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April 2005

MTID Discussion Paper No. 85

Vertical Coordination in High-Value Food Commodities: Implications for Smallholders

Pratap S. Birthal, P.K. Joshi, and Ashok Gulati

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ABSTRACT

Rising per capita income, urbanization and globalization are changing the consumption basket in the developing countries towards high-value commodities (like fruits & vegetables, milk, meat, poultry, fish, etc.). This paper explores how smallholders can benefit from the emerging opportunities from a silent demand-driven changes in high-value agriculture in India. The study examines the institutional mechanisms adopted by different firms to integrate small producers of milk, broilers and vegetables in supply chain and their effects on producers' transaction costs and farm profitability. The study finds that the innovative institutional arrangements in the form of contract farming have considerably reduced transaction costs and improved market efficiency to benefit the smallholders. The study does not find any bias against smallholders in contract farming. Also, the study does not find that the relevant firms have exploited their monopsonistic position by paying lower prices to farmers. On the contrary, contract producers were found enjoying benefits of assured procurement of their produce and higher prices. The study lists policy hurdles in scaling up the innovative models of vertical coordination in high-value food commodities.

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VERTICAL COORDINATION IN HIGH-VALUE FOOD COMMODITIES: IMPLICATIONS FOR SMALLHOLDERS

Pratap S. Birthal[1], P. K. Joshi[2] and Ashok Gulati[2]

1. THE KEY ISSUES AND HYPOTHESES

In most of South and Southeast Asia, and in much of sub-Saharan Africa, agriculture is dominated by smallholders, who derive their livelihoods by cultivating small pieces of land and supplementing their incomes with dairy, poultry or fish farming. And, the number of such small-sized holdings has been steadily increasing under the growing population pressure. For instance, in India, the share of smallholdings (< 2 ha) in the total number of holdings has increased from 70 percent in 1971 to 80 percent in 1995 (GOI 2003). It is expected to reach 83 percent by 2010 (Jha 2001). In such a scenario, the fundamental issues that need to be looked into are: Does the existing dominance of subsistence farming have some opportunities to bring them out of the low-income trap? Do smallholders have better income augmenting opportunities in high-value agriculture emanating from the unfolding process of rising income levels and growing urbanization, market liberalization and globalization?

Earlier evidence from several developing countries indicates that such opportunities do exist for smallholders in the high-value food segment (Barghouti et al. 2003; Pingali and Rosegrant 1995; von Braun 1995). In the Indian context, it has been

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found that demand for and supply of high-value food commodities (e.g. fruits, vegetables, livestock and fisheries) have grown much faster than that for foodgrains (Kumar et al. 2003; and Joshi et al. 2004). The share of high-value commodities in gross value of agricultural output has increased from 26 percent in 1981-82 to approximately 40 percent in 1999-2000. A question is often posed whether the smallholders would be able to participate in such a fast changing commercial agriculture. High-value commodities are often perishable in nature and generally feed the local markets that are usually thin and fragmented. Marketable surplus of an individual producer is too small to be bargained and traded remuneratively in distant markets due to high marketing and transaction costs (Delgado 1999; Escobal et al. 2000). Beside these problems, the prices of high-value food commodities are highly volatile. All these factors escalate the transaction costs and increase risks in production and marketing considerably that may be discouraging for smallholders.

The key issue that needs to be addressed is how smallholders can switch to high-value food commodities with minimum transaction costs and market risks. Experiences gained in developed countries and also in many developing countries in Southeast Asia, Africa and Latin America have revealed that various forms of institutions, such as cooperatives, producers' associations and contract farming, have the potential to reduce transaction costs by vertically coordinating[3] production, marketing and processing (Warning and Key 2000; FAO 2001; Narayanan and Gulati 2002). In the Indian context,

[3] Vertical coordination refers to the synchronization of successive stages of production and marketing with respect to quantity, quality and timing of product flows (Martinez 2002). Vertical coordination includes open production (open or spot market), contract production and vertical integration.

with the exception of milk and sugar, vertical coordination through cooperatives is a recent phenomenon in high-value and perishable commodities. It is encouraging to note that such institutions are gradually emerging in niche areas and are successfully coordinating with the farmers in production and marketing of high-value food commodities (Asokan and Singh 2003). These institutions have attracted a lot of attention, and already professional debates have taken place on their role in distribution of benefits, particularly to smallholders.

It is important to understand how firms coordinate with the farmers and what their implications are to smallholders. The present paper is an attempt in that direction. To be more precise, it intends to investigate such issues as (i) What are the processes adopted by different business houses in linking production and marketing of high-value food commodities? (ii) What is their effect on transaction costs and farm profitability, especially from the point of view of smallholders? (iii) What are the various policy options that can be arrived at for strengthening vertical linkages between smallholders and the business houses? Our key hypotheses is that the vertical coordination in high-value food segment helps in lowering the transaction costs and market risks of smallholders.

To test the hypotheses, we chose three important and most perishable high-value commodities viz., milk, broilers and vegetables in India. It may be mentioned that India is one of the largest producers of these commodities. In 2001, India ranked first in production of milk (82 million tons) and fruits (49 million tons) (FAO 2002); second in

vegetables[4] (68 million tons); and sixth in broiler production (1.4 million tons) (Landes et al. 2004). Unfortunately, these commodities are prone to high post-harvest losses and value-addition is woefully lacking in India. Only about two percent of the production of fruits and vegetables, 15 percent of milk, and one percent out of the total of 4.5 million tons of meat are processed at commercial scale (GOI 2002). It is, therefore, essential that post-harvest losses are minimized and value-addition is increased by strengthening the farm-firm linkages.

This paper consists of six sections. A brief introduction is followed by a theoretical development on the relationship between vertical coordination and transaction costs, and methodology adopted for estimation of transaction costs. The implications of vertical coordination on transaction costs and farm profitability are presented in section three. In section four, the factors that influence producers' participation in the emerging institutions have been examined. Policy impediments in replicating the successful models of vertical coordination are given in section five. And, in the last section, policy changes have been recommended to strengthen farm-firm linkages with a view to benefiting smallholders.

2. APPROACH, METHODS AND DATA

A. TRANSACTION COSTS

Transaction costs are the costs incurred by trading partners associated with the exchange of goods and services. These include costs involved in collection of market

[4] This does not include tuber vegetables.

information, negotiations, monitoring and enforcement of business transaction (Jaffee and Morton 1995). In a perfectly competitive situation, institutions with the lowest production and transaction costs for a given activity will have an edge over others and dominate the market (Coase 1960; Williamson 1979 & 2001). The major factors influencing transaction costs and thereby the types of institution include asset-specificity, uncertainty, and externality. The more specialized is the asset, higher is the cost of its transferring to the next best use. Uncertainty influences the costs of searching information, screening, negotiation, bargaining and monitoring. Higher the uncertainty, higher is the cost of renegotiating the contract. The externality principle states that a firm will move from spot markets to vertical coordination if the participants in the adjacent markets impose deliberate or unintended negative externalities. In spot markets, producers are free to produce and sell any amount of any commodity and buyers are free to purchase any quantity from any seller. In contrast, full integration prevails in a situation of high asset-specificity and externality, and low uncertainty. The firm has complete control over production, marketing, processing and distribution. The intermediate institutional structures are cooperatives, producers' associations, contract farming, etc. with a number of variants (Eaton and Shepherd 2001).

B. ANALYTICAL APPROACH

Theoretical developments in transaction cost economics have been accompanied by very little empirical analysis due to measurement problems. De Janvry et al. (1991) and Williamson (1993) have suggested that the difference between selling and buying prices could serve as an approximation of the transaction costs. Some researchers have

treated transportation costs (Fafchamps 1992; Omamo 1998) and the distance of sale point from the production site as proxies for transaction costs (Holloway et al. 2000). Some authors have classified transaction costs into tangible (transportation costs, communication costs, legal costs, etc.) and intangible (uncertainty, moral hazards, etc.) costs and have used proxies for these in the analysis of choice of markets (Hobbs 1997; Escobal 1999 and Holloway et al. 2000).

