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Contract Farming in Potato Production: An Alternative for Managing Risk and Uncertainty

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Abstract

The cost of potato cultivation has been found 17 to 24 per cent higher under contract farming over various costs than under non-contract system, mainly due to high investments on seeds, fertilizers and machine power. Yield has been found 255.78 quintals per ha in the contract farms, which is 8.84 per cent higher over the potato yield obtained from the non-contract farms. Gross income has been Rs 99753 per ha in the contract farms as against Rs 41572 per ha in non-contract system. The sale price of potato has been found much higher (Rs 390/q) for contract than non-contract farms (Rs 177 /q). The net return over operational cost (cost 'A_1') has been found as Rs 11882 per ha in non-contract farms, which increased more than five-times under contract farming system, it being Rs 62982 per ha. Similarly, the net return has been found five-and-a-half times more in contract than non-contract system over cost C_1 (without rental value of the land). The net return over cost C_2 has been observed as Rs 51866 per ha for contract farms and only Rs 800 per ha under non-contract system. Benefit-cost ratio on various costs has been found to vary from 1.40 to 1.02 for without contract and from 2.71 and 2.08 for contract farming. The impact of contract farming has been quite visible and remarkably favourable on yield and profitability of potato production at the existing pattern of resource-use and production technology prevalent in the Haryana farming system.

The regression analysis has indicated significant influence of manure and fertilizers and human labour on the return of potatoes grown under contract farming situation. MVP-MFC ratios of plant protection, manure-fertilizers and human labour have been found much higher, indicating tremendous scope to increase the profitability in potato production under contract farming situation whereas in the case of non-contract system, irrigation

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and plant protection have shown sufficient scope to raise the crop income. The yield uncertainty has been less in contract than non-contract potato production. There has been no price uncertainty in the contract farming of potato whereas in the non-contract system, it exits to a large extent due variations in the price of potatoes sold in the market. These findings have clearly underlined the superiority of contract farming over non-contract farming system in potato production.

Introduction

Despite much technological and economic advancements, the condition of farmers continues to be unstable due to uncertainty in crop yields and prices of produce, coupled with the natural calamities. Although the National Agriculture Insurance Scheme covers all farmers and all crops throughout the country with built-in provisions for insulating farmers against financial distresses caused by natural disasters and for making agriculture financially viable, it reaches only those farmers who take loan from the institutions. It needs to be made more farmer-oriented and effective to cover the common farmer, particularly the marginal and small farmers. To protect the resource-poor small farmers from risks in production and price-uncertainty, a practically feasible and sound agricultural policy has to be evolved right from the sowing of crops to post-harvest operations, including market fluctuations in the prices of agricultural produce. The central government continues its efforts towards ensuring remunerative prices for agricultural produce through announcement of Minimum Support Price (MSP) policy for major agricultural commodities, but the perishable and cash crops like vegetables and fruits are still away from the MSP scheme. The price structure and trade mechanism have to be continuously reviewed to ensure a favourable economic environment for the agriculture sector and to create a buffer mechanism to protect the producers against low prices during glut in the market.

To establish an agrarian economy that ensures better prices of agricultural produce to the farmers and good quality raw-material to the agro-based processing industries, commitment-driven contract farming is a viable alternative farming system. It provides assured prices to the farmers and desired farm-produce to the contracting agencies. Several Indian and multinational companies have already initiated such steps in India and have repeatedly demonstrated its success. Contract farming is being tried even for the bulk production of subsistence crops, such as rice, maize and wheat. The governments of Punjab and Haryana are encouraging it as a means of crop diversification. The agricultural products produced by the marginal and small farmers in the remote villages, are seldom found satisfactory for

the demand of agro-processing industries. The agro-based food processing industries require timely supply of quality raw material in adequate quantities. This underlying paradox of the Indian agriculture has given rise to the concept of contract farming. It promises to provide a proper linkage between the farm and the market. Recognizing the need for and merits of such a linkage for the farming community, several corporates involved in agro-commodity marketing, processing, exports, etc. have attempted to establish convenient systems to ensure timely and consistent supply of raw materials of the desired quality at pre-agreed cost. The contract farming covers loose buying arrangements, simple purchase agreements, supervised production with input provision, with possibly tied loans and risk coverage. It usually involves four basic elements — pre-agreed price, quality, quantity (minimum /maximum) and time for supplying of products.

