CHAPTER 7
PARTICIPATION AND EFFICIENCY IN CONTRACT FARMING

As observed in the previous chapter, contract farming improves the farmers' return from the contract crops. Therefore, it is imperative to study further whether such contracted crops are grown efficiently or not. Further, it is also important to examine different factors determining the participation of farmers in contract farming and its impact on employment generation.

7.1 Determinants of Farmers' Decision to Participate in Contract Farming and Impact on Income

7.1.1 PepsiCo

The treatment effect model used to determine contract farmers' decision to participate in contract farming is presented in Table 7.1. In selection equation, dependent variable was dummy for contract participation. The negative and significant coefficient of age of the farmers indicates that older the farmer, lesser is probability of participation in contract farming. The proportion of area under non-traditional crops was a strong predictor of participation in contract farming scheme i.e. farmers growing other than wheat-paddy crop preferred to participate in contract farming.

At second-stage of econometric analysis, treatment effect model was used instead of OLS for correction bias in sample selection. In outcome equation, gross income of potato was positively affected by farm size, off-farm income, agricultural machinery, proportion of area under non-traditional crops and contract participation. The farmers with higher operational holdings were likely to have more income. The coefficient on the contract variable implies that participation in contract farming raises gross income of potato by ₹ 18,393 per acre. The positive and significant impact of constant on potato income indicates that there were some other factors that increase the gross income. The *ath* parameter shows correlation between error terms of the selection and the outcome equation. This parameter was statistically significant which implies that there was selection bias, so it was essential to estimate gross income using the treatment regression model.

Table 7.1

Treatment Effect Model of Gross Income for Potato Crop

Predictor	Coefficient	SE	P>z
Dependent variable: Binary which assume value 1 for contract participation and zero otherwise			
Household size (persons)	-0.133	0.102	0.192
Age (years)	-0.024*	0.016	0.09
Education (years)	0.090	0.066	0.176
Operated area (acres)	0.004	0.010	0.663
Farm implements (no.)	0.187	0.148	0.207
Off-farm income	0.001	1.250	0.337
Proportion of area under non-traditional crops	0.065***	0.012	0.000
Constant	-1.112	1.232	0.367
Gross income			
Household size (persons)	-231.578	298.283	0.438
Age (years)	-29.620	55.493	0.594
Education (years)	-162.882	213.800	0.446
Operated area (acres)	61.021**	25.324	0.016
Farm implements (no.)	224.420	485.360	0.644
Off-farm income	0.029	0.038	0.446
Proportion of area under non-traditional crops	85.063	60.014	0.156
Contract	18393.47***	3215.728	0.000
Constant	30013.55***	4146.801	0.000
ath (ρ)	0.728*	0.401	0.07
LR test of independent equations			
Chi-squared (1)	0.00		
Probability > chi-square	0.955		

Note: ***, ** and * implies statistical significance level at 1%, 5% and 10% level respectively.

7.1.2 Rana Sugars Limited

Table 7.2 shows the results of treatment effect regression for sugarbeet crop. The coefficient of age was negatively significant that mean the farmers' probability to participate in contract farming was lesser if the farmer was older. The coefficient of farm experience was found to be positively significant, which implies that farmers with more farming experience were likely to participate in new models.

Gross income of sugarbeet farmers was positively affected by the farm size and contract participation. The coefficient on contract variable implies that contracting raises gross income by ₹ 18041. The coefficient of farm size was positively significant, which implies that the farmers with large operational holdings earned more income due to economies of scale. The significant and positive influence of constant on sugarbeet income indicates that there were some other factors that increased the income. The *ath* parameter was not statistically significant implies that there was no selection bias. This indicates that selectivity bias holds no influence on sugarbeet income earned from contract farming. Thus, it was not necessary to estimate gross income of sugarbeet using treatment effect model.

7.1.3 Paras Spices Pvt. Ltd.

Table 7.3 shows the result of treatment effect model for chicory crop. It was evident from the findings that household size had a positive and significant influence on the contract farming participation. Similarly, farm machinery and farm size were also found to have significant impact on the contract farming participation. Other variables like age, education turned out to be insignificant for causing variations in contract farming participation. This indicates that the company mainly considers economic indicators for farmers' selection. Therefore, it can be conjectured that the contract farming participation was a non-random selection. The results also indicate that participation in contract farming leads to the income rise by ₹ 44,768. An increase in operated area increased income by ₹ 69.25 per acre, which was significant at 5 per cent level. The *ath* parameter was statistically significant which implies that there was selection bias, so it was essential to estimate gross income using the treatment regression model.