This study has attempted to quantify tangible transaction costs incurred by the producers. Thus costs of travel, communication, transport and storage, loss in quality and quantity during transportation, credit, extension services, market fee, commission charges, and personnel time (own and hired) have been included. Except for the costs of own personnel time (human labor), all other costs are pecuniary costs. For the purpose of costing, own personnel time was evaluated at the existing market wages and was categorized as non-pecuniary component of transaction costs. Benefits to the producers were estimated in terms of changes in the production and transaction costs due to institutional arrangements. Net profit was computed as the difference between the realized prices and the unit cost of production, including transaction costs.

C. DATA

Primary field surveys of contract and non-contract producers of milk, broilers and vegetables were conducted to gather information on their production and transaction costs. One firm for each of these commodities was identified to select the contract producers for the survey. These included Nestle India Limited-- a multinational firm for

milk and milk products, Venkateshwara Hatcheries Limited (VHL)-- a private sector domestic firm engaged in contract broiler farming, and Mother Dairy Fruits and Vegetables Limited (MDFVL)-- a wholly owned subsidiary of public sector entity (namely, National Dairy Development Board), which sources fruits and vegetables through producers' associations.

The survey for the three case studies was undertaken in the year 2002-03 to collect the required information for the year 2001-02. The sample producers were interviewed to collect the required data, using pre-tested questionnaires, specifically prepared for each case study. Data from vegetable and milk producers was based on their memory and for broilers the recall was supplemented with the records maintained by both contract and non-contract producers. Detailed information was collected about the socio-economic characteristics of the sample farmers, production-portfolio, item-wise and cycle-wise (in case of broilers) cost of production, yield levels, labor use, and cost of marketing and acquiring information for various activities. Information was also collected about marketing processes and item-wise cost of acquiring inputs and marketing output for both contract and non-contract producers. A brief description of each firm and sampling procedure is given below.

The dairy farming activities of Nestle India Limited[5] are largely concentrated in the northwestern state of Punjab. The firm has its milk-processing factory at the town of Moga and sources raw milk from the districts of Moga, Ludhiana, Sangrur, Mukatsar,

[5] Nestle India Limited has a retail network of about 700 thousand outlets in India, covering 3300 towns and serviced by over 4000 distributors. Its important value-added products are baby food, infant milk powder, dairy whiteners, sweetened condensed milk, ghee, UHT milk, curd and butter. The firm procured 236 million kg milk from over 85000 farmers in 1002 villages in 2001. (Dhaliwal, 2003).

Ferozepur and Faridkot. These districts have been collectively referred to as 'Moga Milk District'. A random sample of 152 producers[6] supplying milk regularly to Nestle was drawn from 12 villages of the Moga milk district. Selected villages were located in different directions around the factory in Moga within a radius of about 70 kilometers. In addition, 22 non-contract producers selling milk directly to the consumers and to the confectioneries in the nearby towns/cities were identified. The small sample size of non-contract producers was due to the fact that an overwhelming majority of the commercial dairy farmers were selling milk to Nestle India Limited.

Venkateshwara Hatcheries Limited[7] had started contract broiler farming operations during the mid-1990s in some southern and western states. The present study is confined to the southern state of Andhra Pradesh, which is a leading producer of poultry meat in the country. Unlike other agricultural activities, poultry production is widely dispersed. Both contract and non-contract producers have a wide spatial dispersion. Therefore, a relatively small sample of 25 contract producers and an equal number of non-contract producers was randomly selected from 10 villages of Rangareddy, Mehboobnagar and Nalagonda districts in Andhra Pradesh.

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[6] The firm follows a two-fold contracting arrangement. For those having milch animals of more than 25, it enters into a legal contract. For small producers, the milk is procured through the agents, with whom the firm has a legal contract. The latter mode dominates.

[7] The Venkateshwara Hatcheries (VH) group was established in 1971 as a franchise of Babcook Poultry Farm Inc., USA. In 1974, it established 'Balaji Foods and Feeds Limited' for processing of eggs into egg powder. Its broiler breed VENCOBB holds 60 percent of the Indian market. The firm entered into contract farming during the mid-1990s. It has retail chain in major metros also where the fresh and frozen chicken and ready-to-cook frozen chicken are directly sold. It also exports ready-to-eat chicken products. It has a business of about Rs. 1300 crore (approximately US$ 290 million) from poultry related products (Source: Poultry Line Vol. 2 (6): 2002).

The third case study is on the Mother Dairy Fruits and Vegetables Limited[8] (MDFVL) that integrates fruits and vegetable production through a retail chain in Delhi. Its procurement operations extend all over the country and are usually governed by the regional niches in production of specific commodities. Highly perishable commodities are procured from the nearby areas around Delhi. Two producers' associations --- one in rural Delhi and the other in Sonepat district of Haryana (a state bordering Delhi) were identified for selection of contract producers. Each producers' association covers 2-4 villages and has 25 members. MDFVL also procures vegetables from non-members to meet the demand in their retail centers. Required information was collected from all the members (50) of these two associations. In addition, information was collected from 50 randomly selected non-members, who were also supplying vegetables to MDFVL and 50 producers who were selling vegetables in the open market.

Marketing arrangements developed by these firms are different from those in the open market system. Unlike traditional marketing arrangements, these firms ensure procurement of contracted produce at the doorstep of the producers that enables them to save on transport, travel and labor costs. The firms also provide input services at wholesale rates and new technologies, which reduce the cost of production.

[8] The firm was established in 1988 to meet the growing demand for fresh fruits and vegetables in Delhi metropolitan area with direct procurement from the farmers. It sells about 250 tons of fruits and vegetables everyday through its 279 retail outlets. The fresh fruits and vegetables are procured from 100 producers' associations that cover 18000 growers. The producers' associations are informal cooperatives or self-help groups managed by the producers themselves. About 75000 customers visit its retail outlets daily (Source: http://www.safalindia.com).

3. IMPLICATIONS OF INNOVATIVE INSTITUTIONS

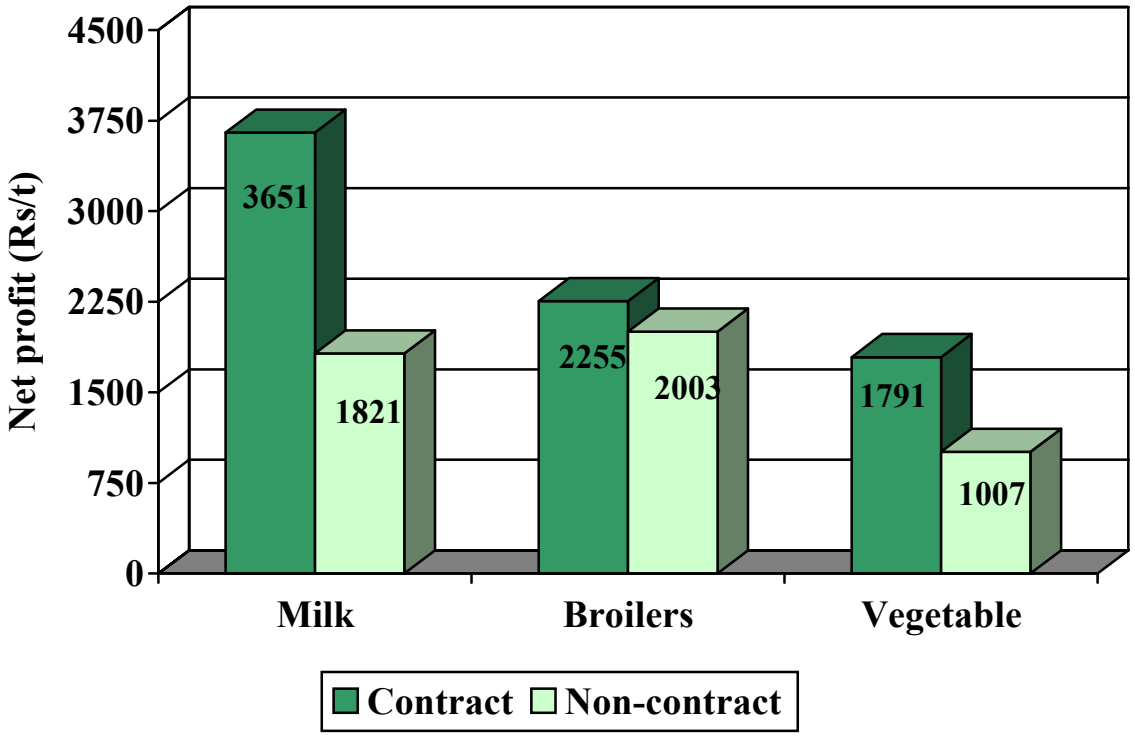
In this section implications of innovative institutions have been discussed on (i) profit and transaction costs, (ii) scale of operation, and (iii) output prices and risk sharing mechanism.

