Article

Can Firm–Farm Associations Solve the Crisis in Indian Agriculture? Observations from North India

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Saroj Verma[1]

Abstract

Contract farming (CF) is considered as a tool to advance agriculture through commercialisation in many developing nations. Although a substantial body of literature shows the impacts of CF on farmers' welfare, its effect on resource-usage efficiency is ignored. Using cross-sectional data from 754 wheat farmers, this study finds that farmers who collaborate with contracting firms are highly efficient than those who are working in non-contract farming (NCF). Furthermore, CF adopters are taking benefits in terms of better resource use efficiency and minimum market risk. However, the participation of marginal and small-scale farmers in CF is almost negligible. Thus, it is suggested that contracting firms should bring these farmers into the ambit of contracting system to uplift their well-being.

Keywords

Contract farming, efficiency, risk, Haryana

Introduction

The issue of small farmers' returns from participation in agro-food supply chains, particularly in contract farming (CF) agreements, in developing nations, has significantly risen in recent years (Barrett et al., 2012; Reardon & Gulati, 2008;

[1] Department of Economics, Akal University, Bathinda, Punjab, India

Corresponding author:
Saroj Verma, Department of Economics, Akal University, Bathinda, Punjab 151302, India.
E-mail: vermasaroj477@gmail.com

Swinnen, 2007). CF is a mechanisation of producing and supplying farm products under an advanced agreement. The essence of such an agreement is to provide a specific type of agricultural or horticultural products at a particular time and price in a pre-fixed quantity demanded by the contracting firm. The contract terms can vary from crop to crop and region to region (Eaton & Shepherd, 2001).

Most authors (Bellemare, 2012; Bijman, 2008; Kaur & Singla, 2018; Sharma, 2016) agree that CF is a product innovation for agricultural development in emerging nations. It enhances the welfare of farmers by providing them with improved technology, related farming information and higher-end markets for their final products (Barrett et al., 2012; Miyata et al., 2009; Ton et al., 2018). However, there is substantial doubt whether these arrangements benefit the farmers. According to Singh (2002), Kalamkar (2012) and Sharma (2016), farmers face constraints, mainly when they grow new crops, as the risks of production and market failure always remain with them. Inefficient supervision or production risk leads to a situation where contracts are manipulated and all contracted production is not bought by sponsoring firms.

Many Indian studies have examined the factors influencing farmers' willingness to adopt CF. In addition, many authors have also explored its welfare impacts (Birthal et al., 2005; Swain, 2012, 2018). As most of them asserted that CF is emerging as a significant tool to enhance farmers' welfare, consequently, it needs a detailed study of whether the corporate sector's involvement in agriculture is actually beneficial for farmers via expanding income level and diminishing production risk and price uncertainty. But, recently, enough attention has not been paid either to compare the efficiency level of significant farm inputs or to estimate the yield and price uncertainties under CF and non-contract farming (NCF) scenarios. Thus, this study attempts to bridge this research gap by exploring the CF system with the help of marginal factor cost and marginal value productivity of wheat growers in Haryana. It looks at how CF affects the wheat production with a special focus on (a) the resource-usage efficiency of key inputs and their influences on crop yield and returns, and (b) the estimation of yield and price uncertainties involved in wheat production at the prevailing pattern of resources and technology embraced by farmers.

This article is structured in different sections. After giving a brief introduction, a critical literature review is discussed in the second section. The third section explains the privileged framework of contract farming in the study area, while the fourth section describes the data and methodology of the study. The fifth section discusses the results of the study. Conclusion and policy suggestions are offered in the last section of the article.