Table 7.2

Treatment Effect Model of Gross Income for Sugarbeet Crop

Predictor	Coefficient	SE	P>z
Dependent variable: Binary which assume value 1 for contract participation and zero otherwise			
Household size (persons)	-0.177	0.123	0.149
Age (Years)	-0.075**	0.032	0.02
Farming experience (years)	0.055**	0.028	0.053
Education (years)	0.102	0.068	0.134
Operated area (acres)	0.005	0.011	0.609
Off-farm income	1.820	1.790	0.309
Farm implements (no.)	0.193	0.140	0.168
Proportion of area under non-traditional crops	0.068***	0.012	0.000
Constant	-0.149	1.402	0.915
Gross income			
Age (years)	-121.017	126.221	0.338
Farming experience (years)	99.861	125.760	0.427
Education (years)	-107.592	228.745	0.638
Operated area (acres)	66.570***	24.917	0.008
Off-farm income	0.023	0.037	0.526
Proportion of area under non-traditional crops	99.267	75.087	0.186
Contract	18041.13***	3987.603	0.000
Constant	30547.62***	4142.054	0.000
ath (ρ)	0.825	0.565	0.145
LR test of independent equations			
Chi-squared (1)	1.92		
Probability > chi-square	0.165		

Note: ***, ** and * implies statistical significance level at 1%, 5% and 10% level respectively.

Table 7.3

Treatment Effect Model of Gross Income for Chicory Crop

Predictor	Coefficient	SE	P>z
Dependent variable: Binary which assume value 1 for contract participation and zero otherwise			
Household size (persons)	0.101**	0.045	0.026
Age (years)	0.040	0.031	0.194
Experience (years)	-0.052*	0.027	0.058
Education (years)	-0.053	0.046	0.248
Operated area (acres)	0.033***	0.012	0.008
Off-farm income	3.530	0.002	0.208
Farm implements (no.)	0.277**	0.129	0.032
Proportion of area under non-traditional crops	0.068***	0.014	0.000
Constant	-2.334*	1.298	0.072
Gross income			
Age (years)	94.289	76.547	0.218
Experience (years)	-36.493	68.146	0.592
Education (years)	-61.607	131.809	0.64
Operated area (acres)	69.625**	36.071	0.054
Off-farm income	-0.086	0.054	0.115
Proportion of area under non-traditional crops	-92.944*	53.413	0.082
Contract	44768.76***	2384.798	0.000
Constant	21477.87***	3197.382	0.000
Inverse mills ratio	-3168.31	1361.537	
ath (ρ)	-0.835*	0.446	0.061
LR test of independent equations			
Chi-squared (1)	1.30		
Probability > chi-square	0.254		

Note: ***, ** and * implies statistical significance level at 1%, 5% and 10% level respectively.

7.2 Technical Efficiency

The participation in contract farming not only influences income of the farmers but it may also have an impact on technical know-how of the farmers and use of farm resources as the companies in order to get better quality of products, provide the various technical and extension services at the door steps of the farmers. Thus, efficiency to produce crop under contract may differ from crop grown under non-contract. The next section has examined the technical efficiency in production of crops grown under contract and non-contract farming.

7.2.1 PepsiCo

Technical efficiency has been measured under overall technical efficiency (OTE) and pure technical efficiency (PTE) by using non-parametric frontier i.e. data envelopment analysis programme (DEAP). The mean value of gross return and various inputs used in the technical efficiency index for potato's contract and non-contract farmers are presented in Table 7.4. The mean value of gross return from potato per acre was higher in case of contract farmers (₹ 76,965) as compared to non-contract farmers (₹ 71,368). The cost on use of human labour was also higher among contract farmers (₹ 5170) as compared to among non-contract farmers (₹ 1702). The use of both fertilizers and plant protection chemicals measured in value terms were higher for contract farmers than non-contract farmers. Furthermore, the mean value of seed cost was also turned out to be higher in case of contract farmers than that of non-contract farmers. However, mean value of machinery labour and harvesting was higher among non-contract farmers than that of contract farmers.

