How Much Contractor Type, Commodity, and Farm Size Matter in Contract Farming: Evidence from High-Value Crop Producers in Nepal

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Why go for contract farming?

- Provides numerous opportunities for farms:
  1. access to the stable market and pricing
  2. inputs and marketing services.
  3. stimulates technology and skill transfer
  4. promotion of sanitary and phytosanitary standards.
  5. Relaxes liquidity constrant
  6. Develops agricultural input and output markets when government's role is absent, limited, or expands in the case of market failure.

Contract farming: as Monopsonist

- In developing countries, like Nepal, Contract ratification boards or courts are not efficient
- CF often relies on monopsonies to be efficient and can to lead to self-exploitation
- CF can lead to job loss in rural areas since monopsonist can affect price by varying the quantity purchased of the good.
- Cooperatives also do CF.
  - Less restrictive and more focused on keeping smallholders happy.
  - May offer lower prices

Objective of the study

Identify the impact of Contract Farming (CF) in high-value crops (ginger and tomato) on employment and other *outcome variables* (profits, revenues, and yield) of smallholder farm households in Nepal.

Nepal economy

- Agriculture provides
  - about 35% of the gross domestic product
  - employs 75% of labor force.
- 78% of the total agricultural sector workers live in poverty (Mishra et. al. 2016).
- Average farm household owns about 0.8 hectares
- Farm size is decreasing over the last several decades.
- 64% farms are family subsistence farms.
- 3.1% are commercial farming operations.

Nepal economy: vegetable production

- Veg. production worth 45 billion Nepali rupees.
- Terai region is the major vegetable-growing areas
- Tomato and ginger – Nepal has comparative advantage of producing (soil and environment)
- 2012-2013
  - Tomato – 15.1 mt./ha
  - Ginger – 11.7 mt./ha
- 1 $= 104 Nepali rupee

