IFPRI Discussion Paper 01524

April 2016

Can Contract Farming Increase Farmers' Income and Enhance Adoption of Food Safety Practices?

Evidence from Remote Areas of Nepal

Anjani Kumar

Devesh Roy

Gaurav Tripathi

P. K. Joshi

Rajendra P. Adhikari

South Asia Office

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI), established in 1975, provides evidence-based policy solutions to sustainably end hunger and malnutrition and reduce poverty. The Institute conducts research, communicates results, optimizes partnerships, and builds capacity to ensure sustainable food production, promote healthy food systems, improve markets and trade, transform agriculture, build resilience, and strengthen institutions and governance. Gender is considered in all of the Institute's work. IFPRI collaborates with partners around the world, including development implementers, public institutions, the private sector, and farmers' organizations, to ensure that local, national, regional, and global food policies are based on evidence. IFPRI is a member of the CGIAR Consortium.

AUTHORS

Anjani Kumar (anjani.kumar@cgiar.org) is a research fellow in the South Asia Office of the International Food Policy Research Institute (IFPRI), New Delhi, India.

Devesh Roy (d.roy@cgiar.org) is a research fellow in the Markets, Trade and Institutions Division of IFPRI, New Delhi, India.

Gaurav Tripathi (g.tripathi@cgiar.org) is a research analyst in the South Asia Office of IFPRI, New Delhi, India.

P. K. Joshi (p.joshi@cgiar.org) is director of the South Asia Office of IFPRI, New Delhi, India.

Rajendra P. Adhikari (adhikarirp2003@yahoo.com) is a researcher at Brisbane University, Australia, and former joint secretary of the Nepal Ministry of Agricultural Development.

Contents

Tables

Figures

ABSTRACT

Growing inequality has become an important concern in many countries. One of the ways that inequality is perpetuated is through differential market access across regions. This research deals with one of the primary determinants of regional inequality manifested in terms of market access. Nepal is one country where hierarchical geography leads to regional inequality. Differential market access can cause as well as accentuate inequality among farmers. Coordination arrangements such as contract farming can improve outcomes for the farmers and integrators on the one hand, but on the other hand it can accentuate inequality if only some regions benefit from it. With this background, in this paper we study the case of contract farming for exports with farmers in remote hilly areas of Nepal. The prospect for contract farming in such areas with accessibility issues owing to underdeveloped markets and lack of amenities is ambiguous. On the one hand, contractors in these areas find it difficult to build links, particularly when final consumers have quality and safety requirements. On the other hand, remoteness can make the contracts more sustainable if the agroecology offers product-specific quality advantages and, more important, if there is a lack of side-selling opportunities. At the same time, concerns remain about buyers' monopsonistic powers when remotely located small farmers do not have outside options. This study hence quantifies the benefits of contract farming on remotely located farmers' income and compliance with food safety measures. Results show that contract farming is significantly more profitable (offering a 58 percent greater net income) than independent production, the main pathway being higher price realization, along with training on practices and provision of quality seeds.

Keywords: contract farming, ginger, income, food safety, small farmers, Nepal

JEL classification: Q12; Q13; Q17; Q18

ACKNOWLEDGMENTS

We are grateful to the United States Agency for International Development (USAID) for extending financial support to this study through the Policy Reform Initiative Project in Nepal. We are heartily thankful to Dr. Bishnu Dev Pant, executive director of the Institute for Integrated Development Studies (IIDS), Kathmandu, Nepal, and other staff of IIDS for their support in facilitating successful conduct of the primary survey. We are indebted to Dr. Deva Bhakta Shakya, IFPRI's consultant in Nepal, for his expert advice and guidance in planning the survey. Last but not the least, we express our sincere gratitude to the proprietor of Annapurna Organic Agriculture Industry in Nepal, Mr. Parshuram Acharya, for his cooperation in the survey.

This paper was undertaken as a part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM), led by IFPRI. This paper has not gone through IFPRI's standard peer-review process. The opinions expressed here belong to the authors, and do not necessarily reflect those of PIM, IFPRI, CGIAR, USAID, or IIDS.

ABBREVIATIONS

CF	contract farming
FSAI	food safety adoption index
FSMs	food safety measures
ha	hectare
IV	instrumental variables
NPR	Nepalese rupees
OLS	ordinary least squares
TE	triennium ending
VDC	village development council

1. INTRODUCTION

Contract farming (CF) has emerged as an important institution to promote agricultural modernization and commercialization. It has long been prevalent in developed countries and in recent decades has spread widely in developing countries as well (Wong, Darachanthara, and Soukkhamthat 2014). CF is one solution to overcome market-related transaction costs. When transaction costs are high or markets fail because of such factors as asymmetric information, there might be a need for nonspot transactions such as CF.

In agricultural markets in developing countries, there are many ways that markets fail. Credit market imperfections, economies of scale in transportation and marketing, imperfect information about market prices, and lack of capacity for small and marginal farmers to absorb risk are among them. Moreover, the greater the quality and safety issues, the lower the ability of the spot markets to deliver an efficient solution, mainly due to problems of asymmetric information. Also, as Barrett et al. (2011) have shown in contractual arrangements in agriculture, there are significant location effects.

In choosing where to procure from—that is, the location of the farmers to be contracted—several factors have to be taken into account, such as the area's agroecological suitability for production, which could determine the level of production as well as the quality of the produce. Second, as Barrett et al. (2011) pointed out, the contractor also has to factor in a location's associated transaction costs, including those incurred when picking up agricultural commodities; the prevalence of insecurity and crime; the quality of communication services; and the institutional conditions that may influence the likelihood of contract compliance by smallholders. However, one reason that remote areas can be attractive to contractors is that owing to the lack of local markets, contracts could be easier to enforce because opportunities for side selling might be rarer in remote locations. But remoteness also creates grounds for buyers to have monopsonic power, and it can exploit farmers in both selection and value distribution.

Firms do engage in geographic targeting for their supplies, and due to the reasons discussed above, the prospects for CF can be ambiguous in remote areas. On the one hand, remote areas can provide better access to factors such as land and may possibly have comparatively good agroclimatic conditions and better terms of engagement that make them favored, but on the other hand, they have the disadvantage of higher transaction and marketing costs, and remote farmers may lack the capacity to deliver quality. Barrett and et al. (2011) presented studies from India in which contractors deliberately chose remote areas to prevent side selling. Similarly, Manorom and others (2011) showed the benefits of CF to Lao People's Democratic Republic smallholder farmers growing cabbage, maize, and sugarcane in diverse conditions, especially in remote areas.

In a study by Cai and others (2008) of rice farmers in Cambodia, progressive farmers living near the highway tended to join in CF first but to leave it early, while farmers in more remote areas remained under contract longer. The authors also provided empirical evidence that the relatively uncontaminated land in remote areas lends itself to CF of safe food, and moreover, that CF can help in promoting farming practices for safe food. The contracting firm in the study, Angkor Kasekam Roongroeung Co. Ltd. in Cambodia, successfully coordinated market access for farmers living in remote areas where public-sector organizational capacity was weakest. Most of the successful farmers in the study were those in former forestland and land close to mountains, where rice can be produced at higher quality and yield than elsewhere. On the other hand, farmers close to main roads tended to default on their contracts more often than others.