Table 7.4

Summary Statistics of Variables in DEAP of Potato Farmers

Parti-culars	Gross return (₹/acre)	Labour cost (₹/acre)	Machinery cost (₹/acre)	Seed cost (₹/acre)	Fertilizer cost (₹/acre)	Plant protection costs (₹/acre)	Harvesting cost (₹/acre)	No. of irrigations
Contract farmers								
Mean	76965	5170	2474	23546.9	7399.6	4787.6	3704	4.88
CV (%)	11.68	29.38	45.09	23.16	18.75	27.77	13.54	17.38
Min	47840	2600	1000	5300	4000	3116	3000	3
Max	94000	10000	5000	26000	10310	12000	5500	8
Non-contract farmers								
Mean	71368	1702	2576	15643	6588.6	3098	5843.3	5.14
CV (%)	14.43	24.57	41.79	20.77	16.37	30.12	21.58	8.79
Min	52000	900	1500	7900	2100	1800	2500	4
Max	105500	3000	8500	26000	8600	7000	9850	6

The results for DEAP are presented in Table 7.5. It was observed from the analysis that contract farmers were more efficient than non-contract farmers. The mean technical efficiency score for the contract farmers was 0.92, whereas for the non-contract farmers, it was 0.88. OTE score for 32 per cent contract farmers and 22 per cent non-contract farmers was between 0.81-0.90. Further, 58 per cent contract farmers had OTE score more than 0.91 compared to 50 per cent in case of non-contract farmers. Additionally, 10 per cent contract farmers had OTE scores between 0.71-0.80 compared to 18 per cent in case of non-contract farmers. Approximately, 34 per cent contract farmers were on efficiency frontier, while 32 per cent of non-contract farmers were efficient. Thus, it can be concluded that contract farmers were more overall technical efficient than the non-contract farmers. Further, PTE measure has been used to obtain the managerial performance (Kumar and Gulati, 2008). PTE was also higher in case of contract farmers (0.95) as compared to non-contract farmers (0.92). Furthermore, 54 per cent of the contract farmers were on efficiency scale under VRS as compared to 46 per cent in case of non-contract farmers. Thus, it is revealed that contract farmers' managerial performance in production process was also more efficient as compared to non-contract farmers. The results suggest that contract farmers on an average can reduce their cost on inputs by 5 per cent and non-contract farmers by 8 per cent. Scale efficiency that explains the farmers' ability to select optimum size of resources to attain expected level of production was also measured among the farmers. The scale efficiency score was 0.92 for contract farmers and 0.89 for non-contract farmers. Increasing returns to scale were shown by 62 per cent of the contract farmers and 68 per cent of the non-contract farmers (Figure 7.1). This implies that these farmers were operating at sub-optimum scale size and need to increase their scale of operations. Only 4 per cent contract farmers observed decreasing returns to scale and had supra-optimal scale size. CRS were observed in 34 per cent of the contract farmers and 32 per cent of the non-contract farmers. Furthermore, 34 per cent of the contract farmers were scale efficient compared to 26 per cent in case of non-contract farmers. Thus, the efficiency estimate indicates that the contract method of production was more efficient than the non-contract production. Similar results shown by other studies also revealed that contract farmers are more efficient than the independent farmers (Pandit *et al.*, 2009; Begum *et al*., 2012).

Table 7.5

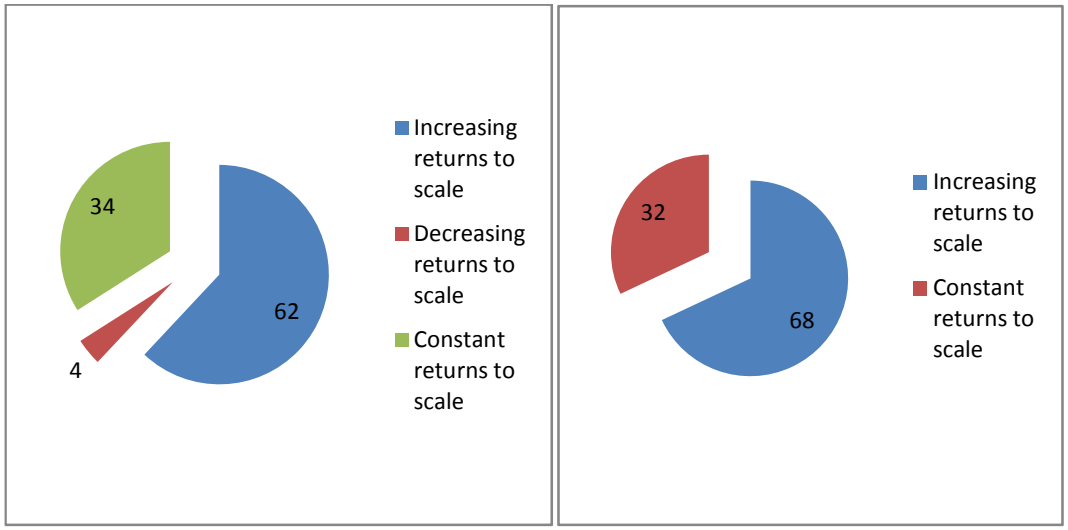
Technical Efficiency Scores among Potato's Contract and Non-contract Farmers