The contract farming is emerging as an important tool for reducing risk in crop production and minimizing price uncertainty of the produce. As it is a new mechanism in Indian agriculture, it needs to be studied in detail whether involvement of the corporate sector in agriculture is beneficial to the producers /farmers. Is it helpful in increasing the yield and income of the farmer at farm level? Is it viable in the socio-economic environment of the small and resource-poor farmers? The present study was planned to get answers to these questions and was undertaken in Haryana. It has examined the impact of contract farming system on potato production with special reference to (i) resource-use efficiency of important inputs and their impact on yield and return for the crop, and (ii) estimation of uncertainty involved in yield and price in potato production at the existing pattern of resource-use and production technology adopted by the farmers.

Data and Methodology

The study is based on the primary data collected from 54 respondents of Haryana through an intensive enquiry. The districts of Karnal, Kurukshetra and Ambala in Haryana were selected purposively because the potato contract farming is being undertaken by a Delhi-based company, M/s DCM Shriram Consolidated Limited (DSCL) in these aras. The contracting agency (DSCL) had covered a large area in north Haryana during the year 2003-04 under the potato production programme with a view to procure raw material for making potato chips. The Indri block of Karnal district, Ladwa and Sahabad blocks of Kurukshetra district and Ambala and Barara blocks of Ambala district were chosen purposively considering the concentration of production programme of DSCL in this area. The villages were selected randomly, three each from Indri and Ladwa blocks, two from Barara block and one each from Sahabad and Ambala blocks. A

sample of 27 respondents was drawn having contract with the DSCL for potato production during the year 2003-04. The number of farmers in each of the selected villages was kept in proportion to the total number of the farmers undergone contract with the DSCL during the year. The non-contract farmers were also selected randomly from these villages in equal number to compare the efficiency under contract and non-contract farming systems of potato production. Thus, a total of 54 farmers were interviewed for collection of data from 10 villages under 5 blocks of 3 districts in Haryana.

The input-output coefficients of potato crop along with their prevalent market prices were recorded on pre-structured questionnaires and schedules during the crop year 2004. The cost concept 'A_1', 'A_2', 'B_1', 'B_2', 'C_1' and 'C_2' was adapted to explain the economics of crop enterprises. Cost 'A_1' included all the direct expenses incurred on crop production in cash and kind, whereas cost 'A_2' included cost 'A_1' plus rent paid for the leased-in land. Cost 'B_1' included cost 'A_2' plus interest on the value of fixed assets (excluding land). Cost 'B_2' covered cost 'B_1' plus rental value of the owned land (minus revenue). Cost 'C_1' included cost 'B_1' plus imputed value of family labour and cost 'C_2' included cost 'B_2' plus imputed value of family labour. The costs of hired and family labour were estimated on the basis of average market rates prevalent for hiring labour in the locality whereas cost on machinery was charged as per the existing hiring rates of these machines in the area for various agricultural operations. Interest on the working capital was charged at the rate of 12 per cent per annum whereas cost of fixed capital was considered @ 10 per cent of the total fixed assets, excluding the value of land. The rental value of owned land was charged at the rate of Rs 20,000 per ha as per prevalent rate in the area and was estimated as Rs 10,000 per crop season.

Beside the common tools for statistical analysis, the linear and Cobb-Douglas production functions analyses were tried to establish statistical relationship between selected inputs and gross income in potato production under the two farming situations. Finally, the linear production function analysis was adopted. The least square method was used to estimate resource-use efficiency for the crop grown under contract and non-contract farming systems. Before undertaking the regression analysis, zero order matrixes were estimated for both the systems to test the multicollinearity amongst the input variables. The following form of the linear production function model was adopted to explain the impact of contract farming system on input-use efficiency [Equation (1)]:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + U \quad \ldots(1)$$

where,

Y = Gross income received from potato production (Rs/ha)

X_1 = Human labour (Rs/ha)

X_2 = Machine power (Rs/ha)

X_3 = Cost of manure and fertilizers (Rs/ha)

X_4 = Cost on plant protection measures (Rs/ha)

X_5 = Irrigation charges (Rs/ha)

b_1……. b_5 = Regression coefficients of the respective variables

a = Intercept, and

U = Error-term.