Elsewhere, experiences in remote areas of East Africa have shown that large CF programs can have broader rural development impacts. Examples include programs for sugarcane in western Kenya and tea in Tanzania. To some extent, both programs have performed well in terms of opening up the underdeveloped areas in which they are located and acting as growth poles (Glover 1994). Kulkarni and Grethe (2009) found that farmers in India who lived in remote places far from credit institutions and who had less opportunity to find subsidiary jobs outside of agriculture participated more in contracting. This finding implies that farmers who are willing to participate are those who lack access to various resources

and information, and that CF can be an intermediate institution that offers necessary services to these farmers. In other words, whether there is positive or negative selection in contracting is an empirical issue.

Owing to lack of local markets in remote areas (for inputs as well as outputs), there is often a greater need for CF to improve returns to farmers. However, accessibility issues and separation from end markets often make it difficult to find contractors willing to coordinate with farmers in such areas, especially when product quality and safety are important in the final markets. Indeed, CF is quite rare in remote areas for products whose contracts include strict quality and safety requirements. Some successful cases are discussed above. In this paper we study another such rare case of CF: ginger growing in the remote areas of Nepal.

We assess this example of vertical coordination with small farmers in remote areas of Nepal not only from the perspective of farmers' net income but also in terms of delivering on food safety through adopting good agricultural practices. These issues are important because in remote areas the questions of gains for farmers (amid fears about buyers' acquiring monopsony powers) and sellers' potential lack of capacity to deliver on quality are quite pertinent. In the case studied, ginger is intended for export markets and therefore has some specific requirements. Ginger is one of the most important crops in Nepal, which is the third-largest producer and exporter of ginger in the world.

In principle, CF can lead to increased productivity, reduced transaction costs, greater risk sharing, and improvements in product quality and safety, but apprehensions remain about smallholders' possibility of being exploited by large firms. In these circumstances, policy makers in Nepal, with its several remote areas, face the difficult policy question of whether to promote, regulate, or prevent the development of CF (Nepal, Ministry of Agricultural Development 2015).

With primary data collected from more than 600 households comprising both contracted and independent farmers from the remote hill districts of Pyuthan, Palpa, and Arghakhanchi in the Western and Mid-western development regions of Nepal, we address questions related to farmers' selection, their returns, and their capacity to deliver on specific product attributes. Results show that participation in CF is unrelated to a farmer's land size. Importantly, CF in ginger is associated with about 58 percent higher net profits. In terms of food safety, through the adoption of good agricultural practices, which could form a part of the incremental profits, the role of contract farming is not so clear-cut, related possibly to the nature of the end markets, which might not strictly demand the highest level of nonprice attributes.

The paper is organized as follows. Section 2 provides a brief background of the Nepalese ginger sector. Section 3 describes the survey data and the methodological approach. Estimation results are presented and discussed in Section 4, while the final section concludes and provides some policy implications.

2. GINGER FARMING IN NEPAL

Ginger is a one of the important high-value spice crops of Nepal. The country is the third-largest producer of ginger in the world (with 11.0 percent of the global share in 2013), followed by India (31.9 percent) and China (18.2 percent). The share of ginger in the gross cropped area of Nepal has increased from 0.08 percent in TE 1991 to 0.39 percent in TE 2013. The contribution of ginger to agricultural value of production has risen from about 0.95 percent in TE 1991 to 3.23 percent in TE 2013. However, the share of ginger in the total agricultural exports of Nepal has remained around 3–4 percent during the same period (Table 2.1). Nepal produced 235.5 thousand tons of ginger on an area of 19.6 thousand hectares (ha) during the triennium ending (TE) 2013.[1] Its yield during the same period was about 12.0 tons/ha (vis-à-vis a global average of about 6.8 tons/ha). During the period 1989–2013, the area, production, and yield of ginger in Nepal have grown by 7.9 percent, 9.5 percent, and 1.4 percent annually, respectively (Table 2.2).

Table 2.1 Share of ginger in gross cropped area, agricultural value of production, and agricultural exports of Nepal, 1989–2013

Year (TE)	% share in GCA	% share in agricultural VOP	% share in total agricultural exports (in value terms)
1991	0.08	0.95	4.25
2001	0.19	1.79	3.65
2013	0.39	3.23	3.63

Source: Authors' calculations based on FAOSTAT (FAO 2015).
Notes: GCA = gross cropped area; TE = triennium ending; VOP = value of production.

The quality of ginger, judged primarily on its fiber content, can be broadly classified as superior or inferior. Ginger varieties with very low fiber content are considered superior and are locally known as *boshe*. The varieties with high fiber content are considered inferior are called *nashe* in Nepal. The superior varieties are in greater demand from both industry and consumers and fetch higher prices. However, cultivation of inferior varieties is more common, and the superior varieties are still not cultivated widely. The superior, or *boshe,* varieties are ideal for producing industrial products like ginger oil, while spice industry prefers the fibrous *nashe* varieties for producing ginger powder.

The sharp increase in area under ginger over the years underlines the growing importance of ginger as a high-value crop in Nepal (Table 2.2). Annual growth of 9.5 percent in production of ginger in Nepal has been mainly due to expansion in production acreage (7.9 percent annually on average) and with marginal contribution from growth in yield (1.4 percent annually). However, note that the yield of ginger in Nepal (12.1 tons/ha) in 2013 was much higher than that in India (5.0 tons/ha) and China (10.5 tons/ha). Globally, Nepal ranked eighth in the world in ginger yield in 2013, behind major ginger-producing countries such as Thailand (15.6 tons/ha), Japan (27.7 tons/ha), and Taiwan (29.2 tons/ha). Thus, Nepal has some ground to cover before it can become competitive with major players in the international ginger markets.

[1] Tons are metric tons.

