COPERATIVE-LED CONTRACT FARMING ON FARM PRODUCTIVITY IN INDIA

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Abstract
This paper address the question whether farmers who are participated in contract farming are more productivity and efficient in growing contract crop than the non-contract farmers. In this regard, 600 households from three villages have been surveyed from the state of Bihar in India. Cob-Douglas production function has been used in log-linear form to measure the farm productivity. The result suggested that contract farmers are able to achieve average high yield compared to non-contract one. Land and cost of seed are the major factors which helped contract farmers to attain higher level of productivity in growing the contract crop.

Keywords: Agriculture, Contract Farming, Productivity, Technical Efficiency

JEL Code: C13,Q12, Q13

1. Introduction

Agriculture remains the main source of livelihood for more than 60 percent of the country's population, even though India emerged as a service sector driven economy. Therefore, it has been attracting the attention of policymakers and planners. This got manifested in various institutional interventions such as the transfer of land from landlords to landless peasant, increase the area under cultivation, the introduction of high-yielding varieties, and increase the institutional credit support in mid-1970s.

All these initiatives helped the country to self-sufficient in food and to achieve a long-run growth rate at 2.5 percent per annum. However, the government policies were shifted from domestic-oriented to export-oriented strategies in the nineties, especially without proper intuitional arrangement made the sector weaken. The main aim of the agricultural policy was to promote commercial crops through increase in private investment by withdrawing public investment.

It has been guided by the misplaced notion of the later 'crowding out' of the former. In effect, there was a gradual withdrawal of government support from the sector; farmers directly depend on agriculture as cultivators (more than 85 percent are small and

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marginal landholders those have less than 3 hectares of land) were increasingly placed at the bottom of the global value-chains.

Reddy and Akaiah (2005) argued that squeezing the government support for agricultural research and extension led to a virtual breakdown of field extension mechanism and widened the gap between scientific know-how and field level practice (Swaminathan, 2006). Because of the wrong policy, many farmers had left without adequate access to markets and key inputs and services, including credit. Capital inadequacy, lack of infrastructural support, and demand-side constraints such as controls on movement, storage, and sale of agricultural commodities, etc. have continued to affect the economic viability of the agricultural sector (National Agricultural Policy, 2000).

The crisis in agriculture got manifested such as declining production and productivity, increase the cost of production, and suicide among farmers at a rate unheard in history. Considering these problems, enhancement of smallholders' access to the market both locally and internationally could be one of the important strategies for the growth of agricultural productivity and also combat poverty.

Contract farming is one of such institutional mechanisms which enhances the farm productivity and provide assured price to farmers for their product. It organizes the agricultural production in such way that farmers are obliged to supply their produce to agro-enterprise through a forward contract, resolves the problems caused by market failures, and increases the agricultural productivity and profits for farmers (Key and Rusten, 1999; Eaton and Shepperd, 2001; Singh 2002; Simmons et al., 2005; Mwambi et al., 2016; Mishra et al., 2018).

Recognizing the potential benefits, both central and state governments in India have undertaken different policy measures (i.e., Intern-ministerial Task Force on Agricultural Marketing reform (2002), National Policy for farmers (2007) and Model Contract Farming Act 2018) for the promotion of CF to enhance the agricultural productivity and farmers' income. There has been considerable agreement among researcher, policy maker and development thinker, in the last one and half decades that contract farming is a way of achieving high productivity and output growth in agriculture, particularly among small-scale producers.[3]

The theory and empirics of contract farming suggests that to procure desired quality and quantity commodity to meet the consumers' demand, agro-processing firm provides improved technology, better method of cultivation and management practice (Key and Rusten 1999; Key and Macbride 2003; Singh 2002; Eaton and Shepred 2001; Swain 2016). Since firms have direct interest for improving the quality of product, they usually

[3] Empirical evidence suggests that small farmers are desirable not only because they reduce unemployment but also they distribute income more equitably and stimulate effective demand in the economy. This research Paper is part of a project report titled "India's Agrarian Crisis and the Emergence of Contract Farming: A study of Bihar", sponsored by Indian Council of Social Science Research, Ministry of Human Resource Development, Government of India.

offers improved technology and better technical assistance more conscientiously than a government agricultural extension services (Minot 1986). Some studies have shown that contract farmers are able to achieve higher productivity and efficiency than the non-contract farmers (Swain 2016; Kumar 2006; Ramswami et al. 2005; Dileep et al. 2002; Chang et al. 2006).

