PRODUCTION CONTRACT AND FARM EFFICIENCY: CASE OF WHEAT GROWERS IN NORTH INDIA

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ABSTRACT

Contract farming (CF) is considered a tool to advance agriculture through commercialization 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 CF adopters are highly efficient than non-contract farming (NCF). Furthermore, CF adopters benefit appreciably from contracting in terms of better resource use efficiency and minimum market risk. However, the participation of marginal and small-scale farmers is almost negligible in CF. So it suggests that contracting firms should bring these farmers into the ambit of the contract to uplift their well-being.

Keywords: Contract farming, efficiency, risk, Haryana.

JEL Classification: C01, Q12, Q13.

INTRODUCTION

The issue of small farmers' returns from participation in agro-food supply chains, particularly in contract farming agreements, in developing nations, has significantly risen in recent years (Swinnen, 2007; Reardon and Gulati, 2008; Barrett et al., 2012). CF is a mechanization 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 and Shepherd, 2001). Most authors (Ramaswami et al., 2005, Bijman 2008; Bellemare, 2012; Sharma, 2016; Kaur and Singla, 2018) 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 (Miyata et al., 2009; Barrett et al., 2012; 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 (Dev & Rao, 2005; 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 whether the corporate sector's involvement in agriculture is actually beneficial for farmers via expanding income level and dimining production risk and price uncertainty. But, recently, enough attention has been paid neither to compare the efficiency level of significant farm-inputs nor to estimate the yield and

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price uncertainties under CF and NCF scenarios. Thus, this study attempt 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 (1) the resource-usage efficiency of key inputs and their influences on crop yield and returns, and (2) the estimation of yield and price uncertainties involved in wheat production at the prevailing pattern of resources and technology embraced by farmers.

The article is structured in different sections. After giving a brief introduction, a critical literature review is disscused in section 2. Section 3 explains the privileged framework of contract farming in the study area while section 4 describes the data and methodology of the study. Section 5 discusses the results of the study. Conclusion and policy suggestions are offered in the last section of the paper.

Contract Production and Farmers' Welfare: A Review

The role and effects of contract farming mechanism in the developing nations constitute a hotly debated ground (Masakure and Henson, 2005; Winters et al., 2005; Oya 2012). In the initial twenty first century, Birthal et al., 2005; Tripathi et al., 2005 and Ramaswami et al., 2006 examined the CF scenerio under milk, vegetable and poultry production in Northern India and found that CF adopters enjoy higher earnings, improved market efficiency and low business risk. It also enhances the supply chain efficiency in the economy (Wong, 2014). Contracting agencies offer higher prices for their produce which makes a remarkable difference between the profit of CF adopters and non-adopters. Likewise, Dev et al., 2005; Sharma 2016; Mishra et al., 2018 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 (Warning and Key, 2002).

Indeed, CF improves the farmers' welfare, but many studies interpreted it as a tool for agribusiness organizations 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; Sharma, 2016; Kaur and Singla, 2018). Generally, farmers find that the contracts are biased and imposed strictly. Firms provide poor extension services, overpriced input facilities, pass on the risk to the farmers, offer low prices of products, favor large farmers, delay payments and do not compensate for natural calamity loss (Glover et al., 1990; Kalamkar, 2012). However, farmers adopt CF if their adopting expected returns are higher than non-adopting returns (Barrett et al., 2011). Bogetoft and Olesen (2004) claim that the majority of small-sca,e growers adopt CF to diversify the production risk rather than to lift the output level.

Framework of Contract Farming in Study Area

CF nature depends on many factors, i.e., types and varieties of crops, the firm's aims and resources, and the farmers' experience (Eaton and Shepherd, 2001). This study mainly identifies two models: (a) the direct formal model and (b) the partial formal model.

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Different contracting models have different arrangements for pricing and other farming factors, depending primarily on the types and varieties of crops. In figure 1, the direct formal model is shown where the contracting firm directly trades with farmers through a written formal agreement between both. Whereas Figure 2 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 is 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 inputs, providing all technical and extension services, and assisting financially. They also visit the farm for inspections.

To maximize wheat production, the concerned processing corporation provides hybrid-certified/foundation seeds to farmers. The firm charges a sum of Rs. 1550/- per 40 kgs (on average) as wheat seeds cost from farmers is 36 percent higher to open market seeds 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 percent, 43 percent, and 52 percent 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.