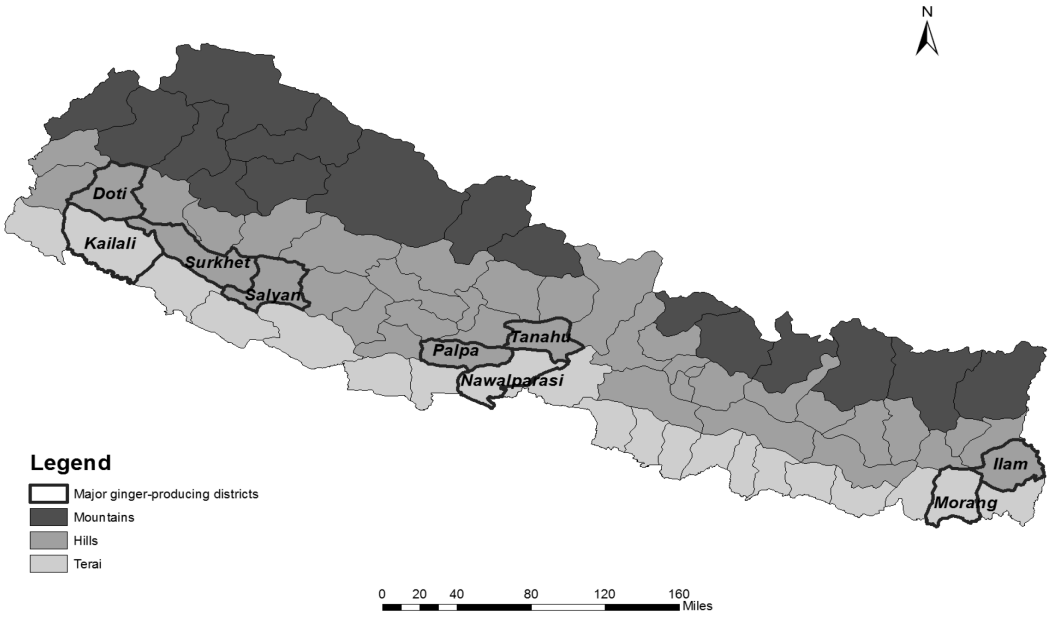
Table 2.2 Trends in area, production, and yield of ginger in Nepal, 1989–2013

Year (TE)	Area ('000 ha)	Production ('000 metric tons)	Yield (metric tons/ha)
1991	3.4	31.7	9.4
2001	8.7	80.4	9.2
2013	19.6	235.5	12.0
CAGR (1989 to 2013)	7.9	9.5	1.4

Source: Authors' calculations based on FAOSTAT (FAO 2015).
Notes: CAGR = compound annual growth rate; TE = triennium ending.

Nepal has the capacity to increase ginger production, and the agroclimatic conditions in the hills of Nepal are quite favorable for ginger cultivation. Around 70 percent of Nepal's total ginger production is contributed by the hill districts, followed by the Terai districts (around 23 percent) and the mountainous districts (5 percent). Table 2.3 shows the area, production, and yield of ginger by development region in Nepal. The Eastern region has the highest contribution in both area (33.9 percent) and production (35.5 percent). However, the Far-western region, with a lower share in area and production, has the greatest average yield of all five regions. The major ginger-producing districts are Doti, Ilam, Kailali, Morang, Nawalparasi, Palpa, Salyan, Surkhet, and Tanahu (Figure 2.1).

Figure 2.1 Map of major ginger-producing districts in Nepal



Source: Authors' work based on Nepal, Ministry of Agricultural Development (2013).

Table 2.3 Area, production, and yield of ginger across development and agroclimatic regions in Nepal, 2013

Region	Ginger area (ha)	Ginger production (metric tons)	Ginger yield (metric tons/ha)	% share area	% share production
Development region					
Eastern	6,578	83,488	12.7	33.9	35.5
Central	2,356	29,652	12.6	12.2	12.6
Western	5,271	57,465	10.9	27.2	24.4
Mid-western	3,406	39,389	11.6	17.6	16.8
Far-western	1,770	25,305	14.3	9.1	10.8
Agroclimatic region					
Hills	13,751	169,085	12.3	71.0	71.9
Terai	4,567	54,208	11.9	23.6	23.1
Mountains	1,063	12,006	11.3	5.5	5.1
Nepal	19,381	235,299	12.1	100.0	100.0

Source: Authors' calculations based on Nepal, Ministry of Agricultural Development (2013).

Ginger exports from Nepal increased from 2,461 tons in 1991 to 34,947 tons in 2013, for an average growth rate of 13 percent per year. However, exports in value terms, at constant prices, grew at only 2.9 percent per year during the same period—a continuous decline in the unit value of exports of ginger (Table 2.4). The unit value of exports of ginger declined from US$1,104/ton in 1991 to US$130/ton in 2013, at constant prices. Despite Nepal's being a major producer and exporter of ginger, it also imports ginger to fulfill domestic demand, especially during the off-seasons. The import of ginger has been increasing over time, and in TE 2013 it accounted for about 28 percent of its export.

Table 2.4 Exports and imports of ginger in Nepal, 1989–2013 (constant 2005 US dollars)

	Exports			Imports			
Year (TE)	Metric tons	US$000	Unit value (US$/ton)	Metric tons	US$000	Unit value (US$/ton)	Trade surplus/ deficit US$000
1991	2,461	2,717	1,104	0	0	NA	2,717
2001	8,050	3,327	413	554	665	1,200	2,663
2013	34,947	4,550	130	9,717	1,587	163	2,964
% CAGR (1989–2013)	13.0	2.9	-9.0	46.8	35.7	-7.5	4.2

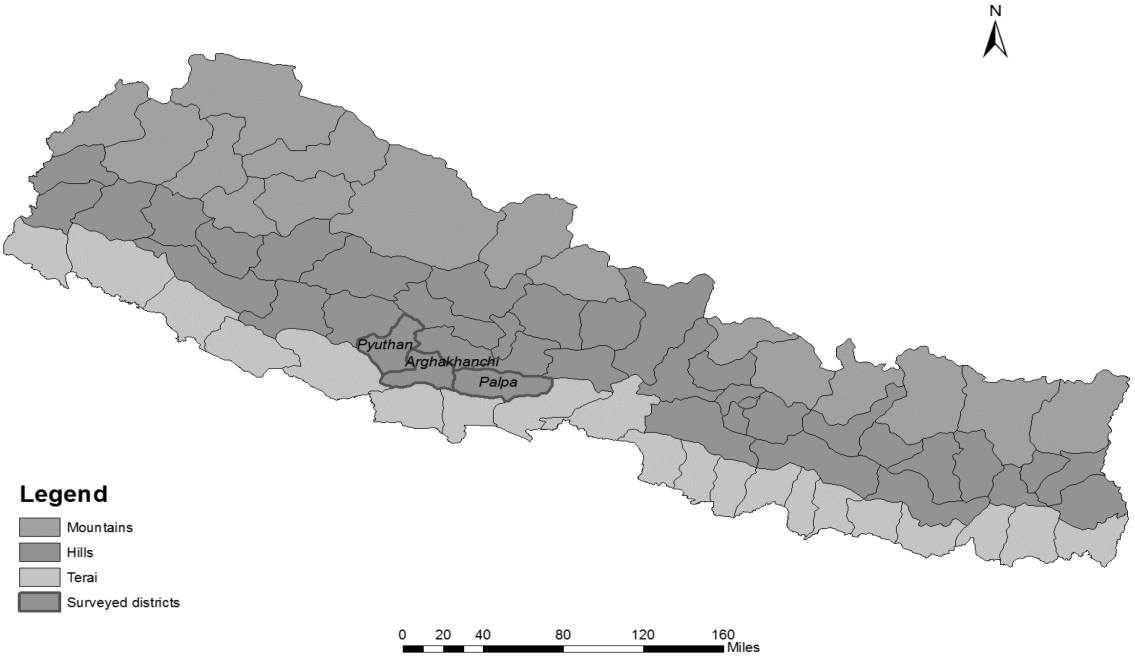
Source: Authors' calculations based on FAOSTAT (FAO 2015).
Note: TE = triennium ending. CAGR = compound annual growth rate.