Not only the contract mode of production has direct impact on crop productivity, it has spillover on non-contract crop grown by contract farmers and non-contract farmers also. Because of the technology and management practices brought by the processing firm, the production efficiency of contract crop would be higher than the non-contract crop.

Various literature suggested that Contract farming is expected to increase farmer's efficiency either through exploiting economies of scale (Macdonald, 2006) or through providing better knowledge and inputs (Eaton and Shepherd, 2001; Key and McBride, 2003; Ramswami et al., 2005; Baumann, 2000; Mishra et al., 2018) that would not be otherwise available in the open market. Minot (1986) argued that firms that provide improved technology and better technical assistance conscientiously increase their efficiency than the government's agricultural extension services.

Ramswami et al. (2005) observed that contract production is more efficient than the non-contract production due to the lower cost paid for inputs by the contract farmers. In the contract mode of production, the contractor facilitates production by providing credit, better technology and inputs,[4] thus reducing the risks of market imperfection (Singh, 2002; Eaton and Shepherd, 2001). It is to say that CF relieves farmers from input constraints, enabling them to apply inputs at an optimal level. Thus, contract production is likely to be more productive and efficient than non-contract production.

Many empirical studies examined the farm productivity and efficiency of a farmer under contract production (Kumar, 2006; Ramaswami et al., 2005; Chang et al., 2006; Key and William, 2003; Bellemare, 2009; Swain, 2016; Mishra et al., 2018; Nguyen et al., 2018; Dubbert, 2019; Khan et al., 2019; Bidzakin et al., 2020) and observed a close link (positive impact) between CF and farm productivity. It is because of better technology, management, farm size, input factors like seeds, chemeicals, fertilizers, human capital, labour etc.

The objective of this study is to assess the impact of CF on farmer's technical efficiency (TE) of growing green chili. We took Bihar as the case study for two distinct reasons -i) in the wake of the agrarian crisis, the state government has been promoting CF since last one decade, ii) though contract mode of production has spread in different regions of the state[5], it has not received the attention of researchers and no study has examined the efficacy of CF.

[4] Generally, the contractor provides around 70% to 80% of the total cost of production and facilitates market for the contract crop. Since the contractor supplies such a large share of the production costs, it reduces the amount of credit needed.

[5] Milk production and marketing by COMFED, vegetable procurement and marketing by Kaushalya Foundation in Nalanda district, seed production in Ara district, Basmati rice

2. Data Source and Methodology

This study is based on primary data that has been collected from 600 households from the state of Bihar where contract farming is in operation. Multistage sampling techniques have been used. The first stage involved a purposive sampling of choosing Junedi Farmers Producer Company Limited on the basis of area covered for farming.

The second stage involved stratified random sampling method. Under this company, six villages (Nanad, Bhagwanpur, Dariyasarai, Junedi, Kadamtar and Gorma) are registered. To select the villages, a pilot survey has been conducted on different parameter such as Household head, Gender, Total Land, Cultivated Land and crops grown and found that three vilages namely Nanad (having large area and population in Nalanda District), Junedi and Gorma are those villages where majority of farmers are associated with the firm. It has also been seen that these villages are growing many crops like such as Rice, Wheat, Groundnut, Chilly, Potatao, Cucumber, Masur, Pulse, Mung Dal, Maize and green vegetables but Green Chilly is the only crop which is cultivated under contract farming.