A. PROFIT AND TRANSACTION COSTS

The key issue is to understand how the selected firms develop new institutional arrangements and benefit farmers in promoting high-value food commodities? In this section, we have assessed the performance of new institutional arrangements in the supply chain of these selected perishable and high-value food commodities. Profits obtained and costs incurred by the farmers are regarded as indicators of performance for new institutional arrangements. The results reveal striking difference in the profits of contract and non-contract farmers for all the commodities under study (Figure 1). The contract farmers attained substantially higher net profit than the non-contract farmers. Milk contract farmers, for example, attained double the profit[9] than that of the non-contract milk farmers. The corresponding profit difference was 78 percent for vegetable farmers and 13 percent for broiler farmers. Such a high difference in profit was attracting farmers to supply their raw material to the firm and thus was strengthening linkages in the evolving supply chain. It is evident that higher profit is one of the key motivations for the farmers to integrate with the firm(s) in supplying raw material(s).

[9] Dairy farmers supply cattle and buffalo milk that differs in fat content. The milk from both the sources was converted into 4 percent fat corrected milk (FCM), following Hemme *et al*. (2003).

Figure 1—**Net profit of contract and non-contract milk, broiler and vegetable producers**



The advantage that contract farmers had over non-contract farmers was mainly due to savings in production and marketing costs. And to verify this observation, production and transaction costs of milk, vegetables and broilers were estimated for contract and non-contract farmers. The results in Figure 2 clearly indicate that the total cost (production + transaction), of these commodities was much lower for contract than non-contract farmers. Details about costs and profit of contract farmers for milk, broilers and vegetables are given in Appendix I, II and III, respectively. The costs of milk production of contract farmers were less by approximately 21 percent in milk and 26 percent in vegetable than those of non-contract farmers. The lower total costs can be

mainly attributed to lower transaction costs (Table 1). The share of transaction cost in total cost for non-contract farmers was 20 percent for milk and 21percent for vegetables; it was only 2 percent for contract farmers. Such a comparison was, however, not possible in the case of broilers, as the firm provided free chicks, feed and veterinary services to the contract farmers. However, the transaction cost was comparable, which was 58 percent less for contract farmers.

Figure 2—Production and transaction cost of contract and non-contract farmers for milk and vegetable

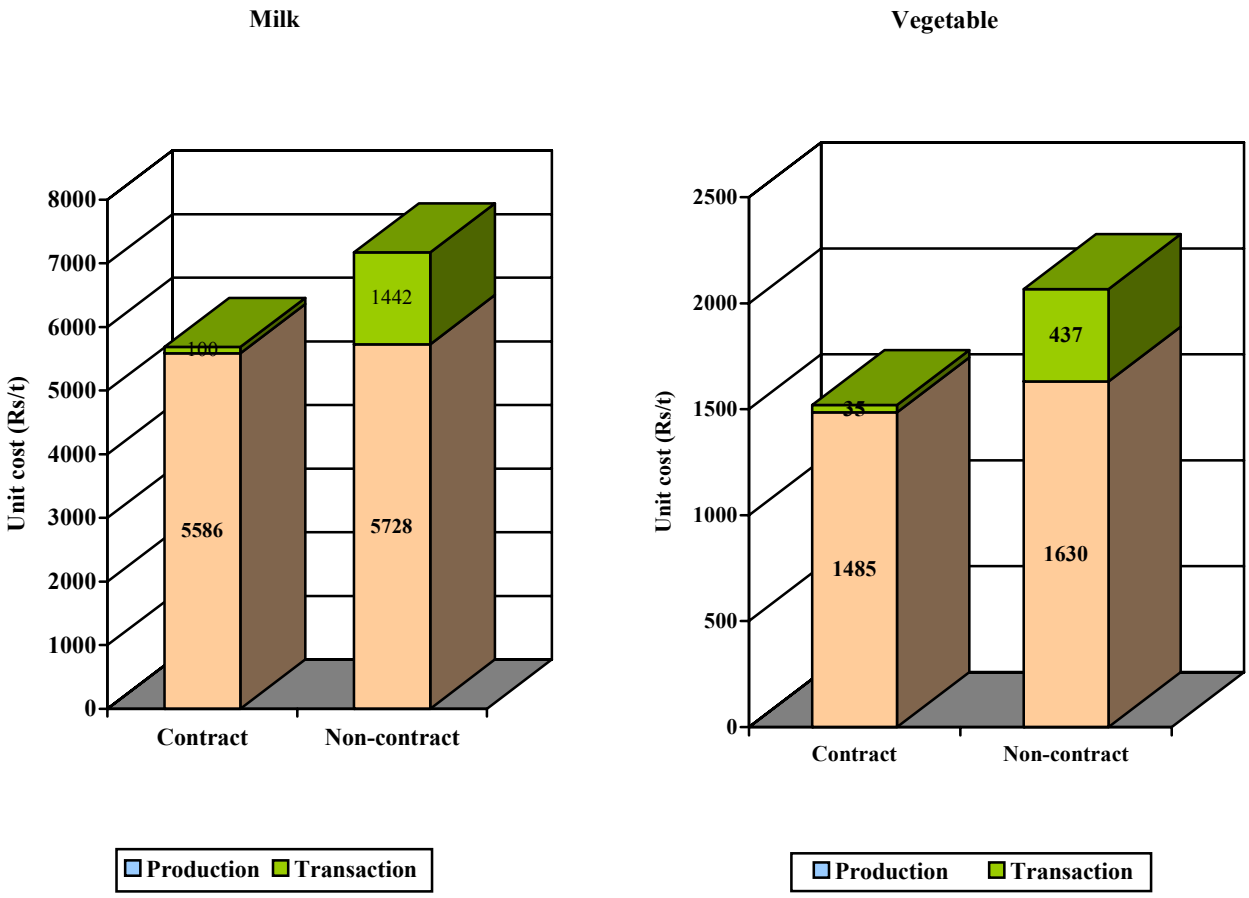


Table 1—Production and transaction cost of milk, broiler and vegetable production in contract and non-contract farming (Rs/ton)

Commodity	Contract farming			Non-contract farming		
	Production cost	Transaction cost	Total cost	Production cost	Transaction cost	Total cost
Milk	5586	100	5686	5728	1442	7170
Broiler*	808	38	846	27322	90	27412
Vegetable**	1485	35	1520	1630	437	2067

* For broiler, the firm provides free chicks, feed and medicines to the contract farmers.
** Refers to spinach only.

It was obvious that the contract farmers were taking advantage of new institutional arrangements that reduced the costs of their travel, transport of inputs and produce, access to information and new technology. In the case of milk and vegetables, the transaction costs were less on contract farms due to savings in time, transportation cost and labor cost for marketing of produce. These were mainly due to collection of these commodities by the firms from the producer's village. It may be concluded that access to market and information about new technology at negligible costs motivate farmers to participate in such evolving institutional arrangements.