3. DATA AND METHODOLOGY

Data

The study is based on a primary survey of ginger-cultivating farm households in Nepal, using a structured questionnaire. The data collected at farm household level includes farm and farmer characteristics, cropping pattern, economics of cultivation, marketing channels, and good agricultural practices. The survey was conducted during December 2014 in the hill districts of Pyuthan, Palpa, and Arghakhanchi, located in the Western and Mid-western development regions of Nepal (Figure 3.1). We chose these districts for their high concentration of contract farmers who grow ginger for Annapurna Organic Agriculture Industry.

Figure 3.1 Agroclimatic zones in Nepal and surveyed districts



Source: Authors' work based on Nepal, Ministry of Agricultural Development (2013).

Annapurna Organic Agriculture Industry, situated in the Arghakhanchi district, is the sole processor of ginger in Nepal. It is owned by a Nepalese entrepreneur and has been in operation since 2002. The company has operated a ginger processing unit in the Kapilvastu district of Nepal since 2010. It produces several processed products such as powdered spices (ginger, coriander, garlic, cumin, turmeric, cinnamon, Sichuan pepper, and chili powder); coffee; dried and sliced ginger (*sutho*); and other ginger products such as candy, jam, juice, and pickles. The company is primarily involved in exporting these products, with around 80 percent of its revenue coming from exports and only 20 percent from the domestic market. The company has had written contracts with about 3,000 ginger farmers from eight districts of the Western and Mid-western development regions: Arghakhanchi, Dang, Gulmi, Palpa, Pyuthan, Rolpa, Rukum, and Salyan. At present, however, the company contracts with only about 700 farmers, located predominantly in Pyuthan district, and followed by Arghakhanchi and Palpa districts.

We surveyed 605 ginger farmers—322 contract farmers and 283 noncontract farmers—chosen randomly from 53 wards under 14 village development councils (VDCs) from the three sample districts. The share of the sample size allocated to each sample district was in proportion to the number of contract farmers. Hence, the numbers of farmers identified for survey from Pyuthan, Arghakhanchi, and Palpa districts were 314, 198, and 93, respectively. The VDCs within districts were also selected based on the presence of contract farmers specializing in ginger production. An approximately equal number of noncontract farmers were randomly identified for survey in the same or adjacent wards within the respective VDCs of each sample district.

Methodology

We empirically analyzed the data collected through field surveys in the three hilly districts. One of the main objectives of the study is to estimate and compare the welfare of contract versus independent ginger growers, using profits as a proxy for farmers' welfare. Measurement of farm profits is complex, however, because of incomplete markets and unobserved transaction costs that make it difficult to properly price inputs and outputs (Barrett 1997). In addition, we analyze profits by looking at disaggregated information on the elements of costs, which we collected through presurvey interactions in order to minimize measurement errors.

The costs of producing ginger, a fairly low-technology crop, consist of labor (own and hired), rental value of land, tax on land, seed (including seed treatment), farmyard manure (if used), pesticide (if applied), and rental for machinery (if employed). Postharvest costs are related mainly to transporting the produce to market. In the broad costing group, we collected detailed information to get as accurate an estimate of costs as possible. For example, we obtained labor costs for different activities such as land preparation, farmyard manure application, mulch collection, planting/sowing, irrigation, weeding, spraying, harvesting, and cleaning. Information on different inputs used and their prices were obtained from the respondents separately in order to estimate the cost of cultivating ginger. Farmers' profits were then calculated as the difference between total revenue and total costs. Finally, we used partial budget analysis to estimate the costs and returns for both contract and independent growers.

Apart from issues related to farmer selection and impact on farm profits, we are also interested in the role of CF in delivering on food safety practices, because the produce is intended for export markets. To do so, we developed a food safety index at the farm level to estimate farmers' compliance with food safety practices. The survey gathered information from farmers on 45 distinct good agricultural practices, including record keeping and site management, propagation material and nutrition management, water management, plant protection, and postharvest management.

We sought an objective response from farmers on whether or not they follow each of the 45 mentioned practices; we summed up all affirmative responses given by a farm household to create an aggregate score of good practices, which serves as a proxy for that household's compliance with food safety measures (FSMs). We then identified the maximum and minimum scores among surveyed households to develop a standardized index for compliance with FSMs, and calculated a food safety adoption index (FSAI) for each household as follows:

$$\text{FSAI} = \left(\frac{S_A - S_L}{S_M - S_L}\right) \times 100, \tag{1}$$

where S_A is the household's actual score, S_L is the minimum score among surveyed households, and S_M is the maximum score among surveyed households. We compared the average FSAI of contract and noncontract farmers, and we also looked at the distribution of farmers by level of adoption. Kumar and others (2011) used an index similar to this FSAI for assessing farm-level compliance with FSMs in milk production.

To investigate CF's effect on the well-being of farmers, we attempt to answer two specific research questions through econometric methods. The first is what characteristics of farm households are associated with their being in a CF arrangement—that is, the issue of participation. Note that we put the

issue forward as one of participation and not selection, because several characteristics that we observe now would be different at the time of selection. The second question is the impact of CF on the economic welfare (profits) of farmers, in light of their remote location and the buyer's possible monopsony (recalling that there is only one ginger processor in Nepal).

One of the big problems in the CF literature is to identify the causal impact of participation in CF on farm profits. It is straightforward to see that several observed and unobserved characteristics that result in positive or negative selection into participation in CF are also likely to have an effect on farm profits (such as skills in farming or social connectedness). Alternatively, participation in CF is usually not random but based on specific characteristics, including location. To the extent that all the districts studied are in remote areas, we mitigate the problem of location's effect in contracting to some degree. The possibility of omitted variables implies that simple linear estimates of the effects of contracting on profits can be biased.

To try to address the nonrandom nature of participation in CF, several papers have used a two-step procedure (for example, Bellemare 2012; Ito, Bao, and Sun 2012; Katchova and Miranda 2004; Miyata, Minot, and Hue 2009; Simmons, Winters, and Patrick 2005; Wang, Zhang, and Wu 2011; Gupta and Roy 2012) in assessing the impact of CF on farm returns. Following suit, we also use a two-step procedure with instrumental variables to address the issue of endogeneity of the contracting variable.

In the first stage, the dependent variable is binary (farmer participates in a contract = 1, otherwise = 0), and the independent variables are a mix of qualitative and quantitative variables. We use a logit model to examine the impact of factors associated with a farmer's being in a contract or being independent. Specifically, the logistic regression is given by

$$Y = \ln[p/(1-p)] = \beta_o + \sum \beta_i X_i, \tag{2}$$

where p represents the probability that the farmer participates in CF and β_i are regression coefficients estimated by the maximum likelihood method. X_i represents the vector of characteristics of farmer i, including several socioeconomic and demographic characteristics.