The resource-use efficiency can be measured on the basis of marginal value productivity (MVP) and the marginal factor cost (MFC) of a particular input. Therefore, in the present study, the resource-use efficiency was worked out by comparing MVP with the corresponding MFC. The yield uncertainty ratio was estimated with the help of the following formula (Dileep *et al.*, 2002) [Equation (2)]:

$$\text{Yield Uncertainty Ratio} = \frac{\text{Average Highest Probable Expected Yield} - \text{Average Lowest Probable Expected Yield}}{\text{Average Most Probable Expected Yield}} \quad \ldots(2)$$

Similarly, the price uncertainty ratio was calculated using formula (3):

$$\text{Price Uncertainty Ratio} = \frac{\text{Average Highest Probable Expected Price} - \text{Average Lowest Probable Expected Price}}{\text{Average Most Probable Expected Price}} \quad \ldots(3)$$

Framework of Contract Farming

Contract farming is a system for the production and supply of agricultural produce under agreement between producer and buyer. There are several types of price fixation models, viz. Pepsi model, Tripartite model, Tamilnadu model, etc. prevalent for price fixation was followed. The terms and nature of a contract may differ as per the variety of crops, agencies, farmers and practised-technologies and the context in which they are practised. In the present study, the contract farming was undertaken for the production of potato (variety Chipsona-1) under forward contract between

the farmers and the contracting agency, DCM Shriram Consolidated Limited (DSCL). The DSCL has established a potato procurement-cum-input supply centre, locally called as 'Hariyali Kisaan Bajaar', at the village Lathi Dhanaura on Ladwa-Indri road in the Kurukshetra district of Haryana. The DSCL provided the seeds of potato (variety Chipsona-1) to the selected farmers at the rate of Rs 900 per quintal and technical know-how free of cost as and when required. Under the arrangement, the farmers were to sell their produce on a prefixed price of Rs 390 per quintal to the DSCL and the seed was made available to farmers by the contracting agency. The contracting agency had fixed the procurement price of potato by working out the cost of cultivation and including sufficient profit at average yield. The contracting agency had to procure the produce from the farm gate at the prefixed price. The size and maturity of the potatoes along with the percentage of ingredients were also prefixed and mutually agreed by the producer and the contractor.

Results and Discussion

Economics of Potato Production

The operational cost, i.e. Cost A_1, of potato production was Rs 29,690 per ha on non-contract farms, and was slightly higher (Rs 36,771 /ha) in the case of contract farms. The total cost of production, i.e. Cost C_2, was 17.45 per cent higher for contract farming, it being Rs 47,887 per ha as compared to Rs 40,772 per ha without contract. The costs of potato cultivation, presented in Table 1, depict that the cost was about 17-24 per cent higher over various costs under contract farming than non-contract farming. The higher production cost in contract farming was mainly due to higher investments on machine power, seeds, manure and fertilizers by this group of farmers. The cost of potato seeds was higher in contract farms as the contracting agency had arranged good quality seeds along with the recommended package of practices, suitable guidelines and timely supervision of the crop by the expert scientists. The cost on weedicides and plant protection measures was significantly higher in the case of non-contract farms. This indicates that the incidence of weeds and insects, pests and diseases was more on non-contract potato farms, which required more investment to control these problems.