Efficiency scores	Contract farmers			Non-contract farmers		
	OTE	PTE	SE	OTE	PTE	SE
1.00	17 (34)	27 (54)	17 (34)	16 (32)	23 (46)	13 (26)
0.91-0.99	12 (24)	16 (32)	21 (42)	9 (18)	13 (26)	16 (32)
0.81-0.90	16 (32)	7 (14)	11 (22)	11 (22)	11 (22)	17 (34)
0.71-0.80	5 (10)	-	1 (2)	9 (18)	3 (6)	3 (6)
0.61-0.70	-	-	-	4 (8)	-	1 (2)
0.00-0.60	-	-	-	1 (2)	-	-
Mean efficiency	0.92	0.95	0.92	0.88	0.92	0.89
Min. efficiency	0.74	0.83	0.80	0.60	0.79	0.70
Max. efficiency	1.00	1.00	1.00	1.00	1.00	1.00

Note: Figures in parentheses indicate per cent of farmers with T.E. score.

Figure 7.1

Scale Efficiency of Potato among Contract and Non-contract Farmers



(a) Contract farmers (b) Non-contract farmers

7.2.2 Rana Sugars Limited

The pattern of input use and gross returns among sugarbeet and wheat farmers is given in Table 7.6. The mean value for gross return was ₹ 50,967.4 per acre in sugarbeet and ₹ 26,629 per acre in wheat. The expenditure on human labour was maximum ₹ 13,000 among sugarbeet farmers. The labour cost consists of labour

Table 7.6

Summary Statistics of Variables in DEAP of Sugarbeet and Wheat Farmers

Parti-culars	Gross return (₹/acre)	Labour cost (₹/acre)	Machinery cost (₹/acre)	Seed cost (₹/acre)	Fertilizer cost (₹/acre)	Plant protection costs (₹/acre)	Harvesting cost (₹/acre)	No. of irrigations
Sugarbeet farmers								
Mean	50967.4	8274	2483	1000	3263	1413.2	4580	20.28
CV (%)	15.43	23.57	17.20	4.01	28.51	46.32	7.33	20.09
Min	29700	4500	1400	900	1750	800	4000	10
Max	68000	13000	3500	1150	6650	4000	6000	30
Wheat farmers								
Mean	26629	1347	1752	1237	2065.2	1057	1156	4.76
CV (%)	6.99	46.82	22.83	14.02	10.12	38.52	35.78	11.47
Min	22350	600	1200	1000	1750	450	900	4
Max	30500	3000	2900	1600	2700	2200	3000	6

on spraying, irrigation and weeding. The seed cost was less for sugarbeet as the contract firm provided the seed on the subsidized rate. However, in case of wheat crop, the cost was highest on harvesting and human labour (₹ 3000 each) followed by machinery (₹ 2900) and fertilizers (₹ 2700).

Under the assumption of CRS, 18 per cent of the sugarbeet farmers were fully efficient, while 24 per cent of the farmers had score between 0.91-0.99. Further, 30 per cent of the farmers had OTE scores between 0.81-0.90. While 18 per cent had score between 0.71 to 0.80 and remaining 10 per cent between 0.61 to 0.70. Thus, OTE mean score was turned out to be 0.86. When technical efficiency was measured under VRS, the proportion of fully efficient farmers increased to 64 per cent. The mean PTE score was 0.97. The results suggest that sugarbeet farmers can reduce their input usage cost by 3 per cent. The scale efficiency score was worked out to be 0.87. 82 per cent of the farmers operated on sub-optimal returns to scale that meant these farms were too small to its scale of operations. No one operated at supra-optimal scale size. 18 per cent farmers were scale efficient as they had constant returns to scale (Figure 7.2).