In the case of broiler, hardly any cost was incurred by the contract farmers on extension, communication and transportation for acquiring inputs. These costs were as high as 80 percent of the total transaction cost in broiler production. The principal attraction for the broiler farmers for participating in the contractual arrangement was the availability of chicks, medicines and feed from the firm. These inputs accounted for about 75 percent in the total cost of broiler production and were the critical inputs for productivity and profitability. The firm bears mortality risk of 5 percent, and remaining is

to be borne by the producer. This means that broiler contract farmers were enjoying indirect credit for important inputs without any interest and, transferring some risks to the firm. This may perhaps be the main attraction to the farmers, particularly smallholders, for establishing strong links with the broiler firm.

Reduction in transaction costs through vertical coordination is beneficial to the firm and the farmers mutually. The firm gets an assured and timely supply of the desired raw material. It helps the firm in having a better control over its operational and fixed costs and minimizing the risk on account of underutilization of its capacity; thus eventually minimizing the cost of processing. It also enables the firm to improve its market reputation. On the other side, the farmers get assured market for their produce that is otherwise not possible on a regular basis. Greater access to market improves the farmers' capacity to withstand risks arising out of production and price fluctuations. Besides they have a more reliable access to production inputs, capital, technology and information. Such a win-win situation was found to have remarkably increased farmers' participation in contract farming in niche areas and commodities; 76 percent of vegetable farmers and 56 percent of broiler farmers had expanded their scale of operation between 1990 and 2000. Non-contract vegetable and broiler farmers also expanded their scale of operation but only at a lower level, by 54 and 44 percent farmers, respectively. Such a noticeable expansion by the contract farmers revealed that they were gaining from the innovative arrangements made for production and marketing.

B. SCALE EFFECTS

There have been apprehensions that smallholders would not be able to take full advantage of the new institutional arrangements (Glover 1987; Watts 1994; Key and Runsten 1999). These arguments are based on the fears that firms in order to reduce their transaction costs (such as distribution of inputs, credit and extension services) may be inclined to have a tie-up with a few large farmers rather than dealing with a large number of scattered smallholders. Another factor that supports contracting with large landholders is their better capacity to invest in production-related inputs, technology information, and ability to withstand risks. However, large farmers have better access to market information and strong bargaining power that might add to the firm's transaction costs.

To examine the state of affairs of smallholders[10] and their linkages with the firms, a disaggregated analysis was carried out based on the size of farms for vegetable production and scale of operations for milk and broilers. The distribution of smallholders in the sample clearly showed that they were well represented in the contractual arrangements in the three case studies (Table 2). The doubt that the firm may ignore and discriminate against smallholders did not have any ground. To take advantage of economies of scale, dairy and vegetable firms were contracting through producers' associations rather than dealing directly with individual farmers. The milk and vegetable

[10] For milk, smallholders were considered as those who had milk animals up to 5; while farmers having milk animals between 6 and 10 were characterized as medium, and more than 10, as large farmers. For broilers, those had up to 5000 birds per cycle were defined as small farmers, and the ones with 5000-10,000 birds as medium, and with more than 10,000 birds as large farmers. For vegetables, small farmers were those who had land less than 2 ha, and those having land between 2-4 ha as medium, and with more than 4 ha land, as large farmers.

firms had organized farmers into groups or cooperative associations for activities such as procurement of inputs, technical advice, facilitating credit needs, collecting output, etc. Such a mechanism has helped the firm in overcoming the difficulties faced in approaching too many scattered smallholders individually. It eventually could help in controlling escalation in transaction costs.

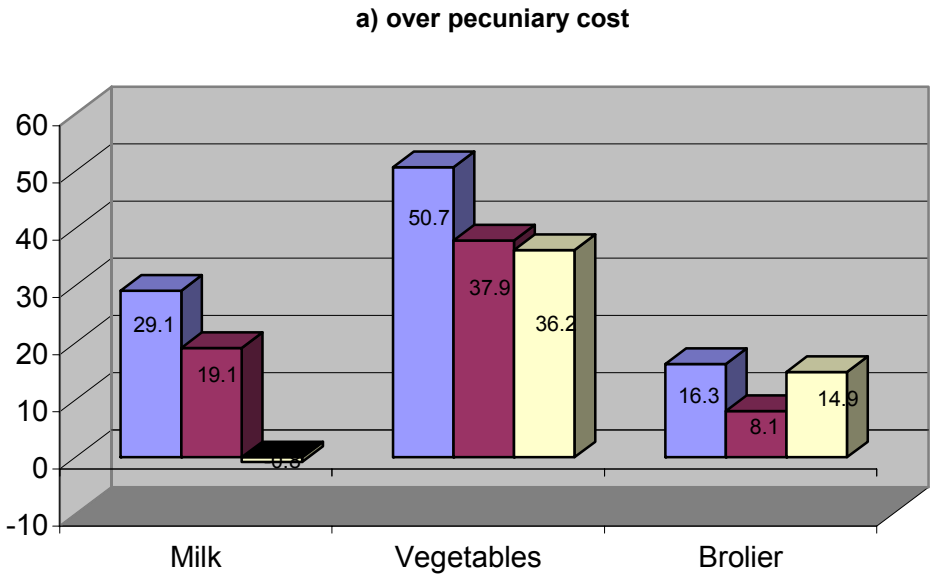
Table 2—Distribution of sample farmers associated with contract farming (percent)

Commodity	Small	Medium	Large
Dairy	56	27	17
Poultry	32	32	36
Vegetable	37	36	27

It was well established that contract farmers, irrespective of size of the farms, were producing milk, broilers and vegetables at a lower cost and were attaining higher profits than the non-contract farmers (Figure 3; Table 3). The smallholders could save approximately 28 percent cost in vegetable production and 20 percent in milk production as a result of contract farming. The corresponding savings in case of large farmers were 22 percent and 14 percent, respectively. This reduction in cost was mainly due to lower transaction costs (Tables 4 and 5). Large framers have lower transaction costs. However, there existed some variance from this trend for contract vegetable producers, where the transaction costs was higher for large farmers. The main reason for such a variance was because of higher transportation cost from production to collection center. The pecuniary cost of production (that excluded family labor) of smallholders was however lower than that of large farmers. It was observed that by and large the pecuniary costs increased with

higher scale of business, while non-pecuniary costs (mainly family labor) showed a decline (Table 6). However, some anomaly was observed in the trend. For example, the pecuniary cost decreased for broiler production when moving from medium to large producer, and for vegetables when moving from small to medium. The issue needs more investigations to decipher such anomaly to generalize the pattern in pecuniary cost *vis-à-vis* size of farm. However, our analysis showed that the lower pecuniary cost on large farms for broiler production was due to economies of scale in use of electricity, bulbs, disinfectants, and higher body weight per bird as compared to medium farms. For vegetable production, medium farmers take advantage of irrigation and packaging costs. Smallholders are sufficiently endowed with own family labor, whereas large farmers generally depend on hired labor that needs to be effectively monitored, adding to their production cost. That was why large farmers preferred to select labor-saving production portfolio unless cheap and timely labor was available. It was corroborated clearly by the vegetable case study, wherein a marked difference was observed in area allocated to vegetables by small and large farmers. In the sample households, the smallholders allocated 57 percent area to vegetables as compared to 34 percent by the large farmers (Table 7).