Production Contract and Farmers' Welfare: A Review

The role and effects of contract farming mechanism in the developing nations constitute a hotly debated ground (Masakure & Henson, 2005; Oya, 2012; Winters et al., 2005). In the initial years of the 21st century, Birthal et al. (2005), Tripathi et al. (2005) and Ramaswami et al. (2006) examined the CF scenario under milk,

vegetable and poultry production in Northern India and found that CF adopters enjoy higher earnings, improved market efficiency and low business risk. CF also enhances the supply chain efficiency in the economy (Wang et al., 2014). Contracting agencies offer higher prices for their produce, which makes a remarkable difference between the profit of CF adopters and non-adopters. Likewise, Sharma (2016), Mishra et al. (2018) and Saroj et al. (2023) in India; Simmons et al. (2005) in Indonesia; Bolwig et al. (2009) in Uganda; and Kumar et al. (2019) in Nepal detected that contract growers earn higher income and produce advanced quality yield with a better resource usage efficiency as compare to their counterparts. It raises farmers' living standard, creates more employment and develops new cropping technologies that expand inclusive welfare of farmers, especially smallholders (Cahyadi & Waibel, 2013; Chand et al., 2017; Mishra et al., 2018).

Indeed, CF improves the farmers' welfare, but many studies interpreted it as a tool for agribusiness organisations to fraud growers for their own proceeds (Porter et al., 1997; Singh, 2002). Small holders are exploited by large agribusiness firms due to their limited bargaining power (Singh, 2002). In Punjab and Haryana, marginal and small farmers are excluded from contracting system on the bases of their assets holding size. This discrimination exists because agribusiness firms are not willing to involve in contracts with those farmers who actually need this to cope up with the competitive international market (Dileep et al., 2002; Kaur & Singla, 2018; Sharma, 2016). Generally, farmers find that the contracts are biased and imposed strictly. Firms provide poor extension services and overpriced input facilities, pass on the risk to the farmers, offer low prices of products, favour large farmers, delay payments and do not compensate for natural calamity loss (Kalamkar, 2012). However, farmers adopt CF if their adopting expected returns are higher than non-adopting returns (Barrett et al., 2012). Bogetoft and Olesen (2004) claim that the majority of small-scale growers adopt CF to diversify the production risk rather than to lift the output level.

Table 1 focusses on the impacts of CF on the farmers' welfare in various aspects, both developed and developing. The table includes the studies from 2010 to 2024, including numerous agricultural goods. The contracting impacts on farmers' income is multifaceted. The majority of data from the preceding research indicates that contract farming has a beneficial influence on farmers' income. Contract farming provides price certainty, access to markets, technical support and various extension services. However, one study by Mwambi et al. (2016) shows opposite results that CF is insufficient to increase the revenue of households and farms.

Production Contract Framework in the Study Area

CF nature depends on many factors, that is, types and varieties of crops, the firm's aims and resources, and the farmers' experience (Eaton & Shepherd, 2001). This study mainly identifies two models: (a) the direct formal model and (b) the partial formal model. Different contracting models have different arrangements for pricing and other farming factors, depending primarily on the types and varieties

Table 1. Studies on Contract Farming and Farmers' Welfare.