Yields and returns from potato cultivation under contract and non-contract farming situations are summarized in Table 2. It is evident from the results that the yield of potato was 255.78 quintal per ha in the contract farms, which was 8.84 per cent higher over the yield obtained from the

Table 1. Cost of potato cultivation with and without contract on the sample farms

(Rs/ha)

Particulars	Without contract	With contract	Increase / decrease %
Hired labour charges	2483	2637	6.18
Machine power charges	3875	6721	73.44
Cost of seeds	17165	20219	17.79
Cost of farmyard manure	967	1106	14.44
Cost of fertilizers	2771	3773	36.14
Irrigation charges	463	495	6.89
Cost of weedicides	367	223	-39.18
Cost of plant protection	733	526	-28.33
Interest on working capital	864	1071	23.85
Cost A_1	29690	36771	23.85
Rent paid for lease-in land	0	0	0.00
Cost A_2	29690	36771	23.85
Overhead cost	432	536	23.85
Cost B_1	30122	37307	23.85
Rental value of owned land	10000	10000	0.00
Cost B_2	40122	47307	17.91
Family labour days	650	580	-10.77
Cost C_1	30772	37887	23.12
Cost C_2	40772	47887	17.45

non-contract farms. The gross income was about 140 per cent more in contract than non-contract farms. The remarkable difference between the gross income of the two systems was mainly due to higher price (Rs 390 / q) provided by the contracting agency to contracting farmers on one hand and the lower price in the local market (average Rs 177 /q) for potatoes grown on non-contract farms, on the other hand. Also, the yield of potatoes in contract farms was much higher than that in non-contract farms. It highlights the advantage of contract farming of potato over the non-contract system. The net return over operational cost (cost 'A_1') was Rs 11882 per ha for non-contract potato production, which increased by 430 per cent when grown under contract system, it being Rs 62982 per ha. The net return was 473 per cent higher under the contract system over cost C_1 (without rental value of the land) as compared to that under non-contract system. The net return over cost C_2 was Rs 51,866 per ha for contract farms whereas it was only Rs 800 per ha in the case of non-contract system. The benefit-cost ratio (BCR) of potato over various costs varied from 1.40 to 1.02 under non-contract system whereas it ranged between 2.71 and 2.08 under the contract farming system. The BCR was 94 to 104 per cent higher under

Table 2. Economics of potato cultivation with and without contract on the sample farms

Particulars	Without contract	With contract	Increase / decrease, %
Yield (qt/ha)	235	256	139.95
Gross income (Rs/ha)	41571	99753	139.95
Net income (Rs/ha) over			
Cost A_1	11882	62982	430.06
Cost A_2	11882	62982	430.06
Cost B_1	11450	62446	445.40
Cost B_2	1450	52446	3517.93
Cost C_1	10800	61866	472.85
Cost C_2	800	51866	6386.38
Benefit-cost ratio over			
Cost A_1	1.40	2.71	93.74
Cost A_2	1.40	2.71	93.74
Cost B_1	1.38	2.67	93.74
Cost B_2	1.04	2.11	103.51
Cost C_1	1.35	2.63	94.89
Cost C_2	1.02	2.08	104.30
Cost of potato production (Rs/q) over			
Cost A_1	126.34	143.76	13.79
Cost A_2	126.34	143.76	13.79
Cost B_1	128.18	145.85	13.79
Cost B_2	170.73	184.95	8.33
Cost C_1	130.94	148.12	13.12
Cost C_2	173.50	187.22	7.91

contract than under non-contract potato production. These findings clearly revealed the positive influence of contract system of potato production on yield and return of the crops at the existing pattern of resource-use and production technology prevalent in the Haryana farming system. Similar results have been reported for the contract farming of vegetables by Dileep *et al.* (2002) and Khemnar *et al.* (1994) in their studies.

The per quintal cost of potato production estimated for both the farming situations portrays that the cost of per quintal potato production was 8 to 14 per cent higher for the contract farms over various costs. It was due to the fact that the contract farmers had applied more critical market inputs, which resulted in higher yield of better quality potatoes and fetched higher price of the produce in the market.