Figure 3—Net gain in profit from contract farming over non-contract farming (percent)



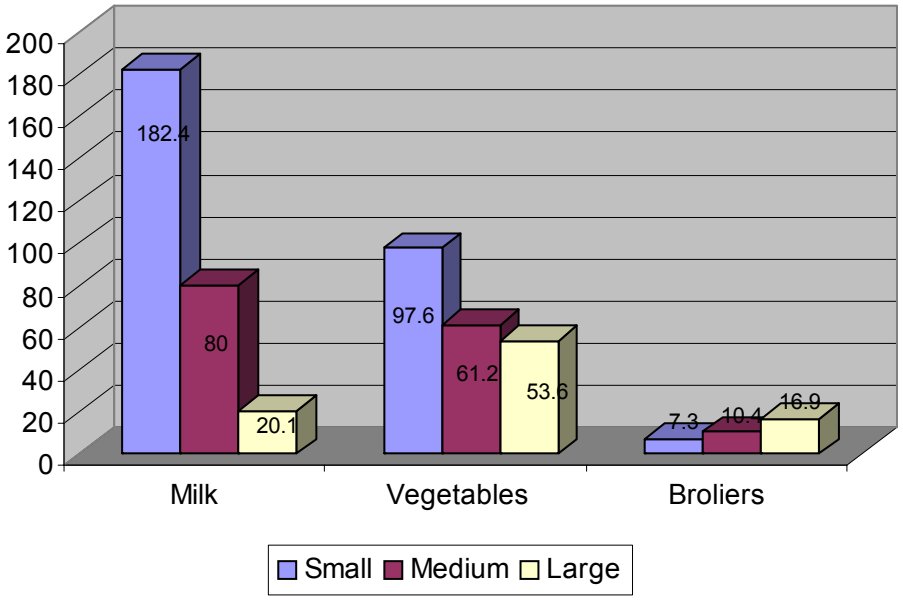


Table 3 —Farm size-wise unit cost of production and profit in milk, broiler and vegetable of contract and non-contract producers (Rs/ton)

Farm size	Milk		Broiler*		Vegetable**	
	Contract	Non-contract	Contract	Non-contract	Contract	Non-contract
			Unit cost of production (Rs/ton)			
Small	6266	7797	1022	27692	1522	2127
Medium	5489	6901	848	27854	1486	1985
Large	5475	6394	812	27052	1531	1958
All	5686	7170	846	27412	1520	2067
			Net profit over total cost (Rs/ton)			
Small	2446	866	2238	2087	1818	920
Medium	3745	2081	2273	2058	1809	1122
Large	4329	3604	2261	1934	1792	1167
All	3651	1821	2255	2003	1791	1007
			Net profit over pecuniary cost (Rs/ton)			
Small	4170	3229	2708	2328	2309	1532
Medium	4622	3881	2308	2136	2287	1659
Large	4892	4932	2266	1972	2215	1628
All	4606	3720	2318	2107	2267	1585
			Net profit over total cost (%)			
Small	39.04	11.11	218.98	7.54	119.45	43.25
Medium	68.23	30.16	268.04	7.39	121.74	56.52
Large	79.07	56.37	278.45	7.15	117.05	59.60
All	64.21	25.40	266.55	7.31	117.87	48.72

* In the case of broilers, the unit cost of production of contract producers is low because it does not include the cost of chick, feed and medicine, which are supplied by the firm free of cost.
** Refers to spinach.

Table 4—Share of transaction cost in total cost of milk and vegetable production and marketing under different farm sizes (percent)

Farm Size	Contract farmers		Non-contract farmers	
	Milk	Vegetables	Milk	Vegetable
Small	3.27	2.23	24.50	23.84
Medium	1.51	0.54	17.62	17.48
Large	1.17	3.00	14.72	13.94
All	1.76	2.30	20.11	21.14

Table 5—Transaction cost of different farm sizes for broilers' production and marketing (Rs/ton)

Size	Contract	Non-contract	Difference (%)
Small	59	142	58.5
Medium	37	81	54.3
Large	34	65	47.7
All farmers	38	90	57.8

Table 6—Pecuniary and non-pecuniary cost of production and marketing of milk, broilers and vegetables in different farm size of contract producers (Rs/ton)

Farm Size	Milk	Broiler*	Vegetable**
		Pecuniary cost (Rs/ton)	
Small	4542	552	1031
Medium	4612	813	1008
Large	4912	807	1078
All	4731	783	1044
		Non-Pecuniary Cost (Rs/ton)	
Small	1724	470	491
Medium	877	35	478
Large	563	5	453
All	955	63	476

* Cost of chick, feed and medicines is not included as the firm supplies these inputs without any charges.

Table 7—Share of vegetable area in gross cropped area in different category of farms (%)

Farm size	Contract farmers	Non-contract farmers
Small	57	57
Medium	54	38
Large	34	27

These facts revealed that smallholders were neither being deprived of their participation in contract farming nor were being exploited by the firms. The smallholders could minimize their transaction costs and increase their income by participating in contract farming. The savings in transaction cost were mainly on account of marketing their small produce, acquiring inputs and easy access to improved technology through contract farming. As regard production, smallholders had the comparative advantage of utilizing their own family labor, while for marketing their produce, they were taking advantage of the firm, which ensured procurement of perishable commodities at remunerative prices. Contrary to the argument favoring contracting of firms with large farmers, it was observed that the firms were finding it more convenient and beneficial to contract with smallholders and their associations. There were four obvious reasons for it: (i) Less effect on overall supply in the event of crop failure of one or few farmers (idiosyncratic risk); (ii) More flexible production portfolio (due to limited fixed assets and more family labor) of smallholders, which would help in quickly responding to consumers' changing preferences; (iii) Smallholders could ensure better quality as they strictly comply with the production practices advised by the firm mainly due to more family labor and lower bargaining power; and (iv) Low marketable surplus of smallholders increases their dependency on the firm for profit maximization.

C. PRICE AND RISK SHARING

There have been apprehensions that the contract farming would ultimately lead to monopsonic situation and could exploit farmers (Glover 1987; Little and Watts 1994). Such a situation arises when the market is not competitive and one of the trading partners

acts opportunistically to exploit the farmers. To verify this phenomenon, we compared the prices offered to contract farmers with those in the prevailing market. We observed that the contract farmers were being offered relatively higher prices than the prevailing market prices. In case of vegetables, the contract farmers received 8 percent higher prices, mainly for a better quality and as an incentive for ensuring a regular supply. In case of vegetables, the prices offered to the farmers were determined by the prevailing prices in the Delhi Fruit & Vegetable Market (one of the largest trading markets for fruits & vegetables in India) with a premium of 5-20 percent above this benchmark price, depending upon commodity and quality. In case of milk, the prices were determined on the basis of SNF and fat content. Since the milk market is highly competitive, there was only a marginal price premium (4 percent) for the contract farmers over the prevailing market prices. In the case of broilers, the prices were fixed by BROMARK[11]. Nevertheless, the firm shared additional profits due to rise in market prices with the farmers. Also, the firm offered an incentive of 25 percent for a better feed-conversion ratio. In all these case studies, we did not observe any kind of monopsonic behavior to exploit farmers. Also the existence of perfect competition in these markets did not allow any of these firms to trade in exceptionally large volumes and control the market.

Sharing of risk between the producer and firm is another advantage in the case of broiler industry. The firm bears full market risks. It is important because broiler prices are often faced with high price-volatility that affects profit considerably. Both the parties share the production risk depending on its nature and magnitude. The mortality risk up to

[11] BROMARK is an apex organization of the different stakeholders in broiler production.

5 percent of the chicks is considered to be natural and is borne by the firm. For mortality exceeding 5 percent, the firm charges Rs. 0.10/kg of live body weight of the grown-up broiler for every one percent increase in the mortality. Such a risk-sharing mechanism provides protection to the producers, particularly the smallholders, under volatile market conditions.

The implications of risk-sharing mechanism on profit and yield of contract and non-contract farmers were examined by computing the Coefficient of Variation (CV) in different cycles. The striking differences in CV of profits between contract and non-contract farmers are evident from Table 8. Whereas the CV of profit of contract farmers was almost stable over different cycles, it was very high with sharp fluctuations for non-contract farmers. Since there was only marginal difference in CV of yield between contract and non-contract farmers, the price volatility in case of broilers was the major reason for high variability in profits. It can also be seen that the CV of yield was higher for non-contract farmers during March-April and May-June periods. This was because of higher temperature during these periods, which had resulted in high mortality rate. Ramaswami et al. (2004) have estimated that contracting in broiler industry could shift about 88 percent of risk from the farmer to the processor. Such a risk-sharing mechanism helps contract farmers, particularly the smallholders in improving their management strategies and minimizing production and price risks. Experiences in the past have revealed that high risk in production and prices had led to the closure of several poultry farms. Alternatively, poultry farmers were gradually shifting to contract farming. No analogous risk-sharing mechanism was found in case of milk and vegetable production.