Author, Year and Product	Findings	Impacts
Olomola (2010) Cotton, ginger, rice, soyabean and tobacco in Nigeria	Contract farming has favourable impacts on per capita income. Farmers' productivity and profitability rise when they adopt contract farming.	+
Meshesha and Gardebroek (2011) Honey in Ethiopia	Contract farming increases beekeepers' yearly income substantially.	+
Jones et al. (2011) Organic cocoa in Uganda	Contracting system demonstrates rising trend of farm productivity.	+
Minot (2011) Tea, coffee, tabacco, sugarcane, cotton in Sub Saharan Africa	Contract farming is more profitable for farmers who participate in it.	+
Cahyadi and Waibel (2013) Oil palm in Indonesia	Contract farming has a huge favourable impact on small landholders' income. They produce higher and better-quality yield under contract farming.	+
Wang et al. (2014) China	Contract farming effectively increases the farmers' returns. Contract farming has been found effective in increasing production.	+
Girma et al. (2015) Honey in Ethiopia	Contract farming increases total income of growers.	+
Mwambi et al. (2016) Avocado in Kenya	Contract farming is not sufficient to increase farmers' income.	−
Swain (2016) Hybrid paddy in India	In the case of labour-intensive crops, there is high involvement of small farmers in contract farming.	+
Chand et al. (2017) India	Considerable rural employment is offered by contract farming.	+
Kumar et al. (2018) Tomato in Nepal	Profits earned by contract farmers is significantly higher than those of non-contract farmers. Contract farming leads to significantly high yield.	+
Kaur and Singla (2018) Chicory and sugar beet in India	Contract farmer may earn double returns from high-value crops than traditional crops through contract farming. But it excludes the smallholder participation.	+ −
Mishra et al. (2018) Basmati rice in India	Contract farming leads high level of yield. Contract farmers tend to hire more workers, so it also increases employment.	+
Swain (2018) Gherkin and hybrid paddy in India	Compared to non-contract farmers, farmers engaged in contract farming employ more family labour.	+
Kumar et al. (2019) Paddy in Nepal	Farmers earn higher profit when they grow under contract farming. They get access to improved paddy seeds through contract farming, which leads production enhancement.	+
Saroj et al. (2023) Wheat in India	Earning higher profit is an important stimulus for contract farmers. Contractual strategy improves crop productivity and returns.	+
Mohapatra et al. (2024) Rice in India	Contract farming develops the social culture and spatial collaboration of farmers	+
Saroj and Paltasingh (2024) Wheat in India	Contract farming lifts farm income, productivity as well as efficiency.	+

Note: + and − indicate the positive and negative impacts, respectively.

of crops. In Figure 1(a), the direct formal model is shown, where the contracting firm directly trades with farmers through a written formal agreement between both. Figure 1(b) presents the partial formal model, under which some large farmers purchase inputs from the firm in a bulk amount and distribute them to marginal and small farmers who directly cannot contact the contracting firm because of their less landholding area and limited bargaining power. These marginal and small farmers sell back their final production to these large farmers and then pass it to the firm. In short, these large farmers work as middlemen between the contracting firm and a band of marginal and small farmers. However, there does not exist any formal written agreement between large farmers and groups of marginal and small farmers, but between the contracting firm and these large farmers, it exists. In the second case, because there is no direct contact between the contracting firm and small farmers, large farmers are responsible for overseeing the whole production process, including distributing seeds and other