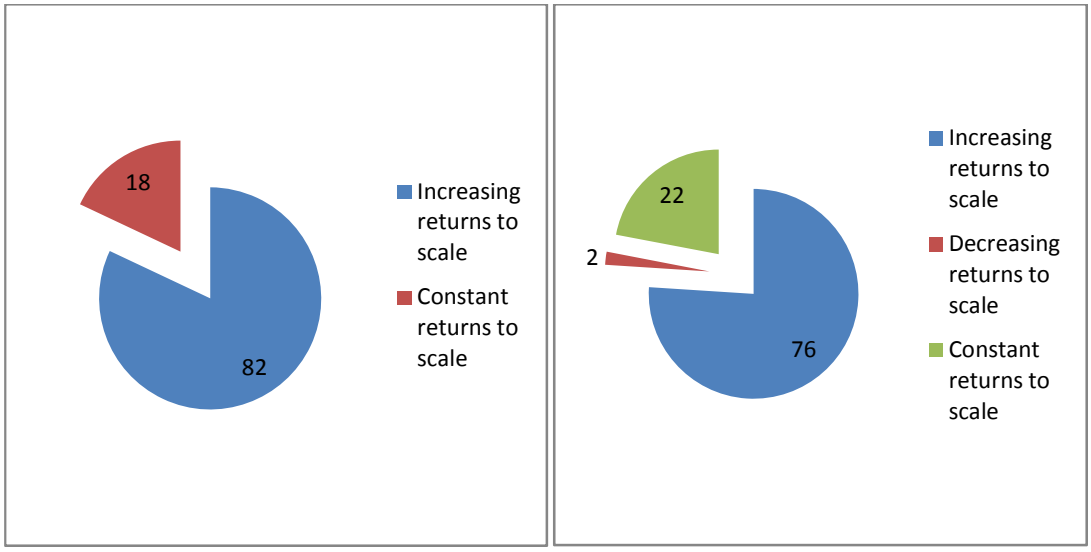
Table 7.7
Technical Efficiency Scores among Sugarbeet and Wheat Farmers

Efficiency scores	Sugarbeet farmers			Wheat farmers		
	OTE	PTE	SE	OTE	PTE	SE
1.00	9 (18)	32 (64)	9 (18)	11 (22)	30 (60)	11 (22)
0.91-0.99	12 (24)	17 (34)	15 (30)	14 (28)	10 (20)	26 (52)
0.81-0.90	15 (30)	1 (2)	16 (32)	21 (42)	9 (18)	13 (26)
0.71-0.80	9 (18)	-	5 (10)	3 (6)	1 (2)	-
0.61-0.70	5 (10)	-	5 (10)	1 (2)	-	-
0.00-0.60	-	-	-	-	-	-
Mean efficiency	0.86	0.97	0.87	0.89	0.95	0.92
Min. efficiency	0.61	0.88	0.61	0.66	0.80	0.81
Max. efficiency	1.00	1.00	1.00	1.00	1.00	1.00

Note: Figures in parentheses are percentage of the farmers with T.E. score.

Figure 7.2

Scale Efficiency of Sugarbeet and Wheat among Contract and Non-contract Farmers



(a) Contract farmers (b) Non-contract farmers

In wheat, technical efficiency calculated under CRS assumption revealed that 22 per cent of the farmers were fully efficient and set the best practice example for inefficient farmers. It means that at these farms, there was no wastage of any inputs. These farmers were most efficient amongst the sample farmers. 28 per cent had score between 0.91-0.99 and were considered to be relatively less efficient. Further, the proportion of the farmers with OTE scores between 0.71-0.80 was 42 per cent. These inefficient farms can improve their efficiency by reducing inputs. The mean OTE score was turned out to be 0.89. The proportion of fully efficient farmers increased to 60 per cent when measured under PTE. The mean PTE score was 0.95. 19 farms which were efficient under VRS, but they were found inefficient under CRS assumption. The inefficiency on these farms was not caused by the usage of poor inputs, but by inappropriate scale size. The scale efficiency was 0.92 (Table 7.7). Increasing returns to scale was shown by 76 per cent farms. These farms need to increase their scale of operations. Just 2 per cent observed supra- optimal scale size. Further, 22 per cent farms were operated at constant returns to scale (Figure 7.2).

7.2.3 Paras Spices Pvt. Ltd.

The mean value of various inputs used in production of chicory and wheat crop involved in the technical efficiency index are presented in Table 7.8. The mean value of gross return for chicory was ₹ 67,354 per acre. Among total cost of cultivation, average labour cost (₹ 10,098) was turned out to be maximum followed by harvesting cost (₹ 7910) and fertilizer cost (₹ 4727). Further, among wheat growing farmers, average gross return was ₹ 25885 per acre. The highest share in total cost was of fertilizers (₹ 2329) followed by machine labour cost (₹ 1786) and labour charges (₹ 1774).