Table 8—Cycle-wise coefficient of variation (CV) in yield and profit of broiler in contract and non-contract farming (percent)

Production cycle*	CV** of broiler yield		CV** of net profit	
	Contract farmers	Non-contract farmers	Contract farmers	Non-contract farmers
January-February	10	8	22	65
March-April	8	16	20	137
May-June	5	22	22	296
July-August	20	21	20	270
September-October	9	7	26	107
November-December	8	7	26	49

* One cycle completes in 38 days from one-day old chick to fully matured for meat.
** CV of broiler yield and net profit for each cycle is over different farms.

The study clearly showed that the speculation of monopsonic behavior by the firm did not exist. On the contrary, farmers were enjoying benefits of assured procurement of their produce and higher prices, even though prices could be higher marginally. Generally, in the absence of assured prices, farmers opt for low risk crops. Empirical evidence suggested that farmers were averse to risk and even were ready to pay a premium (lower product prices) for guaranteed income schemes (Binswanger 1980; Hazell 1982). In our case studies, assured prices and market access were encouraging farmers to diversify agriculture towards high-value and perishable commodities. Such a mechanism, which insures the farmer against price risk, benefits the firm also in terms of assured supply and better quality of raw material.

4. DETERMINANTS OF FARMERS' PARTICIPATION

The firms under study do not discriminate in choosing members for contractual arrangements unless a producer is highly indebted. All the firms under study open the membership in their area of operation. However, it is producers' socio-economic characteristics that influenced their decision to participate in contract farming. A clear understanding of these factors would help in upscaling of the contract farming models for promoting high-value food commodities. We have used logit model to identify those characteristics that influence producers' participation in contract farming. The structural form of the model is given in Equation (1):

$$C_i = \delta_1 + \delta_2 Z_i + \mu_i \qquad (1)$$

where, C_i is a dummy variable taking the value of 1 if the farmer participates in the contract program, and 0 otherwise. Z_i is a vector of independent variables, and includes factors like schooling, age, labor availability, ownership of assets, experience in particular commodity, etc.; δ_1 and δ_2 are the estimated parameters, while μ_i is the error-term. The selected variables in the model are described below.

It was hypothesized that availability of family labor, non-farm income, smallholdings and higher education and age of the household would have a positive effect on the decision to participate in contractual arrangements. It was expected that households with greater surplus labor were more likely to join contract farming schemes because of labor-intensive nature of the commodities contracted. Producers having

income from non-farm sources were also more likely to participate in contract schemes due to lesser experience in farming and/or want of time for marketing. On asset specificity, it was considered that greater the asset specificity, higher would be the probability of participation in contract farming due to higher transaction cost. Further, on the basis of experience in commercial farming it was hypothesized that the less experienced producers would participate more eagerly in the contract farming. Similarly, a person with higher education level was expected to have a better access to information and more clarity about emerging institutions. An elder person being less mobile was expected to participate much more in schemes that made marketing available at his doorsteps. The definitions and hypothesized values of the socio-economic variables included in the model are outlined in Appendix IV.

The results of the logit model are reported in Table 9. By and large, the income from non-farm sources and experience in particular production activity were influencing producers' decision to participate in contract farming. Other variables included in the model were non-significant. It was interesting to note that income from non-farm sources had a positive and significant influence on producers' participation in the case of milk and vegetable contract farming. It was obvious that greater focus on non-farm activities, and scarcity of time encouraged the producers to participate in those institutions that could facilitate acquiring inputs and disposing of outputs. Contract farming offers such opportunities.

Table 9—Factors influencing participation in contract farming in milk, broilers and vegetable production: results of logit function

Variable	Milk	Broiler	Vegetable
Age	- 0.0247	0.0410	0.0047
	(0.0251)	(0.0429)	(0.0174)
Schooling	- 0.0759	0.0518	0.0025
	(0.0640)	(0.1218)	(0.0454)
Experience	0.0811**	-0.3598**	0.0813***
	(0.0370)	(0.1111)	(0.0319)
Land size	0.1937	-0.1886	0.0608
	(0.1226)	(0.1544)	(0.0807)
Total stock	0.0381	-0.00001	-
	(0.0599)	(0.00005)	
Non-farm income	1.6835**	-0.2256	0.7678*
	(0.6747)	(1.5352)	(0.4593)
Labor availability	0.7128	-0.2005	0.1264
	(0.3605)	(0.1518)	(0.0898)
Constant	0.0089	2.0974	-1.9218**
	(1.4173)	(2.7558)	(0.9589)
Chi-squared	23.0731***	20.2485***	19.2960***
Number of observations	176	50	132

*** significant at 1 percent probability level; ** significant at 5 percent probability level; and * significant at 10 percent probability level.
Figures within the parentheses are standard errors.

Producers' experience in different activities yielded mixed results. While experiences of milk and vegetable producers had a positive impact on participation in contract farming, broiler producers were found to have gradually withdrawn from contract farming with more experience. It was because the processes of acquiring inputs and disposal of output were observed to be almost similar for contract and non-contract broiler farming. The key inputs (chicks, feed and medicines) were being delivered at the farm and output was being lifted from the farm, irrespective of contractual arrangements. Under such arrangements, contract as well as non-contract broiler producers could save on transportation and marketing costs. Therefore, broiler producers, after acquiring some

experience in production and marketing, gradually withdrew from contract farming to trade independently in the open market. On the contrary, milk and vegetable producers who opted out from contractual arrangement had no such advantage. The transaction costs for milk and vegetables non-contract producers escalate as their volume of marketable surplus is too small. It has already been discussed earlier that the transaction costs for milk and vegetable contract producers are significantly lower than for non-contract producers.

An attempt was also made to predict the shifting of non-contract producers to the contract mode and vice-versa. The actual and predicted frequencies revealed that given the opportunity an overwhelming majority of the non-contract milk producers (86 percent) and vegetable producers (65 percent) would switch over to contract mode of production. But in the case of broiler farming, only 24 percent of the non-contract producers would opt for contract farming. The probability of change from contract to independent production was extremely low in case of dairy and vegetable production and high in broiler farming**.** The basis for such a shift has been explained earlier, viz., 'contract producers learn rules of the game with experience and opt out for independent production'.

5. POLICY CONSTRAINTS IN EXPANDING VERTICAL COORDINATION

The study has clearly revealed that strengthening farm-firm linkages through new institutional arrangements is mutually beneficial for the producers and the firms. Despite substantial reduction in transaction costs and improvement in marketing efficiency, such farm-firm linkage models replicate at a very slow rate. Among others, there are many policy and infrastructure obstacles in evolving new institutional arrangements. After discussions with the representatives of the firms, the important ones are enumerated below:

- High-value food commodities require an infrastructure that is quite different from that of cereals and pulses. Most of the high-value food commodities being perishable in nature, which require refrigerated transportation and cold storages at every stage of value addition. These are, however, woefully lacking. Cold storage facilities are inadequate. There are nearly 4600 cold storages in India with a capacity of about 18 million tons which cater to less than 10 percent of the produce. Over 80 percent of this is used for potatoes alone. Hence, there are substantial post-harvest losses.
- One important requirement for successful coordination of value-addition and agro-processing is a regular supply of good quality raw material from farm to firm. This can be achieved through either self-production by the firm or contract farming. The existing land ceiling act restricts the first option, while the latter is not possible unless the government enacts appropriate legislation. As on date, none of the options has a legal standing; which is a discouragement to contract

farming. Apart from this, no legislation exists for a breach of contract by any party (farmer or the firm).