Empirical Model

A Cobb-Douglas production function in log-linear form is fitted to the observations using ordinary least squares (OLS) for estimating productivity difference alone. The specific Cob-Douglas that is fitted in step one is as follows:

Model 1:

$$LnQ = \alpha + \beta_1 X_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + B_5 X_5 + \varepsilon \text{ ……..(1)}$$

Where,

Q = Total output of crop grown by contract and non-contract farmer (in quintal)

α = the intercept

X_1 = Total land under crop grown by contract and non-contract farmer (acres)

X_2 = Total labour days employed for crop grown by contract and non-contract farmer

X_3 = Total cost of power (animal and machine) is used for crop grown by contract and non-contract farmer (in rupees)

X_4 = Total expenditure on agro-chemicals and manure for crop grown by contract and non-contract farmer (in rupees)

X_5 = Total cost for seed for crop grown by contract and non-contract farmer (in rupees)

cultivation in Munger, potato cultivation by PepsiCo and Chili cultivation by Khistiz Agro Tech. Private Ltd in Nalanda district.

Model 2:

$$LnQ = Ln\alpha + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 X_5 + B_6 X_6 + \varepsilon$$

……..**(2)**

In second model contract dummy is (X_6) (one is for a contract farmer and zero is otherwise) has taken as independent variable.

By pooling the sample of contract and non-contract farmers and regressing output would give the impact of contract participation on productivity, but the result may not be robust due to the sample selection bias. To rectify the sample selection bias, sample selection model[6] (Heckman 1979; Greene 2003, p. 780) is used. The model assumes a joint normal distribution between the errors of selection equation (contract/no contract) and the treatment equation (production function).

3. Result and Discussion

Average Performance of Production

In yield terms, the data reveals a variation in yields per acre of both sample contact and non-contract farmers. From table 1, it is observed that yield rate per acre of green chili varies from 140 to 280 quintals among contract farmers while it is 160 to 288 quintals non-contract farmers.

Table-1: Frequency Distribution of Output of Contract and Non-Contract Crop

Yields Rates (Q/acre)	Green chili	
	Contract farmer	Non-contract
	No. of farmers	No. of farmers
100.01-150	3 (0.9)	0
150.01-200	36 (10.3)	11 (4.4)
200.01-250	295 (84.8)	235 (94.4)
More than 250	14 (4.0)	3 (1.2)
Total	348 (100.00)	249 (100)
Mean	230.68	226.35
Minimum	140.00	160.00
Maximum	280.00	288.00
Variance	407.27	210.18

Source: Calculated based on field survey data

High variation in yield is observed among the contract farmers compared to non-contract one. However, contract farmers are able to achieve average high yield compared

[6] In the sample selection model, two equations are estimated simultaneously: (a) a probit equation explaining the decision whether or not to contract, and (b) an equation explaining productivity, which includes a contracting dummy among the explanatory variables. The empirical model corrects for possible sample selection bias by accounting for the joint distribution of the disturbances. In the full-information maximum likelihood approach, the likelihood of observing a particular level of productivity depends explicitly on the likelihood that the farmer contracts.

to non-contract one. It is important to note that 84.8 per cent of contract farmers' are able to achieve 200-01 to 250 quintals per acre while it 94yield varies among 200.01 to 250 quintals per acre while it is 94.4 per cent in case of non-contract farmers.

The next step in the analysis is to work out the average contribution of each direct production input to green chili cultivated by both contract and non-contract farmers. To see the productivity difference between contract farmers and non-contract farmers in growing contract crops (green chili), we pooled both contract and non-contract farmers together and regressed with contract dummy as independent variable. For the robustness of the result we rectify the sample selection bias though Heckman sample selection model. Cobb-Douglas production function is estimated through OLS method.

The results of the empirical estimation for individual crop are given in table-2. The result can be interpreted as measures of the average performance of sample farmers evaluated at the sample mean input levels because the nature of OLS (Meeusen and Van den Broeck 1977). The coefficient of determination corrected for its degrees of freedom shows the explanatory power of the regression equation. More than 95 per cent of variation in output is explained by the selected direct inputs in the analysis of contract and non-contract crop. The entire coefficient of both contract and non-contract crop have the expected signs and magnitudes.