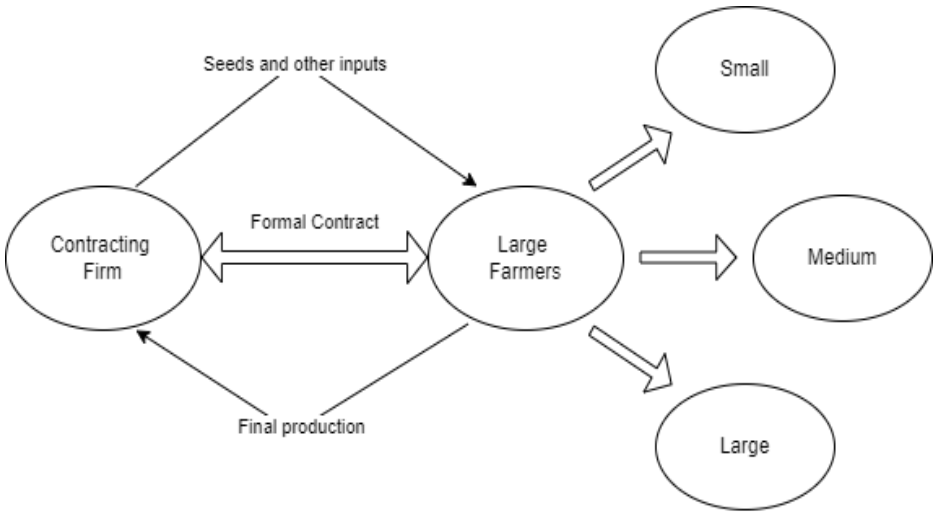

FIGURE 1
MODELS OF CF; (A) DIRECT FORMAL MODEL

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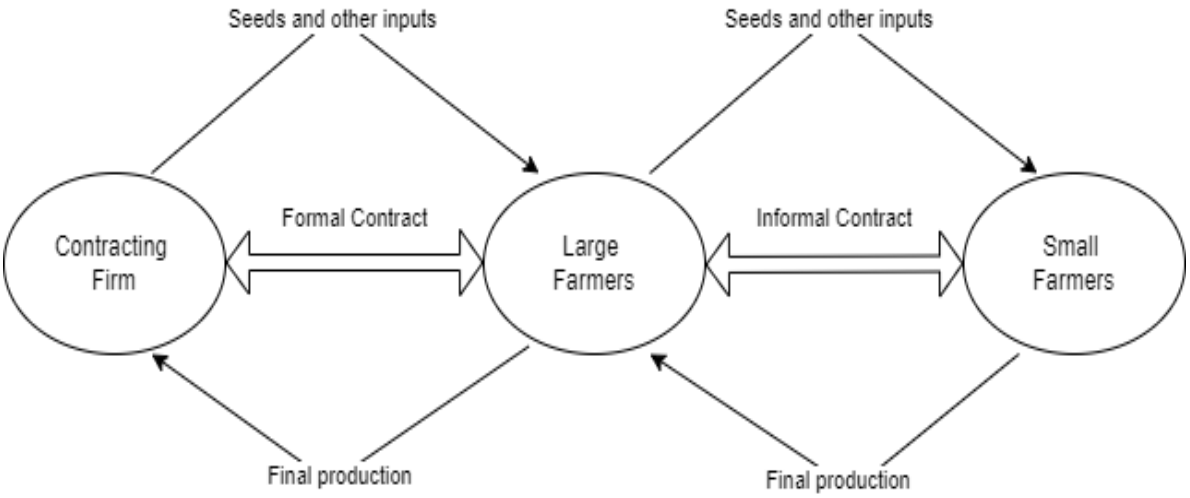

Source: Firm's records and author's field survey, 2019-20.

FIGURE 2
MODELS OF CF: PARTIAL FORMAL MODEL

Data and Methodology

For this study, the data was collected from a field survey under two districts (Sirsa and Hisar) of Haryana during 2019-20. For data collection, these districts were selected purposively since these contribute the maximum share of total wheat production in Haryana (Economic Survey of Haryana, 2017-18, 2018-19). 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 standardized 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 analyze 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 finalized. 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 utilizing efficiency:

$$\log Y = \alpha + \beta_1 log I_1 + \beta_2 log I_2 + \beta_3 \log I_3 + \beta_4 \log I_4 + \beta_5 \log I_5 + \varepsilon$$

where,

Y = Gross income earned by wheat growers (Rs/acres).
I_1 = Wages paid to human labor (Rs/acre).
I_2 = Expenditure paid on machine power (Rs/acre).
I_3 = Expenditure paid on fertilizers and manures (Rs/acre).
I_4 = Expenditure paid on plant protection measures (Rs/acre).

