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An Empirical Study of Gains from Potato Contract Farming

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I

INTRODUCTION

Agricultural economies of developing countries including India are characterised by low productivity with the dominance of subsistence production especially among small growers. Even though commercialisation can yield substantial gains, the transition from subsistence farming to market-driven production is fraught with perils. First, market volatility is an enduring feature of commodity markets. This makes cultivation of cash crops risky. Second, as incomes grow, consumer taste shifts in favour of processed foods. Small farmers are too remote from consumers to track their preferences. Third, small farmers typically lack capital and technical expertise to undertake cash crop production, which are usually more input intensive than subsistence crops (Ramaswami *et al*., 2006). On the other hand, agricultural processing firms very often face the problem of acquiring good quality raw material. In the open market there is no guarantee of uninterrupted supply of the material and it is very difficult to trace back the origin of the produce. Hence, contract farming, if carefully planned and executed, provides a win-win situation for both the producer and processors. It ensures better linkage between farm and market where processor gets timely and consistent supply of raw material of the desired quality at low cost.

MANAGE (MANAGE, 2006) defines contract farming as a system for the production and supply of agricultural/horticultural produce under forward contracts between producers/suppliers and buyers. The essence of such an arrangement is the commitment of the producer/seller to provide an agricultural commodity of a certain type, at a time and a price, and in the quantity required by a known and committed buyer. Indian agriculture is now more interlinked with world agriculture than ever before. In the context of liberalised global trade regime, among different possible avenues that could safeguard the interest of small and marginal farmers, contract farming is the most convenient and safer option (Kiresur *et al.*, 2002). With the initiation of boom in retailing sector, the contract farming gets further fillip. A number of big companies both national and MNCs are setting up retail chains.

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Majority of their agricultural supply will come through the backward linkage by contract farming. The National Agricultural Policy (2000) announced by the Government of India sought to promote contract farming by involving the private sector in order to accelerate technology transfer, capital inflow and assured marketing of crop production (Asokan, 2005).

Contract farming has a major role to play in the potato processing sector in India (Pandit and Pandey, 2007). Prior to nineties, potato processing sector in India was very poorly developed. One of the major reasons was the lack of sufficient processing grade potatoes due to unavailability of suitable varieties. With the introduction of indigenous processing varieties like Chipsona I, II, III and foreign varieties like Atlantic and Kennebec, significantly more potato area is now become suitable for growing potato for processing. A number of big potato processing companies set up their plants, the raw materials for which are mainly collected through contract farming. Pepsi foods is one of the earliest entrants in the food processing sector in India. Its Frito-Lays division makes popular 'Lays potato chips'. It established processing plants in Maharashtra, Punjab and West Bengal.

However, notwithstanding the theoretical benefits, contract farming has been controversial and has been criticised for being exploitative. Farmers have little bargaining power against the giant corporation. Sometimes growers encountered the problems of manipulation of quality standards, poor technical assistance, and sometimes plain cheating and deliberate default (Glover, 1989). On the other hand, the companies also face the problem of selling of the produce in the open market by the farmers, if the market price rules higher than the contract price. Against this backdrop, it is imperative to study the performance of contract farming at the field level. However, most of the literature discussed the general issues of contract farming in India. Some studies like Asokan and Singh (2003) Kumar *et al.,* (2007) dealt with some specific issues like conduct, performance and constraints of contract farming. But it will be important to know how farmers benefited from the contract farming. Therefore, this paper empirically analyses the gains from contract farming from the farmers point of view. Besides, the technical efficiency was also estimated using Data Envelopment Analysis technique for both the contract farmers as well as non-contract (ordinary) farmers in the present study.

II

METHODOLOGY

The contract farmers in the present study were the potato farmers who were under contract with the Frito Lays of Pepsi. The factory is located in Sankrail of Howrah district. The primary data were collected through survey work conducted during March-April, 2008. Four districts of West Bengal, viz., Hooghly, Bankura, Burdwan and Howrah were selected purposively due to the presence of higher concentration of contract farmers. A total of 13 blocks, minimum 3 from each district were selected

purposively depending upon the concentration of the contract farmers from each district. Data were collected from the 144 contract potato growers and 139 ordinary or non-contract potato growers spread over 76 villages. The samples of contract and non-contract growers were drawn randomly preferably from the same location.