Under the assumption of CRS, 18 per cent chicory growing farmers were fully efficient. OTE score for majority of chicory farmers (36 per cent each) was between 0.91-0.99 and 0.81-0.90. Further, 10 per cent farmers had score between 0.71-0.80. Hence, OTE mean score was turned out to be 0.91. Furthermore, technical efficiency under VRS was also measured to find out the managerial performance for organizing inputs in production process. The mean PTE score was 0.98. Under the assumption of VRS, the proportion of fully efficient farmers also increased to 52 per cent. It has been observed that 26 farmers obtained the status of efficient farmers as they had PTE score equal to one. However, under CRS assumption, 9 farmers were on efficiency frontier. For 17 farmers that became efficient under VRS assumption but they found to be inefficient in case of CRS, it can be concluded that overall technical inefficiency among these farmers was not caused by poor input utilization rather caused by the operations of the farmers with inappropriate scale size (Table 7.9). 82 per cent farmers operated on sub-optimal returns to scale which points out that these farms were too small to its scale of operations. No one operated at decreasing returns to scale (Figure 7.3).

Table 7.8

Summary Statistics of Variables in DEAP of Chicory and Wheat Farmers

Particulars	Gross return (₹/acre)	Labour cost (₹/acre)	Machinery cost (₹/acre)	Seed cost (₹/acre)	Fertilizer cost (₹/acre)	Plant protection costs (₹/acre)	Harvesting cost (₹/acre)	No. of irrigations
Chicory farmers								
Mean	67354	10098	2476	1700	4727	1998	7910	26.48
CV (%)	9.00	18.73	16.98	2.84	13.75	24.46	7.41	16.84
Min	54400	5200	1200	1620	3200	1000	6000	19
Max	88400	18000	3000	1900	5610	3500	9500	40
Wheat farmers								
Mean	25885	1774	1786	1160	2329.3	1323	1104	4.72
CV (%)	10.20	16.90	15.13	20.16	14.30	20.81	6.31	9.36
Min	18600	1150	1000	500	1100	600	1000	4
Max	31775	2600	2300	1600	3000	1800	1220	5

Technical efficiency score under CRS assumption revealed that 20 per cent of wheat farmers were fully efficient and set the best example for inefficient farmers to grow wheat. For 42 per cent of wheat farmers, OTE score was between 0.81-0.90. Further, 20 per cent farmers had OTE scores between 0.91-0.99, 14 per cent between 0.71-0.80 and 4 per cent between 0.61-0.70. The average OTE score was 0.88. Further, the proportion of fully efficient farmers was 54 per cent when measured under PTE. The mean PTE score also increased to 0.96. The scale efficiency was worked out to be 0.91. For 17 farms that became efficient under VRS, but were inefficient under CRS assumption, inefficiency among them was not due to poor usage of inputs, but because of inappropriate scale size. Further, 22 per cent farms were scale efficient as these operated at constant returns to scale. 2 per cent farms operated at the supra-optimum scale size that means farms were too large to take full advantage of scale. 76 per cent farms operated at sub-optimum scale size which meant there was need to increase their scale of operations to operate at scale efficient (Figure 7.3).

Table 7.9

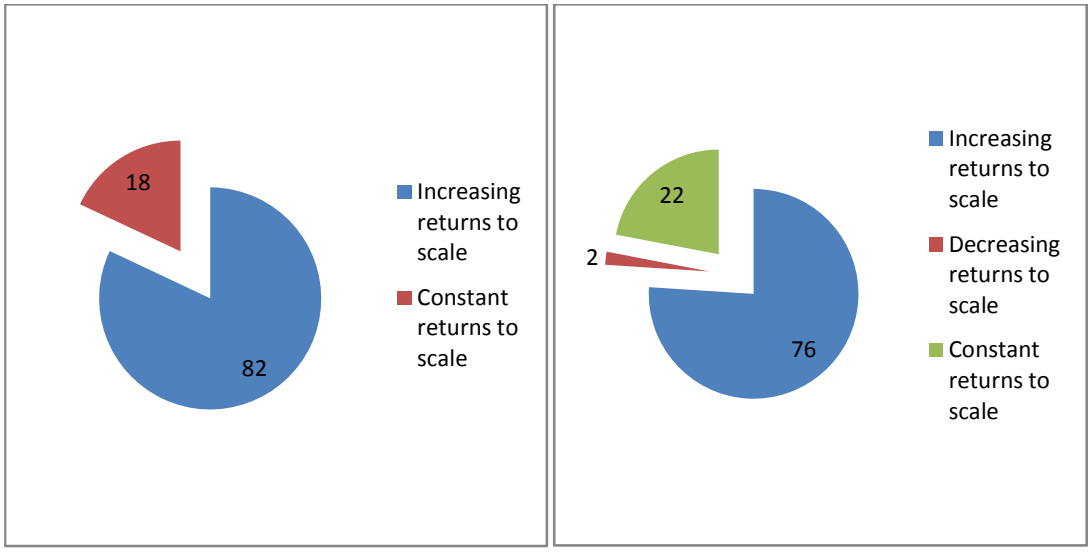
Technical Efficiency Scores among Chicory and Wheat Farmers