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I_5 = Irrigation charges (Rs/acre).
$\beta_1 \ldots\ldots \beta_5$ = Coefficients of regression for the relevant variables, which indicate the elasticities.
α = Intercept
ε = Error term.
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 1 presents the estimated results of the linear production function of CF and NCF for wheat production. The estimated result for CF and NCF didn't confirm significant multicollinearity among independent variables; therefore, the regression equation includes all five important variables, i.e., cost of human labor, machine power, manure and fertilizers, plant protection measures, and irrigation. The R-squared values suggest that independent variables of the production function explain 65 and 64 percent variations in the gross income of wheat production under CF and NCF, respectively. The coefficient (β_i) of human labor, as well as manure and fertilizers, are positively significant at a 5 percent level, indicating a notable impact on the return of wheat grown under CF. The coefficient value of irrigation is negatively significant at a 1 percent level, depicting excessive use of irrigation in contracting crops may reduce the returns from CF. Whereas in NCF, the values of coefficients of manure and fertilizer and plant protection measure are positively significant at 1 percent 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 labor implies that excessive labor use in non-commercial farming may reduce returns.

Table 1
ESTIMATED PRODUCTION FUNCTION FOR WHEAT CROP ON SAMPLE FARMS

Particulars	CF	NCF
Intercept (α)	10.564*** (1.15)	5.945*** (0.596)
Human labor cost (Rs/acres)	0.031** (0.012)	-0.031** (0.013)
Machine power cost (Rs/acres)	-0.054 (0.046)	0.055 (0.034)
Fertilizers and manure cost (Rs/acre)	0.0345** (0.098)	0.402*** (0.035)

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Plant protection measures (Rs/acre)	0.116 (0.033)	0.089*** (0.012)
Irrigation charges (Rs/acre)	-0.019*** (0.025)	0.023 (0.018)
Coefficient of multiple determination (R2)	0.65	0.64

Source: Author's field survey, 2019-20.
Note: Figures given in parentheses are standard errors.

The resource use efficiency is measured in term of the ratio of marginal value product (MVP) and marginal factor cost (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 2, 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 fertilizers for both CF and NCF are almost the same and show a considerable favorable impact on the return from wheat production. The MVP-MFC ratio of human labor 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 labor at the existing technology level, but in NCF, the labor distribution must be reorganized 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.

Table 2
Marginal Value Product and Marginal Factor Cost Ratios of the Used Inputs

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

Source: Author's field survey, 2019-20.

Yield and Price Uncertainty in Wheat Farming

It's 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 3. 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 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 4, 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 i.e., quantity,

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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.

Table 3
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

Source: Author's field survey, 2019-20.

Table 4
ESTIMATION OF PRICE UNCERTAINTY IN WHEAT PRODUCTION

Particulars	Average Expected Price (Rs. /quintal)			Price Uncertainty Ratio
	Highest Probable Price	Lowest Probable Price	Most Frequent Probable Price	
Contract Farmers	2170.00	2170.00	2170.00	0.00
Non-contract Farmers	1830.00	1400.00	1640.00	0.26

Source: Author's field survey, 2019-20.

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 labor and manure and fertilizers have positively significant while irrigation has negatively significant impacts on the crop return. Similarly, under NCF production function, plant protection measures and manure and fertilizers are found positively significant while human labor is found negatively significant with the returns from wheat production.

The MVP-MFC ratio is greatly higher for human labor and plant protection measures in CF, which indicates the appropriate scope of rising returns from wheat production by increasing the utilization of these inputs at privileged technology level and resource-use pattern. The rational use of irrigation and machine power in CF and human labor in NCF can boost the profitability of wheat growers. NCF has been proven to have more risk in term 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, the CF adoption in wheat production has been shown to improve resource utilization efficiency, reduce yield uncertainty, and eliminate price uncertainty which directly contributes to the development of farming sector.

Though, 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

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in terms of agricultural market involvement, their exclusion from contracting technology cannot be overlooked as around 80 percent of total farmers' population in India belonged to these categories. So, the policy recommendation of this study suggest 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 the supply (farmers) and demand (contracting firms) sides.

Limitations of the Study

Due to the lack of time and resources, some concerns remain unexlored in this study. It looked upon only the supply side (farmers) without considering its effects on the demand side (contracting firms). It might benefit the contracting firms more or less, or sometimes it might detriment the firms. As a result, the supply side effects of CF should be examined from policymaing point of view. Furthermore, this study covers only wheat crop under two districts of Haryana. However, it is difficult to conclude about higher-end market technology on the basis of single crop under limited farming area. Consequently, in order to conduct a better farm-level investigation, research needs go beyond these restrictions.

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