In the second stage, to assess the impact of CF on farmers' profits, the profit function can be represented as

$$\pi_i = \alpha + \delta d_i + \gamma X_i + \varepsilon_i, \tag{3}$$

where π_i is net profit per kilogram received by a farm household from cultivation of ginger, d_i is a dummy variable (= 1 if the farmer is in a contract and 0 otherwise), X_i is a vector of observable farm and operator characteristics, and ε_i is an error term.

As discussed above, estimation of equation (3) using a simple ordinary least squares (OLS) regression may result in biased estimates of the impact of contracting on farm profits. This is because farmers are not randomly chosen in contracts. Farmers are either selected for a contract by the contractor or they decide to participate in a contract of their own accord. Both of these possibilities signify nonrandom selection. Hence, unobserved factors could be guiding farmers' decision to enter into a contract. Thus, d_i, the variable representing participation in a contract, is likely to be endogenous and could be correlated with the error term, ε_i. We conducted Hausman's test for endogeneity and found CF to be endogenous in both the profit and FSAI equations, which indicates nonrandomness in the selection of farmers for contracting.

Without the benefit of a randomized assignment of ginger farmers into contracts, and given that unobserved characteristics such as hidden entrepreneurial ability can play a role in the decision to participate in a contract, we rely on instrumental variables (IV) techniques to try to get unbiased estimates of the impact of CF on farm profits. An ideal instrumental variable should not correlate with the dependent variable in equation (2); however, it should be correlated with d_i, the variable representing participation in CF. Additionally, the variable should not be from the vector of farm and operator characteristics, X_i. It is indeed hard to find an ideal instrument in this setting.

We identify two instrumental variables—share of contract farmers in each ward (subdistrict region) for all households, and share of contract farmers by caste group in each ward for all households in the survey database—that are network variables. We hypothesize that as more of the farmers in a given geographical and social neighborhood choose to contract, the likelihood will increase that a particular farmer in that location will also undertake CF. We take care to define the neighborhood as minutely as possible in order to avoid having the instrument be related to the dependent variable through alternative channels.

Consider, for example, networks defined at a broader level, say district. Here, owing to the size, the network measure could include effects on profits through channels such as prices of inputs and outputs. Therefore we defined our network variables at the level of the ward, a subdistrict region. We can argue that profits per kilogram from ginger cultivation in a region this small would likely be independent of geography. Further, we believe that social proximity based on caste is quite important in rural settings of Nepal. Households from same village might not mingle with each other if they are from different castes, while farmers from different villages may interact if they belong to the same caste. In the context of rural Nepal, then, homophily based on caste is likely to be important, so we also created a network measure that combines geographic and social proximity.

To find the share of contract farmers out of the total ginger farmers in each ward, we divide the number of contract farmers in the ward (excluding the respective farmer for whom the network measure is being created) by the total number of farmers in that ward. The share of contract farmers is determined for all the households, contracting and noncontracting, in the respective wards. Similarly, the share of contract farmers by caste group in each ward is calculated as the number of contract farmers of a caste group in that ward (excluding the respective farmer being analyzed) divided by the total number of ginger farmers in that ward.

We check for the strength of these instruments in the first stage by including them in the regression of participation in CF on its determinants. If the network variables as constructed above are strongly correlated with d_i, that is, participation in CF, and our argument that they are not systematically related to per-unit profit in ginger cultivation holds, then they meet the required conditions for an instrument.

In the first stage, the binary variable, participation in CF, is regressed on characteristics and on the instrumental variables, share of contract farmers in ward and share of contract farmers by caste group in ward. The second stage estimates the contribution of participation in CF to profits instrumented from the first-stage regression. We assessed the impact of CF on adoption of food safety practices at the farm level using a similar empirical approach, the difference being that the outcome variable in the second-stage regression is the farmer-specific index of good agricultural practices.

4. RESULTS AND DISCUSSION

General Characteristics of Farmer Households

Table 4.1 reports the general characteristics of the surveyed households. The contract and noncontract farmers do not differ significantly in their resource endowments and most of their socioeconomic attributes (Tables 4.1 and 4.2). However, the incidence of migration for employment and the distribution of households based on caste differ significantly across contract and independent farmers. The average family size of contract and independent farmers is almost the same—about 6 members per household. The two groups of farmers do not differ in average size of landholdings, about 0.8 ha on average.

Table 4.1 Characteristics of contract and noncontract cultivators of ginger in Nepal

Characteristics	Contract	Noncontract
Number of observations	322	283
Age of respondent (years)	46	44
Years of education (HH member with highest level)	10.6	10.7
Household size (number)	6.4	6.3
Size of operational land (ha)	0.80	0.73
Gross cultivated area (ha)	0.89	0.87
Cropping intensity (%)	111	119
Irrigated area (% of cropped area)	14.0	12.5
Households having farming as primary occupation (%)	95.7	92.2
Migration for employment (number per household)**	0.9	0.7
Monthly remittance (NPR)	10,020	8,621
Experience in farming (years)	27	26
Number of plots per household	2.6	2.5

Source: Authors' calculations based on field survey (2014).
Note: ** represents significance at the 5% level. HH = household; NPR = Nepalese rupees.

The cropping intensity (119 percent) of independent farmers is higher than that of contract farmers. Independent farmers are younger than contract farmers, but not significantly so. As shown in Table 4.2, there is not much difference in educational attainment between contracting and independent farmers. Interestingly, the contract and noncontract farmers differ statistically at the 1 percent significance level in their distribution by caste group. More than 50 percent of contract farmers belong to the tribal castes, compared with 32 percent of noncontract farmers (Table 4.2). This finding reinforces our choice of caste-based proximity as one of our instruments.

Table 4.2 Distribution of sample households based on caste, education, and farm size (%)

Category	Contract	Noncontract
Education		
Illiterate	0.3	1.4
Primary	5.6	4.6
Middle	17.4	17.3
Secondary	61.2	59.0
Graduate and up	15.5	17.7
Farm size		
Marginal (< 0.5 ha)	40.4	44.2
Small (0.5–1 ha)	30.7	31.1
Medium (1–2 ha)	22.0	17.3
Large (≥ 2 ha)	6.8	7.4
Social group (caste)* **		
General caste	33	44
Dalit castes	14	24
Tribal castes	53	32

Source: Authors' calculations based on field survey (2014).
Note: *** represents significance at the 1% level.

Further, to examine the extent of smallholder participation in CF of ginger, the sample households are classified based on land, education, and caste. The distribution of sample households explicitly shows that smallholders are well represented in the contractual arrangements: more than 70 percent of the sample farm households are small to marginal in size (less than 1 hectare). Further, the distribution of farm households based on educational attainment also does not depict any significant difference between contract and independent ginger farmers. The distribution of sample farm households based on caste reveals a positive bias toward the lower castes. Based on summary statistics, the distribution of households does not reveal any systematic bias toward exclusion of farmers from CF on the basis of land, education, or caste.