Efficiency scores	Sugarbeet farmers			Wheat farmers		
	OTE	PTE	SE	OTE	PTE	SE
1.00	9 (18)	26 (52)	9 (18)	10 (20)	27 (54)	11 (22)
0.91-0.99	18 (36)	24 (48)	22 (44)	10 (20)	18 (36)	18 (36)
0.81-0.90	18 (36)	-	17 (34)	21 (42)	5 (10)	17 (34)
0.71-0.80	5 (10)	-	2 (4)	7 (14)	-	2 (4)
0.61-0.70	-	-	-	2 (4)	-	2 (4)
0.00-0.60	-	-	-	-	-	-
Mean efficiency	0.91	0.98	0.92	0.88	0.96	0.91
Min. efficiency	0.71	0.93	0.73	0.64	0.86	0.64
Max. efficiency	1.00	1.00	1.00	1.00	1.00	1.00

Note: Figures in parentheses are percentage of farmers with T.E score.

Figure 7.3

Scale Efficiency of Chicory and Wheat among Contract and Non-contract Farmers



(a) Contract farmers (b) Non-contract farmers

Thus, chicory farms were operated at relatively efficient scale than wheat farms. Even being new crop in the region than wheat crop, farmers were operating comparatively more efficiently their chicory farms. By receiving technical information from the company's field manager for chicory crop, farmers gained more knowledge about their resources and practices that made possible for them to use resources more efficiently.

As observed in the above section that contract farming had a positive reaction on farmers' income and resource use efficiency. Further, it may also create demand for the farm labour. Thus, the effect of contract farming on rural employment for the contract and non-contract crops has been discussed in the subsequent section.

7.3 Labour Absorption

7.3.1 PepsiCo

The share of agricultural labourers and cultivators to total workers in Punjab was 35.94 per cent in 2011 (GoI, 2011). Vegetables require more rigorous farm workers as compared to other crops. In literature of contract farming, the possibility of employment generation with contract crops was hypothesized due to

labour intensive nature of crop production under contract and for post harvest operations such as sorting, grading, packing, etc. (Glover, 1994; Glover and Kusterer, 1990; Singh, 2005a). PepsiCo provided trained labourers for grading to the contract potato growers as they were more efficient and paced in their work. More female labour was employed by the non-contract farmers for harvesting and grading due to their lower daily wage rate as compared to male labour. The daily wage rate was ₹ 300 for male labourer and ₹ 200-250 for female labourer as per the information received during the field survey. The contract farmers used mechanical grader for grading that also required 10-12 labourer to operate it. Potato grader graded approximately 1000 bags in a day in context of contract farmers, while non-contract farmers did grading of potato manually. The labour contracts with non-contract farmers at the rate of ₹ 20-25 per bag on acre basis which included picking, grading and packing of the crop (Photo 7.1 and 7.2). The labour absorption was higher for the contract farmers. 26.7 man days per acre were required for one contracted potato crop season while in context of non-contracted potato crop; it was 21.46 man days per acre (Table 7.10). The migrant agricultural labour was also involved for the harvesting and grading of the potato.

Earlier the labour from Bihar comes only during the paddy sowing season, but now they are also coming to Punjab for potato harvesting in groups. This shows that the demand for labour has increased (By Jagdeep Singh, Sidhwan Bet, 40 years old).