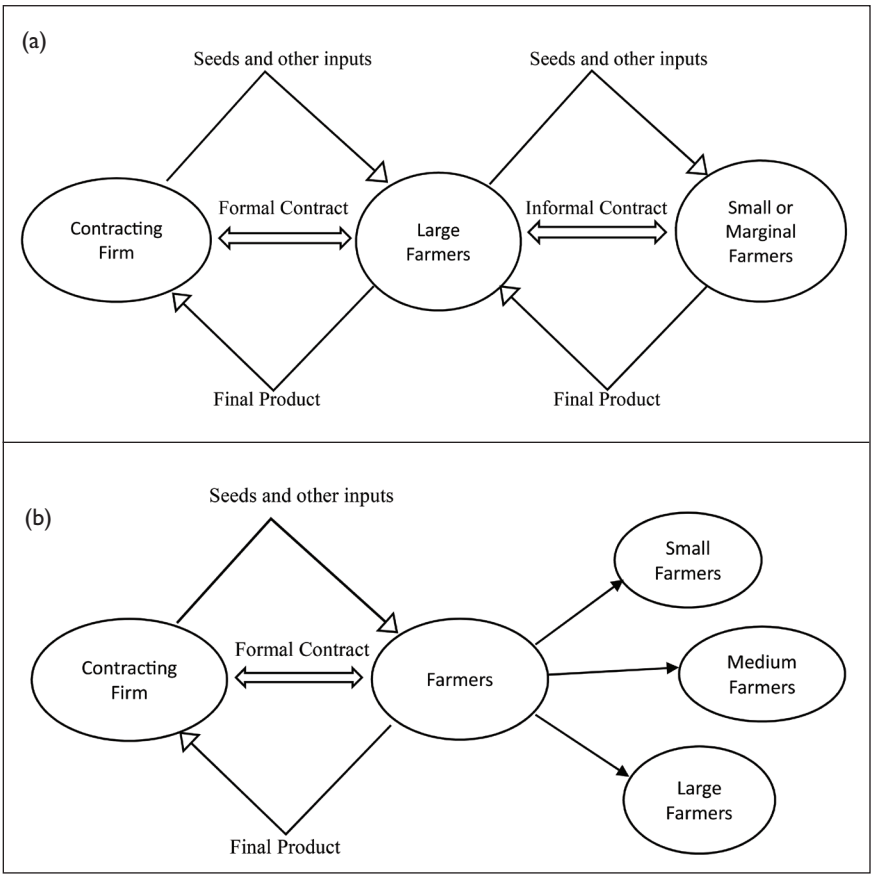

Figure 1. Models of CF: (a) Direct Formal Model (b) Partial Formal Model.

Source: Firm's records and author's field survey, 2019–2020.

inputs, providing all technical and extension services, and assisting financially. They also visit the farm for inspections.

To maximise wheat production, the concerned processing corporation provides hybrid-certified/foundation seeds to farmers. The firm charges a sum of ₹1,550 per 40 kg (on average) as wheat seeds cost from farmers is 36% higher than the open market seed cost. Farmers are being introduced to enhanced farming technology through extension supports provided by the firm's staff (field executives), who regularly visit the farms during production. The processing firm fixes the procurement price by adding an 18% price premium on the minimum support price or privileged market price, which is higher. The contract farmers have to transport their pre-decided production quantity to the processing plant of firms. Within 30 days following the procurement, payment is made to the respective account of farmers. According to the category-wise distribution of the surveyed farmers, around 5%, 43% and 52% of contract farmers belong to small, medium and larger farmers categories, respectively. As a result, it may be argued that processing firms preferred to join medium and large farmers.

Data and Method

For this study, the data was collected from a field survey under two districts (Sirsa and Hisar) of Haryana during 2019–2020. For data collection, these districts were selected purposively since these contribute the maximum share of total wheat production in Haryana (GoH, 2019). A total of 754 wheat growers were surveyed. Out of the total samples, 323 were CF adopters, collected using a multistage purposive sampling procedure, where a farmers' list was initially collected from the contracting firms. This list included general information about the farmers. With its help, the final unit of study (farmers) was surveyed under the contracting system. The remaining 431 samples of CF non-adopters growing traditional wheat seeds were collected through the simple random sampling process. A pre-tested standardised questionnaire was adopted to collect the required quantitative and qualitative data about the farm and farming-specific characteristics of both adopters and non-adopters. Econometric techniques are used to analyse resource-use efficiency and to measure risk in terms of price and yield uncertainty under CF and NCF. The Cobb–Douglas production function is adopted to examine the impact of inputs on the gross income of CF adopters and non-adopters. But the linear production function approach is finalised. Moreover, the ordinary least square method is adopted to estimate and compare the resource-use efficiency of CF adopters and non-adopters under wheat production.

The following log-linear production function approach is used to describe the impact of CF technology on input utilising efficiency:

$$lnY_i = \alpha + \beta_1 lnW_i + \beta_2 lnM_i + \beta_3 \ln F_i + \beta_4 lnP_I + \beta_5 lnI_i + \theta_i + \varepsilon_i$$

In the above given equation; Y is gross income earned by wheat growers (₹/acres); W stands for wages paid to human labour (₹/acre); M is expenditure paid on

machine power (₹/acre); F is expenditure paid on fertilisers and manures (₹/acre); P is expenditure paid on plant protection measures (₹/acre); I is irrigation charges (₹/acre); $\beta_1 \ldots \beta_5$ are regression coefficients, which indicate the elasticities; α is intercept; ε is error term; and θ is village fixed effect.