Analytical Framework

The socio-economic analysis and economics of potato production was worked out with the help of simple tools of mathematics, i.e., averages percentages, etc. Instead of conventional cost concepts like cost A_1, A_2, etc. Here the cost has been calculated operation-wise to compare the cost structures between contract and non-contract method of production in each stage of cultivation.

Technical efficiency is the ability of a farm/firm to achieve maximum possible output with the available resources. In India most of the studies of technical efficiencies have been done in the recent past. Moreover, the studies have been attempted mainly on the field crops like, paddy (Mythili and Shanmugam, 2000; Shanmugam, 2003; Goyal *et al*., 2006), maize (Rao *et al.,* 2003; Anupama *et al.,* 2005), wheat (Singh, 2007), cotton (Shanmugam, 2003), edible oil (Mrutyunjaya *et al.,* 2005), groundnut (Shanmugam, 2003), etc. The research works carried out in India related to efficiency analysis on horticultural crop is scanty. Moreover, most of the efficiency analysis studies employed stochastic frontier production function, which requires some assumptions. In this study, similar to Kumar *et al.* (2005), Data Envelopment Analysis (DEA), a non-parametric technique of technical efficiency estimation was employed.

It uses a mathematical program to estimate the efficiency frontier. It does not need the pre-specification of the production function coefficients. Unlike parametric approaches, DEA makes no assumption of the distribution of the underlying data, and all deviations are assumed to be due to inefficiency (Banker *et al.,* 1989). DEA analyses farms separately while measuring its efficiency relative to all the observations in the sample. Let X be the input matrix of order $k \times n$ and Y the output vector. Here k is the number of inputs. Thus, for i-th farm, Xi and Yi represent the respective inputs and output. Now the problem reduces to obtaining a ratio measure $\mu'Yi/\nu'X_i$ where μ and ν are the output and input weights, respectively. Optimal weights are obtained by solving the following mathematical program:

$$\text{Max}_{\mu,\nu} \ (\mu_i' Y_i / \nu_i' X_i)$$

Subject to

$$\mu' Y_j / \nu' X_j \ \leq \ 1 \ , \qquad j = 1, \ldots, n$$

$$\mu, \nu \geq 0$$

In order to avoid infinite number of solutions, imposing a constraint $\nu' X_j = 1$, we get

$$\min_{\theta,\lambda} \theta$$

subject to

$$-y_i + Y\lambda \geq 0$$

$$\theta x_i - X\lambda \geq 0$$

$$\lambda \geq 0$$

Here, θ is a scalar and λ is an $n \times 1$ vector of optimal weights. θ represents the technical efficiency (TE) corresponded to constant return to scale (CRS). Imposing an additional constraint $1'\lambda = 1$ gives the technical efficiency under variable return to scale (VRS). Efficiency measurements by the DEA model can be used to determine both pure technical and scale efficiencies (TE_{CRS}/TE_{VRS}). The product of these two gives the overall technical efficiency. Efficiency scores in this study are estimated using the computer program, DEAP Ver. 2.1. described in Coelli (1996).

III

RESULTS AND DISCUSSION

Contract Farming Scheme

Frito Lays is undertaking contract farming in several states of India. The quantity under Pepsico contract farming programme has grown almost five times since 2003. The number of farmers contracted has jumped from 800 in 2003 to almost 11000 in 2007. Acreages under contract has grown from 2000 acres to 11600 acres in 2007 (Mukkavilli, 2008).

The potato contract of Frito-Lays in West Bengal is an instance of a "production management" contract where the company supplies inputs and extension, advances credit (in kind), provides price insurance and monitors grower effort through frequent inspections. During 2007-08 about 1650 acres were under direct contract in 7 districts of West Bengal, viz., Hooghly, Bankura, Burdwan, Birbhum, Paschim Medinipur and Howrah. The farmers had been provided seed largely on credit. The company also provided insecticide and pesticide at cost, but this was optional for the farmers. The contract growers supplied land, labour and other variable inputs. It has been seen that the contract agreement was largely verbal. No Government functionary was involved in the contract farming programme. In some places the agreement was not very clear to the farmers and hence, disputes arise. Vendor was appointed by the company who manages the total affair for a group of villages. He is generally an influential person in the society. The big farmer, potato trader, co-operative society etc. were some of the vendors. Technical aspects were looked after by the field agents. He sorts out