- In many states, the by-laws of the market committee legislation restrict the sale within a specified area. Market fee including commission charges are high; ranging from 2 to 7 percent. Some states also impose developmental charges. Transfer of goods outside the defined geographical boundaries attracts imposition of sales tax, octroi, etc. Such restrictions distort the market, reduce its efficiency and discourage formation of farm-firm linkages through contract farming.
- Promotion of agro-processing industry may provide a fillip to contract farming of high-value food commodities. However, this sector is afflicted with various ailments like (i) scale of industry, (ii) over bureaucratization and complicated legal wrangles, and (iii) high taxes. Scale of industry and its operation affect the production efficiency of processing firms. Until recently a number of food products were reserved for Small-Scale Industries (SSIs), which often lack capital, use obsolete technology, are inefficient in production and weak in marketing, and not have any incentive to develop effective farm-firm linkages for reducing their transaction costs. Realizing the importance of scale of industry in agro-processing, the Government of India has recently taken-off some of the food items reserved for SSIs. In a competitive environment it would have been difficult for the SSIs to take advantage of the new technologies and economies of scale in production and marketing, both in domestic and international market.

- Existing bureaucratic and cumbersome procedures discourage the potential agro-processors to venture to this promising business. There are about 17 laws governing the food industry. There are laws that govern a specific commodity or a group of commodities. And, there are separate laws relating to weights and measurements, packaging, adulteration, etc. These laws are administered and implemented by different departments and/or ministries. As for instance, Prevention of Food Adulteration Act 1954 is implemented by the Ministry of Health; Agriculture Produce (Grading and Marking) Act by the Ministry of Rural Development; laws related to standards, weights and measurements are under the jurisdiction of Ministry of Civil Supplies, Consumer Affairs and Public Distribution and the laws related to environment are implemented by the Ministry of Environment and Forests. For setting up a agro-processing unit an investor has to get clearance from all the concerned departments. Such a multiplicity often results in conflicting approaches, lack of coordination and administrative delays.
- Despite fiscal reforms, excise duty and sales tax imposed on processed foods continue to remain high. This pushes-up the market prices of processed food items, which would be naturally much higher than the fresh food. The excise duty on processed meat, fish and poultry products was reduced to 8 percent in the 2004 budget from a high of 16 percent in 2003. Certain processed dairy, fruits and vegetable products have no excise duty. Excise duty on cakes and pastries is 16 percent. Other levies, like sales tax, octroi, market fee etc, are state subjects and vary from state to state. In general, sales tax is about 10 percent. The approach

paper towards formulation of national food processing industries by the Ministry of Food Processing, Government of India, prepared before 2004 central budget put all the levies (including central excise duty) between 21 to 23 percent. (MOFPI 2004) The paper also states that India is the only country to levy excise duty on machinery and equipment for processed foods. Compared to many other countries, this tax burden is high. Comparative tax burden is 10 percent in Philippines, Indonesia and Malaysia, 14-15 percent in Netherlands and United Kingdom, 17 percent in China and Ireland. (CIFTI 2002).

- Rising demand for food and non-food processed products has provided expanding opportunities for the growth of their organized retailing that hitherto had comprised only about 2 percent of the total retail sales in India. This has attracted some large domestic business groups such as Tatas (Westside), RPG (FoodWorld), Rahejas (Shopper's Stop) and Piramal (Pyramids and Crossroads) into food retail trade. Some of these retail food chains are sourcing raw materials directly from the farmers through vertical coordination (Chengappa et al. 2003). The organized retailing is concentrated mainly in the southern metropolis. That is why a silent revolution of innovative institutions is so evidently visible in the southern states of India. The organized retailing should be encouraged to improve marketing efficiency and profit-sharing with producers and consumers.

The Government of India has undertaken several steps to overcome some of the constraints in agricultural marketing and agro-processing sector, particularly after the regulatory and fiscal reforms have been introduced to attract private investment in food

industry (Government of India 2002). Among others, a series of economic reforms program started in early 1990s. These include (i) doing away with the industrial licensing requirement for most of the food items, (ii) automatic approval of investment up to 51 percent foreign equity or 100 percent for Non-Resident Indians, (iii) relaxation in monopoly and foreign exchange acts, (iv) free import and export of food items (except items on the negative list) and capital goods, and (v) permission to financial institutions to finance contract farming schemes strengthening backward linkages. The fiscal incentives include: (i) reduction in import and excise duty and corporate taxes, and repatriation of benefits, (ii) establishment of free trade, and export processing zones, (iii) reduction in custom duty on imports of capital goods, and exemption from corporate and minimum alternative taxes to the firms located in free trade and export processing zones.

The Government of India has recently initiated a scheme to strengthen farm-firm linkages in which reimbursement up to 10 percent of the total purchase by the processor is allowed limited to Rs 1 million (approximately US$ 22.5 thousand) a year. The assistance is also provided for the market survey and brand promotion up to 50 percent of the cost of campaign, limited to Rs 5 million (approximately US$ 112.5 thousand). These measures are slowly attracting the organized sector to participate in strengthening of farm-firm linkages and evolving different innovative institutional models.

Agriculture being a state subject in India, some state governments too have taken initiatives to facilitate/encourage entry of the private/corporate sector to agriculture. As for example, Tamil Nadu has come out with a policy document on contract farming. Industries promoting cultivation of fruits and vegetables through value-addition have

been exempted from land ceiling act. In addition, provisions have been made to lease degraded forestlands and wastelands to the private sector for cultivation of plantation crops with state as a partner. Under the policy, the state provides a capital subsidy up to 20 percent of the fixed assets (green house structures, irrigation and fertilizer equipments, cold room, tissue culture, etc.) subject to a ceiling of Rs 2 million (approximately US$ 45 thousand) to fruit and vegetable industries. The fruit and vegetable industry has been given the status of an industry, enabling it to get preferential treatment in power supply. Punjab has also aggressively launched contract farming to replace the existing rice-wheat system. In some other states, including Madhya Pradesh, Rajasthan and Uttar Pradesh, incentives and other mechanisms to attract private investment in agriculture through contract farming have been worked out. Market fee (2-7 percent) has been exempted in these states for producers who sell their produce directly to the processors. Consequently, some well-known agro-processing players like Hindustan Lever Limited, Nestle India Limited, Britannia Industries, Pepsi Co, Rallis India Limited, Escorts, Mahindra & Mahindra, and Venkateshwara Hatcheries have started adopting 'innovative institutional arrangements' as a means of sourcing raw materials directly from the farmers.

It may be concluded that the present policy environment and infrastructure network are inadequate for promoting vertical coordination and encouraging agro-processing sector. The scattered attempts made in this direction are showing promising results and they need to be replicated in niche areas. It appears that the private sector is keen to invest in agriculture and agro-processing sector to harness the huge untapped potential but the existing policies are discouraging it from venturing into these areas. It is

high time the private sector is encouraged to evolve new institutional arrangements to take advantage of the opportunities emerging from trade liberalization. The government should ensure that smallholders are not left behind in sharing the benefits of the emerging opportunities.

6. CONCLUSIONS

We have examined the institutional mechanisms adopted by different firms to integrate small producers of milk, broilers and vegetables in the supply chain and their effects on producers' transaction costs and farm profitability. The institutions under study have covered contracting with farmers in case of milk and broilers and producers' associations in case of vegetables. The models adopted in the three case studies have shown certain similarities and some dissimilarities in their approach as well as terms and conditions. A common feature is that they provide technical support for production and ensure an assured market to the producers. Dissimilarities too are many. In broiler farming, the firm contributes in terms of major inputs and exercises considerable control over the production process, whereas in the case of dairying and vegetable production, the firm hardly has any influence on producers' decisions. Further, in contract broiler farming, the firm pays fixed growing charges thus protecting producers from the price risks, whereas in the case of dairying and vegetable production, the entire price risk is borne by the producers.