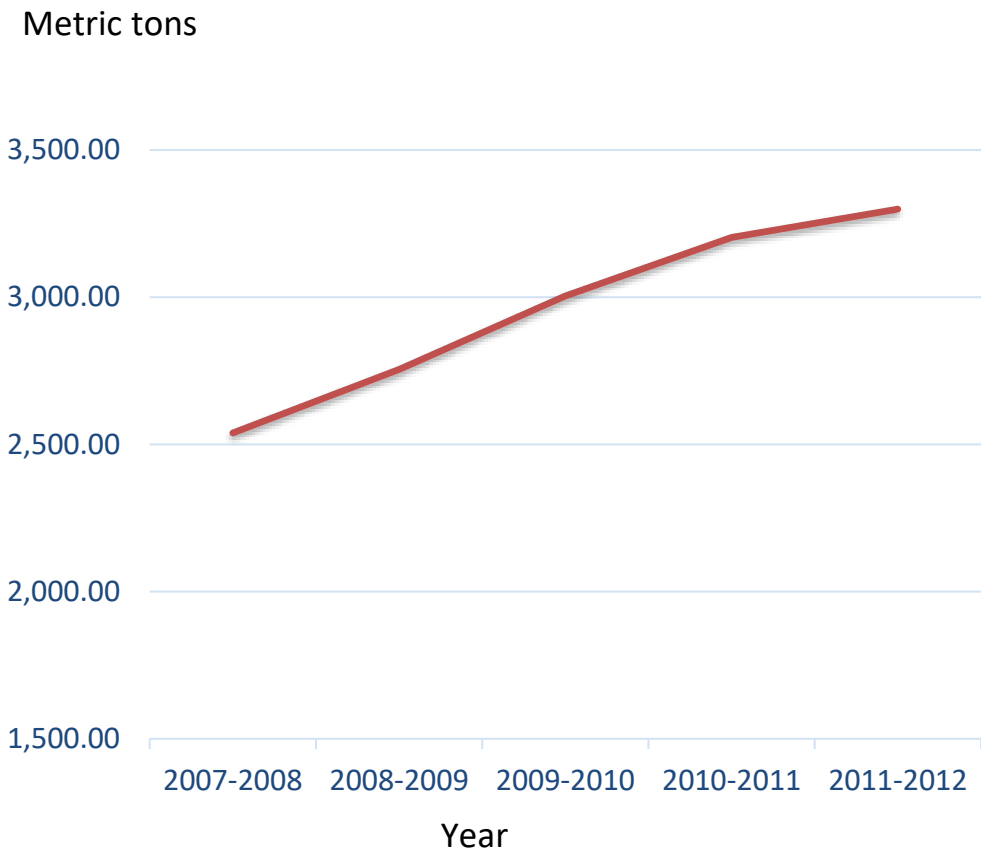
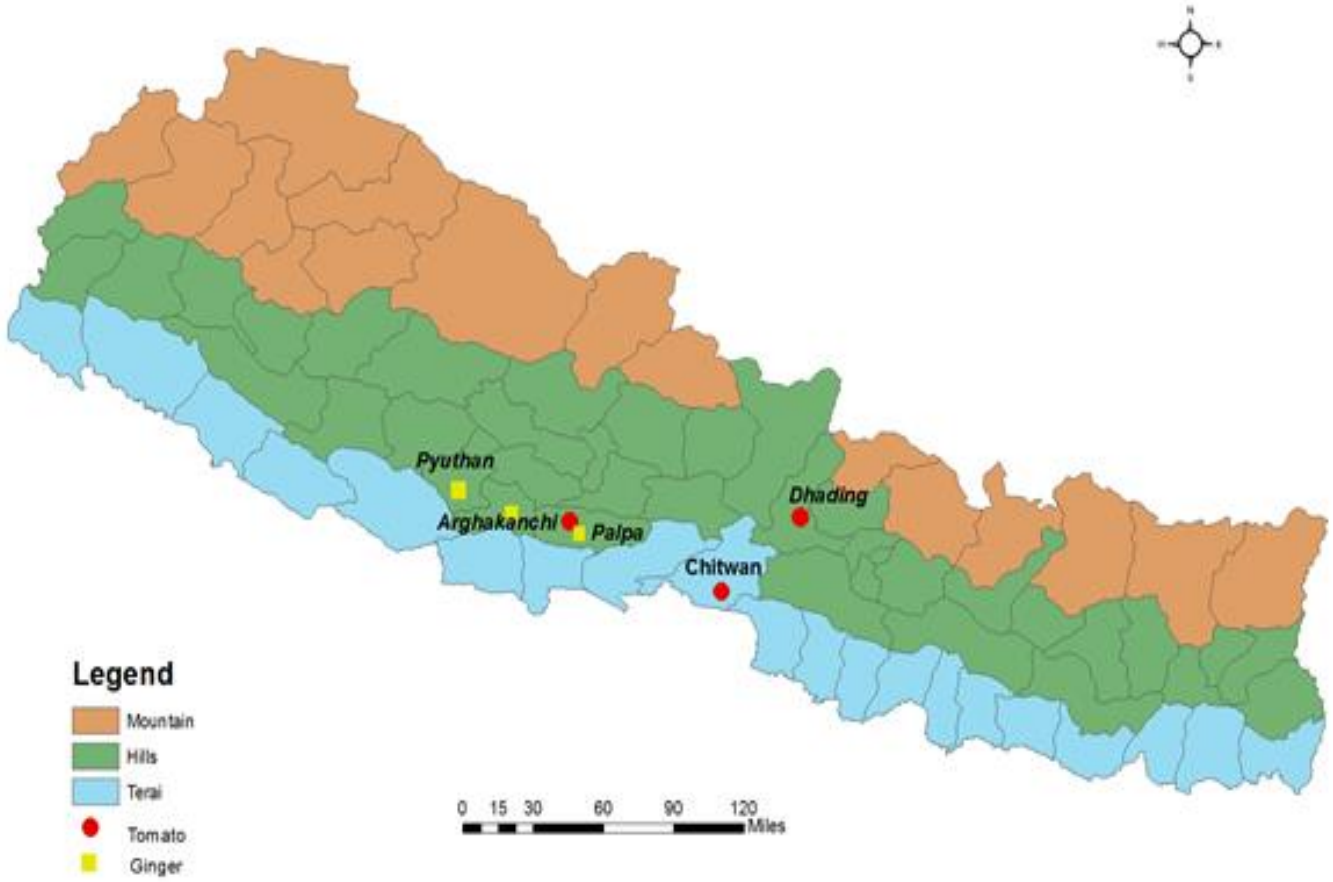