Table-2: OLS Estimates of Average Performance Using Cobb-Douglas Production Function for Sample Farmers

Variables	**Contract farmers**	**Non-contract Farmers**	**Contract and non-contract farmers**
	Green chilly	**Green chili**	**Green chili**
Constant (α)	3.11 (2.10)**	5.06 (13.89)*	3.48 (4.50)*
Land (β_1)	0.77 (3.52)*	0.89 (18.41)*	0.78 (6.67)*
Labour (β_2)	-0.10 (-0.29)	0.10 (1.75)***	-0.03(-0.26)
Chemicals (β_3)	0.10 (0.90)	0.04 (2.33)**	0.06 (1.15)
Power (β_4)	0.02 (0.24)	-0.03 (-0.99)	0.02 (0.36)
Seed (β_5)	0.16 (3.17)*	-0.01 (-0.27)	0.14 (3.97)*
Dummy (β_6) Contract =1, Non-Contract = 0			0.03 (0.1.10)
Adjusted R^2	0.56	0.97	0.69
No of Observation	301	242	542
F	0.00	0.00	0.00

Source: Calculated based on field survey data. **Note:** Robust standard error. Parentheses shows the t-value , ***, ** and * shows the significant level ate one, five and ten per cent. In this equation both contract and non-contract farmer pooled together and keep the contract, dummy as independent variable.

It is observed that land and seed are significantly contributing the output of green chili cultivated by contract farmers, while it is land, chemical and labour are significantly contributing to the output of green chili cultivated by non-contract farmers. Insignificant

coefficient sign of chemical could have captured by the land and seed in case of contract farmers. Contribution of chemical and labour for high output of green chili cultivated by non-contract farmers could be fact that due to lack of improved method of cultivation practice, these farmers are using more chemicals to achieve higher output. Positive sign of land indicated that a direct relationship between landholding and output achieved. This result is in the line of Ching-Cheng et al. (2006) and Kumar (2006).

The contribution of labour to total output is only in case of green chili cultivated by non-contract farmers not in case contract farmers, tells us non-contract farmers are employing more labour power. The contribution of chemical to total output varies across crops. Though, chemical is not significantly contributing the total output achieved by the contract farmers, coefficient value is higher for contract farmers compared to non-contract one. It indicates that contract farmers are tend to use chemicals at higher rate. Singh (2008) argues that contract farmers use higher chemicals in initial period, lead to decline the land quality, and hence they use more and more chemicals year by year so as to maintain the output.

The productivity difference between the contract and non-contract farmer are estimated by pooling both contract and non-contract farmers together, used a dummy independent variable (one for contract and zero for non-contract farmers) in an additive form. It turns out that the differential intercept among contract and non-contract farmers and slope coefficient is statistically insignificant. However, the result of dummy variable implies that the output per cropped of green chili grown by contract farmers is on average, 3 per cent higher than the non-contract farmers.

The second approach for measuring the impact of contracting on productivity involves estimating a production function, taking into account the potential bias in sample selection process. Table 3 reports the result of maximum likelihood estimation and observed statistically insignificant of differential intercepts between contract and non-contract farmers. Though the difference is insignificant, average production for contract farmers is 6 per cent higher than the non-contract farmers in growing green chili.