Nevertheless, the effect of these institutional arrangements on producers' transaction costs and farm profitability has been found enormous. Transaction cost as a result of contract farming has been reduced by over 90 percent in the case of milk and

vegetables, and 58 percent in the case of broilers. The net revenue realization by contract producers has been 2 to 4 times higher in milk and vegetables and 1.1 times in broilers. It is observed that smallholders have benefited most from such arrangements as they have low marketable surplus and their marketing costs are extremely high.

The criticism against contract farming schemes for their bias against small producers has not been found true. Evidence from the case studies has indicated considerable involvement of smallholders in such schemes. We have also examined the criticism against contracting firms on their tendency to extract monopsonistic rent in the output market. This too has not been supported by the results of this study; rather the contract farmers have been receiving relatively higher prices (4-25%) than the non-contract farmers. Many contract farming schemes have in-built provision of credits to small producers to ease their capital constraints and some critics argue that by doing so the firm may make producers excessively dependent on it for credit and thus keep them in perpetual indebtedness (Watts 1994; Runsten and Key 1996). In the case studies, we have not come across such type of perpetual indebtness as a result of contract farming.

Based on the empirical analysis of the three models of vertical coordination, the study suggests the following future policy directions:

- By linking production with marketing the firms contribute in developing markets for high-value food commodities, which hitherto are thin, fragmented and thus exploitative. Contrary to the general perception, the smallholders gain substantially as a result of new institutional arrangements. Therefore, any effort for promoting vertical coordination in high-value food commodities

would not only augment income of smallholders but would also generate employment opportunities in the rural areas.

- Many institutions provide free extension and support services to the producers as part of the contract. The public extension system has been under criticism for its inefficiency in delivery of services and rising burden on public exchequer (Ahuja et al. 2000; Sulaiman and Sadamate 2000), and governments are, in fact, looking for alternative cost-effective extension models. Institutions such as contract farming and cooperatives can be considered as models to facilitate the process of privatization of public extension services at no cost to the public exchequer.
- Many firms have started undertaking agricultural research, which was limited so far, to achieve the desired attributes of raw material and acquire competitive edge. These developments of agribusiness activities could improve the interface between private and public sector research, and is a welcome augury. For example, *Safal* provides technical awareness and training to its members on how to grow chemical free vegetables through Integrated Pest Management. Similarly, the Venkateshwara Hatcheries Limited provides best breeds of chicks and Nestle India Limited arranges breeding and veterinary services.
- Many contracting firms arrange for credit and insurance (in terms of risk sharing) for producers which is in the interest of the firms also. In poor economies where markets for these products are still underdeveloped and

imperfect, such schemes have the potential to ease capital constraint on the public exchequer and provide protection against risk and uncertainty.

- For many firms, the vertical coordination is a means of sustaining/improving their export earnings through continuous improvements in value-addition at every stage. In this pursuit, these firms educate producers also about the quality aspects such as Sanitary and Phyto-sanitary (SPS) issues that are becoming important in international trade.
- In countries like India where the existing infrastructure for agro-processing is inadequate, but demand for processed food is increasing, multiplier effect of institutional and infrastructure development in terms of income and employment generation in the primary, secondary and tertiary sectors would be enormous.

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Appendix I—Production and transaction costs of and net profit from milk under contract and non-contract farming mode

Item	Contract	Non-contract	% Difference	t-statistic
No. of in-milk bovines	7.3	5.3	37.7	2.067**
Milk yield (kg/in-Milk Animal)	11.9	11.4	4.4	0.955
Marketed surplus (%)	84.9	83.0	1.9	0.722
Cost of production (Rs/ton)				
Pecuniary	4694	4535	3.5	0.668
Non-pecuniary	892	1193	-25.2	2.027**
Total	5586	5728	-2.5	0.449
Transaction cost (Rs /ton)				
Pecuniary	37	736	-95.0	10.734***
Non-pecuniary	63	706	-91.1	5.867***
Total	100	1442	-93.1	7.876***
Total cost (Rs /ton)				
Pecuniary	4731	5271	-10.2	2.258**
Non-pecuniary	955	1899	-49.7	4.692***
Total	5686	7170	-20.7	4.182***
Milk price (Rs /ton)	9337	8991	3.8	1.165
Net profit (Rs /ton)				
Over pecuniary cost	4606	3720	23.8	2.129**
Over total cost	3651	1821	100.5	3.415***

***, ** and * indicate significance at 1, 5 and 10 % respectively.

Appendix II—Production and transaction costs of and net benefits from broilers under contract and non-contract farming

Item	Contract	Non-contract	% Difference	t-statistic
Number of producer households	25	25		
Number of chicks placed per crop (cycle)	8149	6891	18.3	0.746
Number of production cycles/year	5.6	5.8	-2.8	0.879
Mean length of the production cycle (days)	42.3	48.4	-12.6	7.106***
Mortality rate (percent)	4.8	4.4	8.7	0.737
Body weight (kg/bird)	1.78	1.79	-0.6	0.128
Feed conversion rate (kg feed/kg body weight)	1.9	2.2	-14.3	3.186***
Marketed surplus (percent)	100.0	99.9		-
Cost of production (Rs/ton body weight)				-
Pecuniary	746	27227	-	-
Non-pecuniary	62	95	-	-
Total	808	27322	-	-
Transaction costs (Rs/ton body weight)				
Pecuniary	37	81	-54.3	2.939***
Non-pecuniary	1	9	-88.9	-
Total	38	90	-57.8.	3.146***
Total costs (Rs/ton body weight)				
Pecuniary	783	27308	-	-
Non-pecuniary	63	104	-	-
Total cost	846	27412	-	-
Gross profit (Rs/ton body weight)	3101	29415	-	-
Fixed growing charges/sale of broilers	2500	28792	-	-
Net incentive/penalty	79	0	-	-
Total from broilers	2579	28792	-	-
Sale of poultry manure	372	434	-	-
Sale of empty feed bags	150	189	-	-
Net profit from broilers (Rs/ton body weight)			-	
Over pecuniary costs	1796	1484	21.0	1.272
Over total costs	1733	1380	25.6	1.437
Net profit from all (Rs /ton body weight)				
Over pecuniary costs	2318	2107	10.0	0.922
Over total costs	2255	2003	12.6	1.107

***, ** and * indicate significance at 1, 5 and 10 % respectively.

Appendix III—Production and transaction costs of and net profit from vegetables (spinach) under contract and non-contract farming

Item	Contract farmers	Non-contract farmers	% Difference	t-statistic
Crop yield (ton/ha)	8.6	8.3	4.0	0.954
Cost of production (Rs/ton)				
Pecuniary	1020	1171	-12.9	2.063**
Non-pecuniary	465	459	1.3	0.266
Total	1485	1630	-8.9	1.588
Transaction cost (Rs/ton)				
Pecuniary	24	318	-92.5	6.583***
Non-pecuniary	11	119	-90.8	5.356***
Total	35	437	-92.0	6.637***
Total cost: production (Rs/ton)				
Pecuniary	1044	1489	-29.8	5.606***
Non-pecuniary	476	578	-17.5	2.846***
Total	1520	2067	-26.5	5.663***
Price (Rs/ton)	3311	3074	7.7	2.303**
Net profit (Rs/ton)				
Over pecuniary costs	2267	1586	42.9	4.453***
Over total cost	1791	1007	77.9	4.727***

***, ** and * indicate significance at 1, 5 and 10 % respectively.

Appendix IV—Selected characteristics of contract and non-contract producers

Variable	Definition	Hypothesis
Age of the household	Age in years of the household makes decision	+
Schooling of the household	Schooling years of the household makes decision	+
Experience in particular activity	Experience in years of producing particular commodity	+/-
Land size	Size of land holding in ha	-
Total stock	Number of livestock or size of broiler shed	+
Non-farm income	Yes if there is any non-farm income, otherwise zero	+
Labor availabe with the household	Adult workers available for agriculture in the household	+

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