Costs and Returns in Ginger Cultivation

The impact of CF on yield, production costs, output prices, and profits is reported in Table 4.3. Average yield of ginger is about the same for contract and independent farmers (91 quintals/ha). There is no difference in the cost of cultivation and output of ginger between contract and independent farmers. However, it seems that higher price realization by contract farmers makes ginger cultivation more remunerative for them. On average, contract farmers realize 40 percent higher profits than independent ginger farmers (Table 4.3). Further, higher profits are observed across all sizes of farms (Appendix Table A.2).

Table 4.3 Economics of cultivation of ginger for contract and noncontract farmers

Economics of cultivation	Contract	Noncontract	Difference	% difference
Yield (Q/ha)	91.0	90.8	0.2*	0.2
Price (NPR/Q)	5,576	4,768	808***	16.9
Value of production (NPR/ha)	529,599	439,174	90,425***	20.6
Cost of cultivation (NPR/ha)	217,029	217,752	-723	-0.3
Cost of production (NPR/Q)	2,384	2,399	-15***	-0.6
Profit (NPR/ha)	312,570	221,422	91,148***	41.2
Profit (NPR/Q)	3,434	2,440	994***	40.7

Source: Authors' calculations based on field survey (2014).

Notes: *** and * represent significance at 1% and 10% levels, respectively. NPR = Nepalese rupees; Q = quintals.

Note that farmers with marginal holdings (< 0.5 ha) seem to receive the highest benefits from participation in CF. For example, per-unit profit for marginal-sized contract farmers is almost double that of the independent farmers of the same size. Our findings are consistent with those in the literature (Wainaina, Okello, and Nzuma 2012; Kalamkar 2012; Ramaswami, Birthal, and Joshi 2006; Tripathi, Singh, and Singh 2005; Birthal, Joshi, and Gulati 2005; Singh 2002; Warning and Key 2002; Leung, Sethboonsarng, and Stefan 2008; Bellemare 2012; Michelson 2013; Miyata, Minot, and Hu 2009; Xu and Wang 2009; Zhu 2007; Simmons, Winters, and Patrick 2005). These are the farmers who would have significantly inferior prospects without contracting in such remote areas.

Though the increase in farmer income from CF comes from several sources on both the input and the output sides, in the case of ginger cultivation in remote districts of Nepal, CF seems to provide an opportunity to produce and sell ginger of higher quality, thus ensuring better prices (Table 4.3). The composition of cost of cultivation is similar for both contract and independent ginger farmers. Labor expenses account for more than 30 percent of the total costs of ginger cultivation for both contract (31.3 percent) and noncontract (33.8 percent) farmers (Table 4.4). Land preparation, harvesting, weeding, and sowing together constitute two-thirds of the aggregate labor costs for both the farmer groups.

Table 4.4 Composition of cost of cultivation of ginger in Nepal (%)

Costs	% share in total cost of cultivation	
	Contract	Noncontract
Labor costs		
Land preparation activities	5.5	5.9
Farmyard manure application	3.9	4.2
Mulch collection	3.7	4.1
Planting/sowing	4.9	5.2
Irrigation	0.0	0.1
Weeding	4.9	5.3
Spraying	0.2	0.3
Harvesting	5.4	5.6
Cleaning	2.8	3.1
Input costs		
Seed	54.4	52.0
Manure	2.3	2.5
Costs for hiring bullocks and equipment		
Bullocks (plowing)	3.4	3.5
Machineries	0.2	0.4
Fixed costs		
Rental value of owned land	4.3	4.1
Land revenue/tax	0.1	0.1
Other costs	0.2	0.2
Transportation of produce to market	**3.7**	**3.2**

Source: Authors' calculation based on primary survey data (December 2014).

Input costs (predominantly seed cost) account for more than 50 percent of the total costs; however, seed costs make up a greater proportion of overall expenses (54.4 percent) for contract farmers than for noncontract farmers (52 percent). Again, the cost of cultivation does not reveal any systematic difference between contract and independent farmers, as one might expect in the context of low-technology production with production systems that are quite uniform across farmers. The details of cost of cultivation of ginger by contract and independent farmers are presented in Appendix Table A.3.

Adoption of Food Safety Measures in Ginger Cultivation

Compliance with FSMs at the farm level is critical to ensure the quality and safety of agricultural products. To this end, CF has the potential to promote the adoption of FSMs at the farm level by educating and training farmers on the potential benefits of the safety measures, and also by adjusting the price if the cost can be recouped from sales to consumers who value such attributes in food. To measure the extent of adoption of food safety practices, we developed an FSAI, as described above, for each ginger-producing farm household. The average status of compliance, based on the FSAI, is presented in Table 4.5.

Empirically, CF appears to have a positive impact on the adoption of FSMs at the farm level. As evident from Table 4.5, the level of compliance with FSMs in ginger cultivation is significantly higher among contract farmers. However, as a whole, compliance with food safety practices at the farm level is not very encouraging. For instance, the adoption intensity of food safety practices for contract farmers was about 33.1, compared with 27.9 for the independent farmers, meaning that contract farmers are adopting only 33 percent of the FSMs prescribed for ginger cultivation, and independent farmers are adopting only 28 percent.

Table 4.5 Status of adoption of food safety practices in ginger cultivation

Land size category	Contract			Noncontract		
	FSAI (%)	S.D.	CV (%)	FSAI (%)	S.D.	CV (%)
Marginal (< 0.5 ha)*	29.8	16.3	54.8	26.3	12.7	48.1
Small (0.5–1 ha)***	34.5	17.6	51.1	27.7	13.8	49.9
Medium (1–2 ha)	35.7	20.5	57.5	32.4	14.6	45.0
Large (≥ 2 ha)*	37.5	22.9	61.3	27.0	15.2	56.3
All***	33.1	18.3	55.5	27.9	13.7	49.1

Source: Authors' calculation based on field survey (2014).
Notes: *** and * represent significance at 1% and 10% levels, respectively. CV = coefficient of variation; FSAI = food safety adoption index; S.D. = standard deviation.

Moreover, compliance with FSMs varies considerably across farms, both independent and contract, as indicated by the standard deviations and coefficients of variation of the FSAIs (Table 4.5). This variation reflects the ways in which different farmers perceive the incentives, which can be driven externally or internally, to supply safe produce. The extent of adoption of FSMs at the farm level is positively related to land size for both contract and independent ginger farmers.

However, average FSAI scores may mask the exact status of FSM compliance within a category of farmers. Therefore, Table 4.6 reports a frequency distribution of farmers by FSM compliance and reveals that about 47 percent of contract ginger farmers and 51 percent independent ginger farmers are not following even 30 percent of the recommended practices (that is, they are low adopters). Further, Table 4.6 reports that the percentage of high adopters of FSMs (following 60 percent or more of recommended practices) is small—7.1 percent of contract farmers and only 2.1 percent of independent farmers. Findings reveal that in order to ensure access to the high-end international ginger market, a significant effort might be needed to enhance FSM compliance at farm level in Nepal.