problems especially regarding disease/pest, cultural practices and visits the farmer frequently. The whole production process was closely monitored to ensure the quality production. Monitoring was also helpful for maintaining good relationship. The price was fixed well before planting. In the open market price fluctuates vigorously. Thus, a farmer received considerable price insurance in the contract farming. However, the price fixed was not uniform across the state. Depending upon the vendor, it was fixed for whole produce or graded produce. In some places some incentive was provided with the base price. Incentive was given on the basis of 'pay for performance', i.e. for quality produce and good cultural practices. Farmers' responsibility ended at heap making in the field or in some cases he had to bring the produce upto the road head. The seed of the variety Atlantic was supplied @ Rs. 2000/q to the farmers. The technical help was provided free of cost.

Socio-Economic Profile of the Potato Farmers

The analysis of socio-economic profiles is very important since they provide the status of society in which farmers operate. Moreover, they exert profound influence on the farmer's decision making pattern. Table 1 presents the potato farmers socio-economic profiles and it could be seen that the contract farmers were more experienced and have more years of schooling. The social participation was significantly more in case of contract farmers. Social participation, i.e., member or office bearer of co-operative societies, religious bodies, political parties, etc. helps farmers to venture out for new scheme of production like contract farming.

TABLE 1. SOCIO-ECONOMIC PROFILE OF THE POTATO FARMERS

Parameter	Non-contract farmers	Contract farmers
(1)	(2)	(3)
Age (Years)	42.56	44.05
Years of schooling	8.03	9.10
Family size (number)	6.38	6.98
Social participation (per cent of farmers)	40.58	54.41
Per cent of total income comes from		
Farming	88.09	85.97
Service	1.18	4.15
Pension	0.07	1.83
Business	3.09	6.86
Others	7.57	1.19
Operational holdings (ha)	1.03	1.46

Table 1 also shows that in addition to the larger operational holding, the contract farmers got comparatively higher share of their total income from the non-farm sources. However, except social participation the difference in other parameters was not very much acute. In fact the company does not discriminate the farmers to include them in the contract farming scheme. But comparatively small and poor farmers hesitate to join the programme.

Varietal Performance

It would be interesting to determine the varietal preferences and yield difference of different potato varieties between these two groups of farmers. Table 2 shows that Atlantic was cultivated only by the contract farmers and it occupied about 43 per cent of their potato area. Frito-Lay gave only Atlantic variety for contract farming. K. Jyoti was the predominant variety for both categories of farmers, the area under it being about 70 and 44 per cent for ordinary and contract farmers, respectively. K. Pukhraj and K. Chandramukhi were the other major varieties. It is interesting to note that the yield level of all the varieties were comparatively lower in contract farmers as compared to non-contract farmers. The possible reasons is that contract farmers devote superior quality land to contract production and also much of his attention are grabbed by the contract cultivation.

TABLE 2. VARIETAL PERFORMANCE

Variety (1)	Particulars (2)	Non-contract farmers (3)	Contract Farmers (4)
Atlantic	Per cent of potato area	0.00	42.96
	Average yield	-	199.70
K. Jyoti	Per cent of potato area	69.45	43.88
	Average yield	244.37	227.30
K. Chandramukhi	Per cent of potato area	9.29	3.23
	Average yield	261.03	244.60
K. Pukhraj	Per cent of potato area	19.67	8.71
	Average yield	291.02	289.80
Others	Per cent of potato area	1.60	1.04
	Average yield	341.05	645.78
Actual weighted average harvest price (Rs./quintal)	ATL	-	450.94
	K. Jyoti	229.31	239.25