Figure 1. Trend in vegetable production

Agroclimatic zones in Nepal and surveyed districts for ginger and tomato commodities



Estimation Methodology

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Average Treatment Effect on Treated (ATT)

$$ATT = E\left[Y(1) - Y(0) \mid T = 1\right] \tag{1}$$

$$ATT = E\left[Y(1) \mid T = 1\right] - E\left[Y(0) \mid T = 1\right]$$

$$ATE(X) = E\left[Y(1) - Y(0) \mid X\right] \tag{2}$$

$$ATE = E\left[Y(1) \mid T = 1, X\right] - E\left[Y(0) \mid T = 1, X\right]$$

$$\mathrm{T}_{ATT}^{PSM}(X) = E\left[Y(1) \mid T = 1, \mathrm{P}(X)\right] - E\left[Y(0) \mid T = 1, \mathrm{P}(X)\right] \tag{3}$$

Where:
T= binary variable (1=CF adopt: 0 otherwise)
Y(1) and *Y(0)* outcomes of the adopters and non-adopters

Estimation Methodology

- We use two matching methods:
  - Nearest Neighbor Matching (NNM)
  - Kernel-based Matching (KBM)
- We conduct sensitivity analysis - whether the inference on estimated effects change even in the presence of significant amounts of unobserved heterogeneity (Mendola, 2007).
- We do balancing test
  - standardized difference (SD) between treatment and control sample
- Test Bounding effect (Rosenbaum, 2012) – to address the problem of hidden bias in matching models

Data and Descriptive Statistics

- Field survey December 2014 to August 2015.
- Structured questionnaire.
  - information on farm and farmer characteristics, cropping patterns, economics of cultivation, participation in CF, marketing channels, and adoption of good agricultural practices.
  - Information on input and output conditions provided by contractors.
- Sample sizes:
  - Ginger - 322 contract farmers and 283 non-contract farmers
  - Tomato - 261 contract farmers and 341 non-contract farmers

Contract conditions

Contracts with input conditions	Contracts with output conditions
The contractor provided input conditions in the contract. This include: (1) Seeds supplied on credit. (2) Extension for improved cultivation practices, including mechanization. (3) Extension for increased post-harvest practices. (4) Provision for irrigation. (5) Supply of fertilizer on credit. (6) Supply of pesticides on credit. (7) Financial credit for operation purposes.	The contractor provided output conditions in the contract. This include: (1) Prices are fixed in advance for a state quantity and quality of produce. (2) Penalizing for a substandard product. (3) The cost of credit and other services are adjusted in the final prices received by farmers. (4) Farmer has to clean produce before supply. (5) Farmers have to sort/grade produce before supply.

Farmer characteristics

	Ginger (single contractor) N=283		Tomato (cooperative contractor) N=322	
	Independent farmers	Contract farmers	Independent farmers	Contract farmers
Average of household head (age)	43.89	45.55	49.62	51.95***
Farming experience (years)	25.7	27.33	24.24	23.91
Household size (members)	6.3	6.42	5.62	6.11***
Male household head (% of total hh)	77.03	72.98	84.67	81.81
Caste, general (% of total hh)	44.16	32.92***	68.19	68.73
Caste, lower (% of total hh)	31.8	53.11***		
Household member with high school education	59.01	61.18	48.66	45.16

Farm characteristics

	Ginger (single contractor) N=283		Tomato (cooperative contractor) N=322	
	Independent farmers	Contract farmers	Independent farmers	Contract farmers
Total land operated (ha)	0.44	0.45	0.26	0.48***
Owned land area (ha)	0.73	0.79	0.26	0.45***
Types of farm				
Small farm (≤ 0.51, *hectare*) %	4.00	37.00	68.00	31.00***
Medium farm (> 0.54 and ≤ 0.85, *hectare*) %	30.00	26.00	22.00	22.00
Large farm (> 0.85, *hectare*) %	29.00	36.00*	10.00	47.00***