Table 4.6 Distribution of farmers by level of adoption of food safety practices

FSAI	Percent of farmers	
	Contract	Noncontract
< 30 (Low)	47.2	50.9
30–60 (Medium)	45.7	47
≥ 60 (High)	7.1	2.1

Source: Authors' calculation based on field survey (2014).
Note: FSAI = food safety adoption index.

Further, to understand compliance with specific FSM practices, we look at FSMs in a disaggregated way. The components of food safety practices exhibit a similar pattern across contract and independent ginger farmers. Plant protection practices were the least adopted, by both contract and independent farmers (Table 4.7). In the area of propagation material and nutrition management as well as that of plant protection measures, the FSAI values for contract and noncontract farmers differ statistically at the 1 percent level of significance. In postharvest management, the two types of farmers also differ statistically, in this case at the 10 percent level of significance. Though the average FSAI value under various domains is higher for contract farmers than for independent farmers, nonetheless all the FSAI values are quite low in absolute terms, with the exceptions being practices related to record keeping and site management, and those relating to postharvest management.

Table 4.7 Status of adoption of different components of food safety practices

Dimension	Food safety adoption index	
	Contract	Noncontract
Record keeping and site management	32.3	30.0
Propagation material and nutrition management***	14.5	9.6
Water management	14.4	12.7
Plant protection***	12.3	6.7
Postharvest management*	45.6	42.3

Source: Authors' calculation based on field survey (2014).
Note: *** and * represent significance at 1% and 10% levels, respectively.

Determinants of Farmers' Decision to Participate in CF

In this section, we identify the factors that determine ginger farmers' decision to participate in CF. The dependent variable is participation in CF, and the independent variables we include are farm, farmer, sociodemographic, and economic characteristics. In particular, we include age of the farmer, gender of the respondent, household size, education, caste, experience in farming, migration, access to a mobile phone, access to an improved variety, distance from road, and location (district) of the village. The choice of the explanatory variables included in the analysis was guided by previous empirical literature on the subject (for example, Bellemare 2012; Roy and Thorat 2008; Kumar, Shinoj, and Shivjee 2013; Fisher and Qaim, 2012; Miyata, Minot, and Hu 2007).

Table 4.8 reports estimates of the regression model. Results show that farm households belonging to general and tribal castes have a higher probability of participating in CF than do lower or Dalit caste farm households. Female ginger farmers are more likely to participate in contract ginger farming. A plausible explanation is their active participation in farmer groups and cooperatives when the male members migrate for employment. The households with agriculture as their main occupation show a higher inclination to participate in CF.

Table 4.8 Determinants of ginger farmers' decision to participate in contract farming

Dependent variable: Participation in contract farming (yes = 1 / no = 0)	
Variable	**Coefficients**
Sociodemographic variables	
Ln(age of the household head)	1.000**
	(0.446)
Ln(household size)	-0.117
	(0.390)
Gender	-0.656***
	(0.186)
Ln(operational land)	-0.0561
	(0.0990)
Migration	0.395
	(0.253)
Caste	
General	0.579**
	(0.282)
Tribal	1.231***
	(0.325)
Education level (highest in the family)	
Primary	2.792
	(1.762)
Middle	2.227*
	(1.334)
Secondary	2.128
	(1.379)
Graduate	2.165*
	(1.304)

Table 4.8 Continued

Dependent variable: Participation in contract farming (yes = 1 / no = 0)	
Variable	**Coefficients**
Economic variables	
Main occupation	0.541*
	(0.283)
Experience in farming	-0.0227
	(0.238)
Cultivation of inferior variety	-0.203
	(0.389)
Cultivation of superior variety	-0.400
	(0.527)
Cultivation of both varieties	0.208
	(0.669)
Mobile phone	0.467**
	(0.228)
Ln(distance of transportation)	0.400**
	(0.160)
District dummy variables	
District dummy (Palpa)	-0.163
	(1.582)
District dummy (Pyuthan)	0.563
	(1.055)
Constant	-7.190***
	(2.529)
Pseudo R^2	0.0996
No. of observations	605
Log pseudo likelihood	-376.47

Source: Authors' analysis based on field survey (2014)

Notes: Standard errors in parentheses; ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively. Clustering is used on the village development council (VDC) variable.

Table 4.8 shows that the age of the household head has a positive and significant impact on famers' decision to participate in CF. Similarly, educational attainment has a positive association with participating in CF. While many studies in the literature support this positive relationship between education and CF (Zhu and Wang 2007; Arumugam et al. 2011; Hu 2012), a number of studies have found a negative or insignificant relationship (Guo, Jolly, and Zhu 2005; Ramaswami, Birthal, and Joshi 2006; Miyata, Minot, and Hu 2009; Wang, Zhang, and Wu 2011; Bellemare 2012; Ito, Bao, and Sun 2012; Wainaina, Okello, and Nzuma 2012; Wang, Yu, and Li 2013). Farmers having access to a mobile phone are more likely to participate in CF. Distance of the village from the road positively influences the decision to participate in CF, showing that remoteness favors contracting.

Impact on Profitability

In this section we present the results of the estimation of the impact of CF on the net profits of ginger farmers in Nepal. Table 4.9 reports parameter estimates for both the IV and OLS regressions. The first column reports parameter estimates of the first stage, similar to the coefficients reported in Table 4.8, except for the inclusion of the instrumental variables as regressors. All the regressions include district fixed effects, and standard errors are clustered at the district level.

Table 4.9 Impact of contract farming on profits of ginger cultivators in Nepal

Dependent variable: Unit profit in ginger production (NPR/kg)			
	Coefficients		
Variable	2SLS, first stage	2SLS, second stage	Simple OLS
Contract farming		14.22**	12.16***
		(5.871)	(2.904)
Sociodemographic variables			
Ln(age of the household head)	0.258***	5.883	6.317
	(0.080)	(5.722)	(5.205)
Ln(household size)	-0.025	-0.930	-0.980
	(0.076)	(2.180)	(2.006)
Gender	-0.087***	0.0838	-0.205
	(0.021)	(0.936)	(0.748)
Ln(operational land)	-0.002	2.292**	2.265**
	(0.024)	(0.817)	(0.833)
Migration	0.089**	-0.382	-0.204
	(0.039)	(1.877)	(1.657)
Caste			
General	0.017	0.386	0.650
	(0.047)	(2.261)	(2.291)
Tribal	0.045*	-0.378	0.182
	(0.025)	(1.389)	(1.131)
Education level (highest in the family)			
Primary	0.399**	2.383	3.475
	(0.194)	(9.511)	(10.09)
Middle	0.292*	-2.407	-1.552
	(0.165)	(7.087)	(7.377)
Secondary	0.255	-2.714	-1.905
	(0.163)	(7.008)	(7.276)
Graduate	0.319**	-2.833	-2.008
	(0.135)	(6.775)	(7.093)
Economic variables			
Main occupation	0.128***	5.839**	6.087**
	(0.019)	(2.675)	(2.570)
Experience in farming	-0.072**	-4.681	-4.683
	(0.031)	(2.946)	(2.959)
Cultivation of inferior variety	0.087	5.568	5.484
	(0.064)	(3.286)	(3.309)
Cultivation of superior variety	0.105	8.566**	8.390**
	(0.070)	(3.141)	(3.112)
Cultivation of both varieties	0.129**	13.10***	13.20***
	(0.051)	(2.764)	(3.121)
Mobile phone	0.044	1.925	2.133
	(0.033)	(1.599)	(1.811)
Ln(distance of transportation)	0.034*	1.555	1.737
	(0.018)	(1.174)	(1.323)
Instrumental variables			
Proportion of contract farmers in ward	0.668***		
	(0.099)		
Proportion of contract farmers by caste in ward	0.290***		
	(0.087)		
Constant	-1.212***	7.709	5.660
	0.390	(18.60)	(19.09)
Observations	605	605	605
R-squared	0.128***	0.315	0.318
District fixed effect	Yes	Yes	Yes