Table-3: Selection Model Maximum Likelihood Estimates: Production Function of Green chili among Contract and Non-Contract Farmers

Variables	**Constant (α)**	**Land (β_1)**	**Labour (β_2)**	**Power (β_3)**	**Chemicals (β_4)**	**Seed (β_5)**	**Type of Farmer (β_6)**
Coefficient	-5.08	0.87	0.07	-0.04	0.04	-0.01	0.06
Z-Value	(15.31)*	(20.03)*	(2.48)*	(-1.24)	(2.14)*	(-0.23)	(1.23)
χ^2			0.00				
Rho			-0.83 (0.04)				
Log Pseudo likelihood			107.69				
Lnsigma			-2.55 (-48.18)*				
Number of Observation			557				

Source: Calculated based on field survey data. **Note:** Table presents maximum likelihood parameter for sample selection model. Dependent variable in the equation is contract (1, 0); Dependent variable in the production function equation is log of production. In the regression all inputs have been normalized relative to the sample mean. The robust stand error. Contract Farmer =1, Non-Contact Farmer = 0, ***, **, * shows the significant level ate ten, five and one per cent level respectively

Farm-Specific Production Function

The above results, though provides a general measure of performance of individual crops, do not contribute much to an explanation of individual variations in performances, as shown in table 4.

Table 4: Half-Normal of Maximum Likelihood Estimation of Frontier Production Function for Selected Sample Farmers

Parameters	Contract Farmer		Non-Contract Farmer
	Groundnut	Green chili	Green Chili
Constant (α)	1.96 (7.11)*	4.77 (6.11) *	5.21 (13.24)*
Land (β_1)	0.88 (17.19)*	0.91 (7.63)*	0.87 (17.64)*
Labour (β_2)	-0.02(-0.42)	0.10 (0.90)	0.10 (2.45)**
Chemicals (β_3)	0.10 (2.46)**	0.10 ((1.09)	0.03 (0.18)
Power (β_4)	0.10 (3.73)*	-0.04 (-0.95)	-0.02 (-0.54)
Seed (β_5)	-0.10 (-5.39)*	0.11 (3.28)*	-0.05 (-0.41)
Sigma square	0.43	0.25	0.10
Log likelihood	158.45	45.42	333.10
σ_u	0.10	0.50	0.09
σ_v	0.17	0.10	0.03
λ (Lambda)	1.68	5.47	2.75
Chi-square	38.51 (0.00)	147.92 (0.00)	842.83 (0.00)
Number of Observation	329	300	242

Source: Calculated based on field survey data.

Note: *, **, *** shows the significant at one, five and ten per cent level respectively. () shows the Standard Error

The following section discusses the farm-specific performances of individual sample contract and non-contract farmers with their feasible or best performance. The method of estimation of maximum likelihood (ML), using the Cobb-Douglas functional form which allows us to obtain the best practical performance output. In the Cobb-Douglas production function (3), the error term w is decomposed into u and v, where u represents farm-specific production behavior relating to its technical efficiency and affiance v represents statistical noise. Measurement of technical efficiency through half-normal and exponential maximum likelihood methods give similar results. The present study reported half-normal because it is slightly tighter than the exponential (Kumbhakar et al. 2006).

4. Conclusion and Policy Implications

In this paper, it has addressed the question whether contract farmers are more productivity in growing contract crop than the non-contract farmers. Contract farmers are able to achieve average high yield compared to non-contract one. It assumes that a

contract production will be efficient when it reduces the farmer's costs of production or when it produces the maximum output with minimum inputs as compared to non-contract production. It is observed that land and seed are significantly contributing the output of green chili cultivated by contract farmers, while it is land, chemical and labour are significantly contributing to the output of green chili cultivated by non-contract farmers. In other words, Land and cost of seed are the major factors which helped contract farmers to attain higher level of productivity in growing of green chili, whereas land, labour, chemical and seed cost contribute to the non-contract farmers.

To promote the contract farming and extract the benefits contract farming, there is a need for better institutional mechanism to make it more inclusive like Land lease market should be liberalized as result small farmers can enlarge their operational landholdings. While contracts are essentially private, the role of government in regulation of contract is important for sustaining the contract. State can act to regulate the market ensuring that contractors do not abuse their market power on producers. To promote contract farming, information regarding the benefits and problems of contract farming should be disseminated. It can be disseminated through information communication technology. There should be effort to increase the better access to output market and credit to make contract farming model successful.

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