The price fixed in the contract system was not uniform across the state. However, the average price of Atlantic was much higher than the K. Jyoti. It is also to be noted that the contract farmers could fetch higher prices even for K. Jyoti than the ordinary farmers. This may be due to their higher social influences. The yield of Atlantic was comparatively less as compared to the next most popular variety Kufri Jyoti. The yield difference may be due to the genetic potential and altered crop geometry. Traditional geometry cannot give processed grade potatoes. Replacing the traditional geometry with advanced geometry increase the process grade yields, while the total yield may drop (Mukkavilli, 2008). In some places farmers complained about the poor quality of supplied seed which may also be one of the reasons. When vendors do not purchase the whole produce, farmers faced the problem of disposing off the rejected potatoes. Due to the bad taste of Atlantic for table purposes, its consumption at home is minimal. Therefore, farmers require a good processing variety which will be of short duration (85-90 days), good yielder (at least at par with

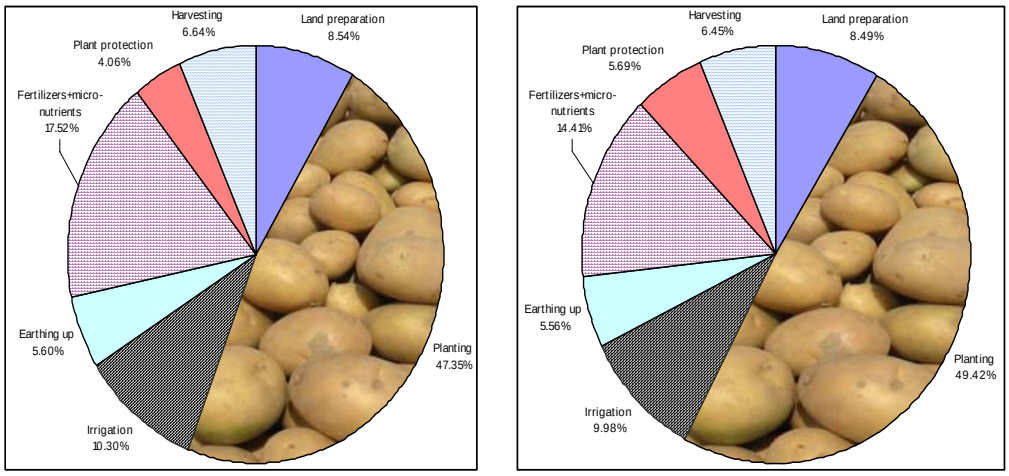
K. Jyoti) and having good taste for table purpose. However, by and large, farmers were happy about the return of contract farming as market price plummeted to a very low level for K. Jyoti in that year.

Economic Analysis of Potato Cultivation

The details of economic analysis are presented in Table 3. The table shows that farmers had to spend Rs. 70,705 and Rs. 74,909 per hectare for cultivation of K. Jyoti and Atlantic, respectively. For same variety K. Jyoti, the contract farmers spent about Rs.4000 less per ha for cultivation as compared to non-contract farmers. This difference was mainly due to the higher seed price and higher dose of fertiliser applied by the non-contract farmers. Higher seed prices in case of non-contract farmers were due to purchase of more percentage of seed coming from the external sources. When K. Jyoti in all farmers and Atlantic was compared it could be seen from the table that the contract farmers spent Rs. 4000 more for cultivation of Atlantic as compared to K. Jyoti. The components for which farmers had to spend more are land preparation, earthingup and plant protection. Deep ploughing and thick ridge make land preparation and earthingup to cost more. The field agents of contract farming recommended expensive plant protection chemicals like Acrobat, Curzate, Crocide, etc. Although the purchase of plant protection chemical was optional, but many farmers purchased those to protect their crops. The higher plant protection cost for K. Jyoti for contract farmers is due to the same reason as compared to ordinary farmers. The percentage share of different cost components have been presented in Figure 1.

TABLE 3. ECONOMIC ANALYSIS OF CONTRACT AND NONCONTRACT POTATO PRODUCTION

	Kufri Jyoti			Atlantic
Particulars	Non-contract farmer	Contract farmer	Overall	Contract farmer
(1)	(2)	(3)	(4)	(5)
Cost of cultivation (Rs./ha)				
Land preparation	5945	6138	6036	6358
Planting	35427	31372	33478	37021
Irrigation	7297	7262	7280	7478
Earthing up	3824	4104	3958	4163
Fertilisers+micro-nutrients	13179	12376	12386	10791
Plant protection	2601	3172	2872	4264
Harvesting	4646	4748	4695	4833
Total cost	72920	69171	70705	74909
Avg. yield (qtl/ha)	244.37	227.30	235.58	199.70
Production cost (Rs./qtl)	317.54	293.05	303.84	375.10
Harvest price (Rs./qtl)	229.31	239.25	234.53	449.82
Gross return (Rs./ha)	52660.00	56472.62	54575.59	89830.73
Net Return (Rs./ha)	-20259.90	-12698.32	-16129.52	14921.92
B:C	0.72	0.82	0.77	1.20