The marginal value productivity (MVP) and marginal factor cost (MFC) of a specific input can be used to calculate resource-use efficiency. MVP shows the increase in gross return from adding one unit of a given input while keeping the other inputs constant. Similarly, MFC is calculated for input factor cost. As a result, the resource-usage efficiency is calculated by comparing MVP to the corresponding MFC.

The following formulas are used to estimate the yield uncertainty ratio and the price uncertainty ratio (Dileep et al., 2002):

$$\text{Yield uncertainty ratio} = \frac{\text{Average highest expected yield} - \text{average lowest expected yield}}{\text{Average most frequent expected yield}}$$

$$\text{Price uncertainty ratio} = \frac{\text{Average highest expected price} - \text{average lowest expected price}}{\text{Average most frequent expected price}}$$

Result and Discussion

Resource-use Efficiency

Table 2 presents the estimated results of the linear production function of CF and NCF for wheat production. The estimated result for CF and NCF did not confirm significant multicollinearity among independent variables; therefore, the regression equation includes all five important variables, that is, cost of human labour, machine power, manure and fertilisers, plant protection measures and irrigation. The R^2 values suggest that independent variables of the production function explain 65% and 64% variations in the gross income of wheat production under CF and NCF, respectively. The coefficient (β_i) of human labour, as well as those of manure and fertilisers, is positively significant at a 5% level, indicating a

Table 2. Estimated Production Function for Wheat Crop on Sample Farms.

Particulars	CF	NCF
Intercept (α)	10.564*** (1.15)	5.945*** (0.596)
Human labour cost (₹/acres)	0.031** (0.012)	−0.031** (0.013)
Machine power cost (₹/acres)	−0.054 (0.046)	0.055 (0.034)
Fertilisers and manure cost (₹/acre)	0.0345** (0.098)	0.402*** (0.035)
Plant protection measures (₹/acre)	0.116 (0.033)	0.089*** (0.012)
Irrigation charges (₹/acre)	−0.019*** (0.025)	0.023 (0.018)
Coefficient of multiple determination (R^2)	0.65	0.64

Note: Figures given in parentheses are standard errors. The asterisks (***) and (**) indicate 1% and 5% levels of significance.

Table 3. Marginal Value Product and Marginal Factor Cost Ratios of the Used Inputs.

	MVP:MFC	
Particulars	CF	NCF
Human labour	12.45	−8.147
Machine power	−10.924	1.212
Manure and fertilisers	4.921	4.415
Plant protection measures	19.906	12.132
Irrigation	−7.286	4.741

notable impact on the return of wheat grown under CF. The coefficient value of irrigation is negatively significant at a 1% level, depicting excessive use of irrigation in contracting crops may reduce the returns from CF. However, in NCF, the values of coefficients of manure and fertiliser and plant protection measure are positively significant at 1% level, implying that there is an appropriate use of these inputs, resulting in a higher return of wheat production. But the negatively significant coefficient of human labour implies that excessive labour use in non-commercial farming may reduce returns.

The resource-use efficiency is measured in terms of the ratio of MVP and MFC of significant inputs used under CF and NCF. The ratio of MVP and MFC describes the economic performance of quality inputs. The analysis results are given in Table 3, presenting that the MVP–MFC ratio of plant protection is the maximum among all the inputs used for wheat production under both CF and NCF. It is 19.9 for CF and 12.13 for NCF, indicating enough possibility to enhance the returns by taking more plant protection measures. The MVP–MFC ratios of manure and fertilisers for both CF and NCF are almost the same and show a considerable favourable impact on the return from wheat production. The MVP–MFC ratio of human labour is largely positive under CF but negative under NCF. It also shows enough possibility to improve the return level by increasing the use of human labour at the existing technology level, but in NCF, the labour distribution must be reorganised at the prevailing resource-use pattern. Similarly, the MVP–MFC ratios for machine power and irrigation under CF are negative and suggest that there is a need to mitigate their excessive usage.

