farmers the linkage effect worked out to 0.532 implying thereby that the purchase of milk by the plant by one rupee would raise the income by 53 paise of the farmers in the corresponding category. In the case of big farmers the coefficient was the highest. Though this category sold less milk to the plant, yet it gained through the sale of fodders. It can also be stated that in the case of large and big farmers the income from employment was more because they employed more hired labour than family labour.

Conclusion

The milk processing plant led to the improvement of the rural economy in multiple ways. It provided incentives for the development of dairy enterprises, fodder crops and production of milk which enhanced the income of different categories of farmers. It also imparted stability and certainty to income due to diversification of sources of income. The relative contribution of the plant in income generation of large farmers was more compared to other categories of farmers.