Profitability per hectare

	Ginger (single contractor) N=283		Tomato (cooperative contractor) N=322	
	Independent farmers	Contract farmers	Independent farmers	Contract farmers
Total labor cost	90,245	85,660	96,934	78,869***
Total input cost	124,903	125,601	71,422	80,409***
Total operations cost	9,270	8,625*	22,050	21,429
Total fixed cost	9,746	9,829	103,616	90,678**
Total cost	**241,614**	**238,681**	**303,480**	**286,026***
Total revenue	**422,569**	**525,962*****	**605,104**	**751,872*****
Total profit	**180,955**	**287,281*****	**301,624**	**465,845*****
Yield (kg/ha)	8,819	9,353*	13,767	18,127***
Total man days (number)	16	19***	24	49***

Average treatment effects using NNM and KBM

	Ginger (single contractor) N=283		Tomato (cooperative contractor) N=322	
	ATT	t-stat	ATT	t-stat
Nearest neighbor matching (NNM)				
Total profits	**112,832**	**5.75**	**234,730**	**4.44**
Total revenues	**103,508**	**5.17**	**222,986**	**3.90**
Yield *(Kg)*	**694**	**1.97**	**4,530**	**3.84**
Man days *(Nos.)*	**3**	**3.40**	**12**	**3.45**
Market price *(NPR/100Kg)*	**795**	**6.80**	57	0.58
Kernel based matching (KBM)				
Total profits	**114,581**	**6.09**	**224,248**	**4.24**
Total revenues	**107,503**	**5.63**	**217,959**	**3.81**
Yield *(Kg)*	**765**	**2.29**	**4,554**	**3.92**
Man days *(Nos.)*	**3**	**3.31**	**14**	**4.34**
Market price *(NPR/100Kg)*	**858**	**7.76**	29	0.30

Farm size

ATE: Nearest neighbor matching method (NNM)

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Farm category	Outcome (in per hectare)	Ginger (single contractor)		Tomato (cooperative contractor)	
		ATT	t-stat	ATT	t-stat
Small (0.01-0.51 ha)	Total profits	**122,389**	**4.54**	**163,155**	**2.37**
	Total revenues	**121,007**	**4.31**	119,2356	1.61
	Yield *(Kg)*	**1,530**	**3.11**	**3,736**	**2.60**
	Man days *(Nos.)*	**2.1**	**2.16**	**9.2**	**3.66**
	Market price*(NPR/100Kg)*	**578**	**3.23**	-309	-1.55
Medium (>0.51-0.85)	Total profits	58,363	1.52	98,023	1.38
	Total revenues	52,544	1.36	95,136	1.26
	Yield *(Kg)*	-48	-0.06	2,848	1.34
	Man days *(Nos.)*	0.7	0.3	**13**	**2.12**
	Market price *(NPR/100Kg)*	**215**	**3.86**	-144	-1.07
Large (> 0.85)	Total profits	**152,910**	**2.93**	**172,704**	**2.26**
	Total revenues	**150,118**	**2.84**	**191,483**	**2.27**
	Yield *(Kg)*	988	1.05	**4,434**	**1.93**
	Man days *(Nos.)*	**5.0**	**2.26**	**25**	**2.10**
	Market price *(NPR/100Kg)*	**267**	**4.36**	117	1.10

Average treatment effects:

Nearest neighbor matching method

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	Outcome (in per hectare)	Ginger (single contractor)		Tomato (cooperative contractor)	
		ATT (in NPR)	t-stat	ATT (in NPR)	t-stat
CFIC vs Independent farmers	Total input costs	**19,469**	**-2.63**	**8,965**	**2.55**
	Total fixed cost	-1,067	-1.33	**-16,125**	**-2.04**
	Total operation cost	**-1,988**	**-2.63**	2,082	1.32
	Total costs	**-28,919**	**-2.44**	-2,674	-0.19
	Total revenues	**85,868**	**2.17**	**169,927**	**3.35**
	Total profits	**114,788**	**3.00**	**172,601**	**3.72**
	Yield *(Kg)*	401	0.61	**4,130**	**4.11**
	Total man days *(Nos.)*	**5**	**2.91**	**24**	**6.21**
	Market price *(NPR/100Kg)*	**775**	**3.43**	-129	-1.41
CFIC and CFOC vs Independent farmers	Total input costs	-3,019	-0.50	7,342	1.58
	Total fixed cost	232	0.40	-8,767	-0.71
	Total operation cost	-839	-1.43	-586	-0.32
	Total costs	-5,463	-0.57	-17,980	-1.01
	Total revenues	**110,767**	**4.15**	**244,074**	**3.29**
	Total profits	**116,231**	**4.53**	**262,054**	**3.77**
	Yield *(Kg)*	593	1.28	**6,037**	**3.91**
	Total man days *(Nos.)*	1.65	1.28	**21**	**4.73**
	Market price *(NPR/100Kg)*	**972**	**5.85**	-90	-0.78

Impacts of Contract Farming (CF):NMM

	Ginger (single contractor)		Tomato (cooperative contractor)	
	ATT (in NPR)	SE	ATT (in NPR)	SE
Total revenue	103,507***	20,014	217,958***	57,224
Total profits	112,832***	19,612	234,730***	52,870
Yield *(Kg)*	694*	351	4,530***	1,179
Total man days *(Numbers)*	3.12***	0.94	14.1***	3.19
Market price *(NPR/100Kg)*	795***	116	57	99

*Significant at the 10% level; **Significant at the 5%; ***Significant at the 1% level.

Probit analysis results

	Ginger (single contractor) n=602	Tomato (cooperative contractor) n=572
Ln farm size (total land operated, *hectares*)	0.097 (0.106)	**0.662***** **(0.090)**
Ln age of head of household (HH)	**0.773**** **(0.37)**	0.474 (0.423)
Farming (=1 if main occupation is farming)	0.319 (0.239)	**-1.031***** **(0.351)**
Male head of household (=1 if male head HH)	**-0.398***** **(0.135)**	-0.116 (0.158)
General caste (=1 if HH belongs to general class)	**-0.719***** **(0.155)**	-0.366 (0.238)
Lower caste (=1 if HH belongs to lower class)	**-0.331**** **(0.152)**	**-0.463*** **(0.249)**
Soil type_1 (=1 if loam/sandy soil)	**0.194*** **(0.113)**	**0.019** **(0.255)**
Ln wealth per hectare	**0.203**** **(0.090)**	**0.122**** **(0.061)**
District_3 (=1 if farm located in Palpa district)	**0.477***** **(0.152)**	

*Significant at the 10% level; **Significant at the 5%; ***Significant at the 1% level.

Conclusion

- Contracts between company growers in the case of ginger is underwritten by a monopsonist.
- Contracts in tomatoes are underwritten by several cooperatives in rural Nepal.
- CF by cooperatives in Tomatoes potentially helps to increase employment in rural Nepal.
  1. (14 vs 3 additional/ha)
- CF indeed raises total profits per acres
  1. Ginger: 113,000 to 115,000 Rs./ha
  2. Tomato: 224,000 to 235,000 Rs./ha
- CF increases yield per hectare
  - Ginger 694-765 Kg./ha
  - Tomatoes: 4,530-4,554 Kg./ha

Conclusion

- Contract ginger producers receive significantly higher market prices (800-850 NPR/100 Kg)
- Small farms (<=0.51 ha.) tend to gain the most from CF when it comes to yields.
- Large farms (>0.85 ha) create more employment (25);
  - Medium size (13); small farms (9).
- CF with both input and output conditions (BC)
  - Both ginger and tomatoes tend to have:
  - higher total revenues per hectare
  - profits per hectare

compared to independent ginger and tomato growers.

Policy Implications

- Expansion of vegetable production through CF schemes improves **employment**, **incomes**, and **productivity**
  1. CF contributes to poverty alleviation and food security.
- Focus should be on large farms producing commodities under **contracts managed by cooperatives**.
- Future Research:
  - measuring and evaluating its ancillary effects of CF on
  1. changes in soil conditions
  2. water usage
  3. cropping systems
  4. nutritional benefits
  5. food prices
  - estimating the effect of **CF under various contractor** types