Yield and Price Uncertainty in Wheat Farming

It is difficult to measure the risk or uncertainty in the production and price of agricultural products since future events cannot be predicted empirically and are affected by various factors such as weather, natural disasters, socioeconomic conditions and other factors that occur in a particular zone. The yield uncertainty ratio is calculated to estimate the uncertainty in crop yield and the results are given in Table 4. The estimated yield uncertainty ratio is 0.22 for CF and 0.35 for NCF, implying that the yield uncertainty under CF is lesser than NCF for wheat farming. It could be because the contracted farmers grow high-quality seeds, follow the specified farming techniques and have access to consistent direction and timely

Table 4. Estimation of Yield Uncertainty in Wheat Production.

Particulars	Average Expected Yield (Quintal/Acre)			Yield Uncertainty Ratio
	Highest Probable Yield	Lowest Probable Yield	Most Frequent Probable Yield	
Contract farmers	25	20	22	0.22
Non-contract farmers	23	16	20	0.35

Table 5. Estimation of Price Uncertainty in Wheat Production.

Particulars	Average Expected Price (₹/Quintal)			Price Uncertainty Ratio
	Highest Probable Price	Lowest Probable Price	Most Frequent Probable Price	
Contract farmers	2,170.00	2,170.00	2,170.00	0.00
Non-contract farmers	1,830.00	1,400.00	1,640.00	0.26

supervision from the firm's team, who visits their fields many times throughout the whole production season.

Similarly, the price uncertainty is estimated for CF and NCF by employing the formula of price uncertainty ratio. The results are shown in Table 5, indicating that there is no pricing uncertainty in CF; it is because the contracting firm purchases the whole production from farmers at a pre-decided price. In the contract agreement, the purchasing norms, that is, quantity, quality, price, etc., are defined by the firm and farmers mutually, and both (contracting firm and farmers) are obliged to trade according to that mutual agreement. The price uncertainty ratio for NCF is 0.26, indicating that the price of wheat in the local market varies significantly based on crop quality, quantity supplied, selling site and location, and modes of transportation and communication, among other factors. These findings clearly prove that the CF system is advantageous over traditional NCF in terms of reduced yield and price uncertainty in wheat farming. These findings are consistent with the study of Dileep et al. (2002), Dhillon et al. (2006), Tripathi et al. (2005) and Key (2013) in different areas where CF is practiced.

Conclusion and Policy Suggestions

Some important conclusions can be drawn by using statistical analysis on 754 wheat growers in Sirsa and Hisar districts of Haryana. The regression analysis of CF production function reveals that human labour and manure and fertilisers have positively significant impacts while irrigation has negatively significant impacts on crop return. Similarly, under NCF production function, plant protection

measures and manure and fertilisers are found positively significant, while human labour is found negatively significant with the returns from wheat production.

The MVP–MFC ratio is greatly higher for human labour and plant protection measures in CF, which indicates the appropriate scope of rising returns from wheat production by increasing the utilisation of these inputs at privileged technology level and resource-use pattern. The rational use of irrigation and machine power in CF and human labour in NCF can boost the profitability of wheat growers. NCF has been proven to have more risk in terms of yield and price uncertainty than CF. Moreover, financial constraints are observed to be more prevalent than technological, extension and situational constraints. This might be because contracting firms are effectively offering technical support and extension services to all the contracted farmers on a regular basis to ensure maximum yield with superior quality. Concisely, CF adoption in wheat production has been shown to improve resource utilisation efficiency, reduce yield uncertainty and eliminate price uncertainty, which directly contributes to the development of farming sector.

It is noted that marginal and small farmers are involved under CF in a very negligible percentage as compared to medium and larger farmers. From a long-term perspective in terms of agricultural market involvement, their exclusion from contracting technology cannot be overlooked as around 80% of total farmers' population in India belong to these categories. So, the policy recommendation of this study suggests that contracting firms should bring the marginal and small-scale farmers into the ambit of the contract to uplift their well-being. Institutional and structural barriers to the CF adoption by these farmers should be eliminated on both supply (farmers) and demand (contracting firms) sides.

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ORCID iD

Saroj Verma https://orcid.org/0000-0002-6442-4369

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