K. Jyoti (for overall farmers) Atlantic

Figure 1. Percentage Share of Different Cost Components

Figure 1 indicates that the major cost components were cost of planting, fertilisers and micronutrients, irrigation and land preparation both for K. Jyoti and Atlantic. The share of planting and plant protection was more in Atlantic as compared to K. Jyoti. Though the yield level of Atlantic was lower but the net return was much higher than that of K. Jyoti. Both the categories of farmers incurred losses in cultivating K. Jyoti but Atlantic gave handsome return of around Rs.15000 per hectare. This was due to the higher prices received by the contract farmers for Atlantic. Tripathy *et al.,* (2005) also found significant better profitability of potato production in Haryana contract farming system. Similarly Singh (2002) also observed that contracting has led to higher farm incomes and more employment for labor in Punjab. Hence, the above discussion concludes that the contract farming is an economically viable enterprise for the farmers. However, it is required to study the long term impact of contract farming by taking multiple years data.

Technical Efficiency

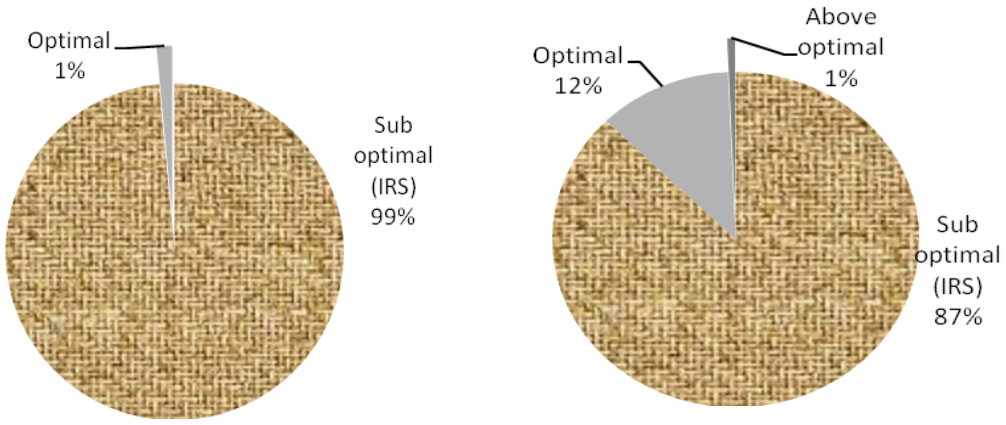
Data Envelopment Analysis was employed to estimate the technical efficiencies. All the inputs and output were converted into their monetary units. The analysis showed that the average measure of overall technical efficiency was 40 per cent for non-contract farmers and 68 per cent for contract farmers. Average scale efficiency was estimated at 47 per cent and 77 per cent for non-contract and contract growers, respectively, while the figures for pure technical efficiency were 86 per cent and 89 per cent, respectively. Hence the results indicated that the contract potato farming was more efficient in all the three measures of technical efficiencies. Further average efficiency scores indicate that the scale in-inefficiency (53 per cent and 23 per cent)

was primarily responsible for the overall technical inefficiency as compared to the technical inefficiency (14 per cent and 11 per cent). The analysis indicates contract and non-contract potato farms can, on an average, reduce their inputs by 60 per cent and 32 per cent, respectively by operating at an optimal scale and by eliminating pure technical inefficiencies through the adoption of best practices of the efficient farms of the farms.