Table 7.10

Average Utilization of Labour in Farm Operations

Farm operation (man-days per acre)	Contract farmers		Non-contract farmers	
Land Preparation	2.52		2.51	
Seed treatment	0.97	Male- 0.10 Female- 0.87	1.0	Male- 0.08 Female- 0.92
Sowing and dressing up	6.73		3.24	
Application of fertilizer	0.47		0.53	
Application of pesticide	0.31		0.34	
Irrigation	0.72		0.70	
Rogueing	0.35		-	
Dehaulming	0.33		0.47	
Harvesting and grading	14.3	Male- 8.85 Female- 5.45	12.67	Male- 5.31 Female- 7.36
Total	26.7		21.46	

Photo 7.1

Labour Picking the Potatoes at Non-Contract Farm

Photo 7.2

Labour manually Grading the Potato on Non-contract Farm

7.3.2 Rana Sugars Limited

Manual labour is necessary in sugarbeet cultivation for distinct operations such as cultivating, weeding, blocking, thinning and topping. 26.7 man days per acre were required for the sugarbeet crop season. Around 65 per cent of the total labour was required only for manual weeding operations. More female workers were preferred by the farmers to reduce their cost of cultivation. The female worker is also known for superior quality work due to their seriousness and nimble fingers (Singh, 2003). While in case of traditional wheat crop only 6.58 man days per acre were obligatory. No female worker was involved in the cultivation process of wheat (Table 7.11). In Punjab, female workers were found mainly in picking works of cotton, F&Vs and also in grading related works.

Table 7.11
Average utilization of Labour in Farm Operations

Farm operation (man-days per acre)	Contract farmers		Non-contract farmers
Land preparation	1.56		1.15
Sowing and rowing	1.12		0.83
Blocking and thinning	1.00		-
Application of fertilizer	1.07		1.17
Application of pesticide	0.98		1.12
Irrigation	1.08		0.98
Weeding	17.38	Male- 11.16	-
		Female- 6.02	
Harvesting	2.21		1.33
Total	26.4		6.58

The company started the sugarbeet harvesting from 27 April, 2016. The company sent its own harvester to the field on the sequence basis of sowing dates. Pulling, topping and loading work were done with harvester. 8 per cent of the contract farmers did harvesting manually. The reason behind it was during the peak season of crop harvesting due to heavy workload, the company's harvester sometimes delayed the harvesting work and even one of the farmers revealed that deduction

rate was less on the produce harvested manually due to less quantity of leaves and mud. However, with harvester also the cost remained almost same as the harvester spreads the beets in the field, so to collect those beets from field and loads it into trucks or trolleys labour was required.

7.3.3 Paras Spices Pvt. Ltd.

The use of human labour in cultivation of traditional crops like wheat-paddy in Punjab has declined over a period of time due to mechanization of main farm operations. However, the magnitude of labour absorption was more in high value crops such as chicory. Further, due to mechanization of harvesting of wheat crop manual work has reduced to just one day. On the other hand, chicory harvesting required 4.36 man days/acre. Furthermore, in chicory human labour was also obligatory for adjusting the thin plants (2.40 man days/acre) and weeding (7.21 man days/acre). 23.36 man days per acre were required for one contracted chicory crop season while for non-contracted wheat crop; it was 6.12 man days per acre (Table 7.12).

Thus, results revealed that high value crops grown through contract farming provided more employment opportunities, particularly for women as compared to the traditional non-contract crops. For potato cultivation, women used to involve in seed treatment, picking and grading of potatoes, while for sugarbeet and chicory cultivation, women indulged in manual weeding operations. Both sugarbeet and chicory crop provided about four times more employment than the traditional wheat crop.

Table 7.12
Average utilization of Labour in Farm Operations

Farm operation (man-days per acre)	Contract farmers		Non-contract farmers
Land preparation	2.34		1.20
Sowing and rowing	0.95		0.79
Adjusting sowing space	2.40		-
Application of fertilizer	2.67		1.16
Application of pesticide	1.87		0.99
Irrigation	1.56		0.98
Weeding	7.21	Male- 6.28	-
		Female- 0.93	
Harvesting	4.36		1.00
Total	23.36		6.12

7.4 Summary

The above analysis shows the positive role of contract farming on employment generation and efficient use of resources. Contract farming has improved the income of sugarbeet farmers without impact of selectivity bias. However, the usage of treatment effect model in case of potato and chicory crops shows the selectivity bias by the contact firms for the selection of farmers. The adoption of modern technology with appropriate usage of inputs made the contract farmers more technically efficient and therefore, accepting the fourth hypothesis that the contract farmers production under contract was more efficient due to companies supervision than the non-contract farmers. Also, potato contract farmers required more labour for the seed treatment and grading. Further, in case of sugarbeet and chicory, contract farmers required more labour as compared to their counterparts i.e. farmers growing traditional wheat crop. Thus, the analysis accepts the sixth hypothesis and claims that vegetables grown under contract had more labour absorption capacity as compared to traditional crops.