Resource-use Efficiency

The results of ordinary least square analysis of the linear production function with and without contract farming system of potato production are presented in Table 3. The zero-order correlation matrix was estimated before running the multiple correlations to test the multicollinearity amongst the input variables. The results estimated for contract farms did not show any significant multicollinearity between the independent variables and hence, all the five variables, viz. human labour, machine power, manure and fertilizers, irrigation and plant protection, were included in the regression equation (Appendix I). In the case of non-contract farming system, human labour depicted high multicollinearity with the manure and fertilizers and plant protection variables. Therefore, the human labour variable was dropped from the analysis to overcome the problem of multicollinearity. The coefficient of multiple determination (R^2) was significant at 5 per cent level of probability in both the production systems. The R^2 value indicated 79 per cent variation in the gross income from potato production because of variation in the use of machine power, manure and fertilizers, irrigation and plant protection inputs considered for analysis under the non-contract farming situation. In the case of contract farms, the R^2 value indicated 75 per cent variation in the gross income due to variation in the use of five input resources considered for the analysis. Out of the five inputs, four showed positive regression coefficients (bi) for potato produced under contract farming whereas irrigation indicated negative but non-significant

Table 3. Estimates of production function analysis for potato produced with and without contract on the sample farms

Particulars	Without contract	With contract
Intercept (a)	16220.20	- 36020.60
Human labour (Rs/ha)	-	16.2757**
		(4.5906)
Machine power (Rs/ha)	2.3967	4.4488
	(1.3321)	(3.0363)
Manure and fertilizers (Rs/ha)	- 0.7386	12.6572**
	(1.0151)	(2.5467)
Irrigation charges (Rs/ha)	17.8361*	- 2.9615
	(7.6436)	(15.9095)
Plant protection expenses (Rs/ha)	10.0218**	37.9606
	(1.7968)	(23.1427)
Coefficient of multiple determination (R^2)	0.7944*	0.7513*

Note: Figures within the parentheses denote standard error of the respective variable.
* Significant at 5% level of probability.
** Significant at 1% level of probability.

value of bi. The coefficients of human labour and manure and fertilizers were highly significant at 1 per cent level of probability, indicating a remarkable impact of these inputs on the return of potato grown under contract farming. The values of bi for irrigation and plant protection were positive and significant in non-contract production system; it depicts their favourable influence on potato cultivation in this system. Manure and fertilizers showed negative but non-significant value of bi for non-contract farms. These results established the fact that human labour and fertilizers under contract farming and irrigation and plant protection under non-contract farming have quite visible and favourable impact on the gross return from the crop at the existing pattern of resource-use and production technology adopted by the farmers for potato production.

Marginal Value Productivity

The resource-use efficiency was assessed by estimating marginal value product (MVP) of the important inputs used for crop production on the selected irrigated farms with and without contract systems. The ratio of MVP and marginal factor cost (MFC) explains economic performance of the inputs. The results of the analysis, presented in Table 4, revealed that MVP-MFC ratios of plant protection, human labour and manure and fertilizers were much higher amongst all the five inputs considered for the analysis under contract farming system. The MVP-MFC ratio for plant protection was the highest amongst all the inputs applied for potato cultivation. It was 37.96 on contract farms and 10.02 in non-contract farms, indicating a considerable scope for increasing the crop income under both contract as well as non-contract farming systems. The MVP- MFC ratio of human labour was 16.28 for the contract farms, which indicated sufficient scope to raise the return from higher use of labour on potato cultivation in these farms. The MVP-MFC ratio for manure and fertilizers was 12.66 under contract farming and was negative under non-contract farming situation. It depicts the fact that there was remarkable scope for increasing the profitability on the contract farms by increased use of manure and fertilizers at the existing level of technology adoption but in the non-contract farming system, use of fertilizers should be rationalized at the prevalent pattern of resource-use. The MVP-MFC ratio of irrigation (17.84) for non-contract farms highlights possibilities for increasing the profitability on the non-contract farms through application of more irrigation water in potato cultivation. The negative ratio of irrigation under contract farming indicates that there was excess use of irrigation water on these farms. The MVP-MFC ratios of machine power were 4.45 and 2.40 for contract and non-contract farms, respectively, indicating comparatively less scope to raise the return from more use of machine labour.