TABLE 4. EFFICIENCY MEASURES OF POTATO GROWING FARMS

	Overall technical efficiency		Scale efficiency		Pure tech efficiency	
Particulars	Non-contract	Contract	Non-contract	Contract	Non-contract	Contract
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average	0.40	0.68	0.47	0.77	0.86	0.89
Minimum	0.02	0.20	0.03	0.25	0.56	0.25
No. of Efficient farms	1.00	17.00	2.00	17.00	29.00	46.00
Standard Deviation	0.20	0.22	0.21	0.20	0.12	0.12

The scale efficiency of the contract and non-contract growers are summarised in Figure 2. The figure depicts that only 1 per cent of the non-contract farmers were operating under optimal scale. The figure is much higher for contract growers which stood at 12 per cent. Almost all the non-contract farmers and a sizeable population (87 per cent) of contract farmers were operating under sub-optimal scale. No non-contract farmer was operating under above optimal scale whereas, the same for contract growers was 1 per cent. Hence, the study indicated that the largest of overall technical inefficiency can be tackled by solving the problem of increasing returns to scale.



Non-contract farms Contract farms

Figure 2. Scale Efficiency of Potato Farms

The frequency distribution of potato farmers by level of efficiency is summarised in Table 5. The table indicates that, as far as overall technical efficiency is concerned, majority of the non-contract potato growers were within the group of 25 to 50 per cent, whereas same for contract group is 50 to 75 per cent.

TABLE 5. FREQUENCY DISTRIBUTION OF FARMERS BY LEVEL OF EFFICIENCY

	<0.25		0.25 - 0.50		0.50 - 0.75		0.75 to 0.90		>0.90	
Efficiency	NCF	CF	NCF	CF	NCF	CF	NCF	CF	NCF	CF
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Overall Technical efficiency	29 (21.64)	3 (2.08)	61 (45.53)	31 (21.53)	39 (29.10)	50 (34.72)	2 (1.49)	29 (20.14)	3 (2.24)	31 (21.53)
Scale efficiency	21 (15.67)	1 (0.69)	52 (38.81)	16 (11.11)	52 (38.81)	44 (30.56)	6 (4.47)	37 (25.69)	3 (2.23)	46 (31.95)
Pure Technical efficiency	-	-	-	-	27 (20.16)	19 (13.19)	49 (36.56)	45 (31.25)	58 (43.28)	80 (55.56)

Note: NCF= Non contract farmers, CF= Contract farmers. Figures in the parentheses indicate the percentage to the respective total farmers.

When the pure technical efficiency is considered it was found that none of the farmers were below the efficiency level of 50 per cent. Further, around 43 per cent of non-contract farmers and 55 per cent of contract farmers were found to be in the efficiency group of more than 90 per cent.

IV

SUMMARY AND CONCLUSIONS

The study analyses the data collected from 139 non-contract and 144 contract potato growers from four districts of West Bengal in the year 2008. It was found that the contract farmers were more experienced and had more years of schooling and social participation. The average farm harvest price of Atlantic (contract variety) was much higher than the K. Jyoti. Cost of cultivation was higher in Atlantic (Rs.74,909/ha) as compared to K. Jyoti (Rs. 70,705/ha). Contract farming gave good returns of around Rs.15,000 per hectare when non-contract farmers as well as K. Jyoti cultivator of contract farmers incurred losses. The Data Envelopment Analysis for technical efficiency estimation indicates that the contract method of production was more efficient than non-contract production. Further the scale inefficiency was primarily responsible for overall technical inefficiency as compared to the technical inefficiency. Majority of the non-contract as well as contract farmers were operating under sub-optimal scale.

Technical inefficiencies could be improved through the adoption of best practices of the efficient farms and the problem of overall technical inefficiency can be tackled by solving the problem of increasing returns to scale. For successful running of contract farming in the long run the agreement should be written documents and

legally binding. Further, the agreement should be for long term, so that farmers can realise its full potential. Keeping in view the two asymmetrical parties, written contract and involvement of Government Departments of Agriculture or local *panchayats* are necessary as it will help in settling the disputes. Price fixation should be uniform across the state and other terms and conditions should be clearly spelt out. Very often farmers face the problem of disposing off the rejected Atlantic potatoes. Home consumption of this variety as table purpose is minimal due to bad taste. Therefore, a good processing variety with short duration (80-85 days), good yielder (at least at par with K. Jyoti) and having good taste for table purpose may be developed.

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