Table 4. Marginal value product (MVP) and marginal factor cost (MFC) ratio for the selected inputs used for potato production (gross income) with and without contract on the sample farms

Particulars	MVP-MFC Ratio	
	Without contract	With contract
Human labour	-	16.28
Machine power	2.40	4.45
Manure and fertilizers	- 0.74	12.66
Irrigation	17.84	- 2.96
Plant protection	10.02	37.96

Yield and Price Uncertainty in Potato Production

It is difficult to predict uncertainly in the yield and price of agricultural products, in general and fruits and vegetables, in particular because the future events cannot be predetermined empirically and are subjected to a number of parameters like climate, socio-economic circumstances and natural calamities, etc. occurring in a particular area. For estimating the uncertainty in yield of potato, yield uncertainty ratio was calculated. The results of the analysis, presented in Table 5, revealed that the yield uncertainty ratio was 0.61 for contract farms and 0.85 for non-contract farms. This shows that the yield uncertainty was less in contract than non-contract potato production. It may be due to the fact that the contract farmers had used good quality seeds, followed the recommended package of practices and availed steady guidance and timely supervision of the scientists of the contracting agency who visited their fields during the cropping season.

The price uncertainty was measured for contract and non-contract farms using price uncertainty ratio formula and the results are presented in Table 6. It is evident from these results that there was no price uncertainty in the case of contract farming system of potato production. The contracting agency procured the produce on the fixed price, as agreed by both the producer and the purchaser in advance. As per contract, the whole produce was purchased by the contracting agency, and the farmers were also bound to sell their produce to the agency at the prefixed rate. The price uncertainty ratio was 0.48 for the non-contract farms, as there was much variation in the price of potato in the market depending upon its quality, quantity marketed, place and location of sale and means of transportation and communication, etc. These results clearly underline the superiority of contract farming system over traditional non-contract farming in price and yield uncertainty of potato production. Similar results have been reported by Dixit *et al.* (1999) and Chandel *et al.* (1997).

Table 5. Estimates of yield uncertainty in potato production with and without contract farming on the sample farms

Particulars	Average expected yield (q/ha)			Yield uncertainty ratio
	Highest probable yield	Lowest probable yield	Most probable yield	
Contract farming	351.11	193.42	257.05	0.61
Without contract farming	310.05	112.50	233.33	0.85

Table 6. Estimates of price uncertainty in potato production with and without contract farming on the sample farms

Particulars	Average expected yield (q/ha)			Yield uncertainty ratio
	Highest probable price	Lowest probable price	Most probable price	
Contract farming	390.00	390.00	390.00	0.00
Without contract farming	250.00	140.00	230.00	0.48

Conclusions

The cost of cultivation, crop yield, gross income and net income over various costs have been found higher under contract farming as compared to the non-contract system of potato production. The benefit-cost ratio is almost double under contract farms as compared to that in non-contract farms. The regression analysis has revealed a significant and favourable impact of fertilizers and human labour on the return of potato crops under contract situation. The MVP-MFC ratio is considerably high for plant protection and fertilizers under contract farms which indicates scope for increasing the profitability on the farms by increased use of these inputs at the existing level of technology and resource-use pattern. The profitability could be increased by the rational use of irrigation under contract farms and manure and fertilizers non-contract farms The yield and price uncertainty has been found higher for non-contract than contract farms. The average price received by the potato growers is much higher in contract than non-contract farms. No price uncertainty has been observed in case of contract farming system of potato production. It is revealed that resource-use efficiency can be increased, yield uncertainty can be reduced and price uncertainty minimized through adoption of contract farming in potato production.

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Appendix I

Zero order correlation matrixes estimated for the selected variables used in potato production with and without contract farming on the sample farms

Variables	X_1	X_2	X_3	X_4	X_5
Contract Farming System					
Human labour (X_1)	1.00	-0.17	0.05	0.16	0.35
Machine power (X_2)		1.00	-0.22	-0.16	0.12
Manure and fertilizers (X_3)			1.00	0.35	0.31
Irrigation (X_4)				1.00	0.15
Plant protection (X_5)					1.00
Non-Contract Farming System					
Human labour (X_1)	1.00	0.28	0.84*	0.09	0.60*
Machine power (X_2)		1.00	0.43	0.49	-0.33
Manure and fertilizers (X_3)			1.00	0.16	0.13
Irrigation (X_4)				1.00	-0.20
Plant protection (X_5)					1.00

* Significant at 5% level of probability.