Source: Authors' analysis based on field survey (2014)

Notes: Robust standard errors in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively. Clustering is used on the village development council (VDC) variable. 2SLS = two-stage least squares; NPR = Nepalese rupees; OLS = ordinary least squares.

The second column in Table 4.9 shows that CF in ginger has a significant positive impact on unit profit. With the preferred IV specification, contract ginger farmers earn a higher profit of 14.22 Nepalese rupees (NPR) per kilogram. The estimates from the IV estimation show that simple OLS estimates are probably downward biased. Other variables that show a significant relationship with unit profit include occupation, farm size, and variety grown. Importantly, estimates in Table 4.9 show that the relationship between land size and profits is positive—large farms have higher per-unit profit. An additional hectare is associated with an increase in profits by about NPR 2.3/kg. The use of a superior variety of seed is associated with an incremental profit increase of about NPR 8.6.

Impact of CF on Adoption of Food Safety Measures

Table 4.10 reports parameter estimates of the relationship between intensity of adoption of food safety practices (as measured by FSAI) and participation in CF in ginger. Results show that participation in CF enhances the prospects of higher compliance with FSMs, as measured by FSAI, by a modest amount, about 7 percent at the farm level. There are several ways in which CF may lead to greater FSAI. It can help in transferring innovative knowledge and skills, reduce compliance costs, and ensure a premium price to farmers based on the quality of the produce. A similar relationship has been reported by Roy and Thorat (2008); Narrod et al. (2009); and Kumar, Shinoj, and Shivjee (2013). These authors found a significant impact of CF on adoption of FSMs through collective action. Further, gender and education have a positive and significant effect on adoption of FSAI. One can also argue that large farms may be able to exploit economies of scale and thus are better placed for compliance with FSMs.

Table 4.10 Impact of contract farming on adoption of food safety practices, ginger cultivators in Nepal

Dependent variable: Food safety adoption index (FSAI)		
	Coefficients	
Variable	**2SLS, second stage**	**Simple OLS**
Contract farming (instrumented)	6.705**	4.946***
	(3.007)	(1.579)
Sociodemographic variables		
Ln(age of the household head)	-14.11	-13.74
	(10.07)	(10.26)
Ln(household size)	-0.362	-0.404
	(2.579)	(2.549)
Gender	1.634	1.388
	(2.476)	(2.394)
Ln(Operational land)	2.522*	2.499*
	(1.320)	(1.348)
Migration	-2.464	-2.313
	(1.541)	(1.575)
Caste		
General	-3.477	-3.252
	(3.627)	(3.713)
Tribal	-2.200	-1.723
	(2.234)	(2.573)
Education level (highest in the family)		
Primary	-14.93	-14.00
	(9.327)	(9.278)
Middle	-6.965	-6.237
	(6.911)	(7.012)
Secondary	-9.448	-8.759
	(6.993)	(7.040)
Graduate	-5.877	-5.174
	(6.948)	(7.136)

Table 4.10 Continued

Dependent variable: Food safety adoption index (FSAI)		
Variable	**2SLS, second stage**	**Simple OLS**
Economic variables		
Main occupation	0.399	0.611
	(3.673)	(3.548)
Experience in farming	7.775	7.773
	(6.524)	(6.482)
Cultivation of inferior variety	0.951	0.879
	(6.001)	(5.977)
Cultivation of superior variety	-4.395	-4.546
	(6.055)	(5.852)
Cultivation of both varieties	2.153	2.242
	(5.646)	(5.623)
Mobile phone	0.964	1.142
	(1.619)	(1.682)
Ln(distance of transportation)	4.086***	4.241***
	(0.564)	(0.618)
Constant	66.15***	64.40**
	(20.45)	(21.50)
Observations	605	605
R-squared	0.274	0.277
District fixed effect	Yes	Yes

Source: Authors' analysis based on field survey (2014)

Notes: Standard errors in parentheses. ***, ** and * represent significance at 1%, 5% and 10% levels, respectively. Clustering is used on the village development council (VDC) variable. 2SLS = two-stage least squares; NPR = Nepalese rupees; OLS = ordinary least squares.

5. CONCLUSIONS

This paper looked at the issue of coordination in agricultural markets in a specific context in which the farmers are located in remote areas. In such a context, participation of smallholders in CF seems to offer challenges, and there are opposing forces for the presence and sustenance of CF. Using 2014 survey data from ginger-producing farm households located in remote hill districts in Nepal, this study shows the impact of participation in CF in ginger on profits and on the adoption of FSMs at the farm level. We also analyzed the determinants for the decision to participate in CF. Our results show that in terms of land size, there is no systematic bias against the small farmers in participation. Other attributes such as age, education, and gender of the head of household are important determinants of participation in CF. Conditional on participation, contract farmers earn significantly higher net profits. The source of this higher profit comes mainly from higher output prices, though training on practices and provision of seeds also take place. Further, CF has a significant positive impact on adoption of FSMs at the farm level, but in economic terms the difference between contract and noncontract growers is modest in this context.

These findings have several important policy implications. One of the strongest criticisms of CF in developing countries stems from the perception that small farmers will be exploited by the "big" integrators, especially when they have limited options, as is the case with farmers in remote areas. In fact, there has been an intense debate in the formal literature, and some researchers and policy makers perceive CF as being close to bonded labor (for instance Sivaramkrishna and Jyotishi 2008; Ghosh 2003; Singh 2002), while others perceive it as a way of promoting agricultural commercialization (Warning and Key 2002; Simmons, Winters, and Patrick 2005; Birthal, Joshi, and Gulati 2005; Pomareda 2006; Miyata, Minot, and Hu 2007; Bellemare 2008).

Findings from this study suggest that CF can increase farm households' income substantially and bring improvement in compliance with FSMs at the farm level. That these take place in remote areas is quite informative. In CF, the choice of farmers by the integrators, the value distribution, and the location effect interact in complex ways, and it is hard to guess the net effects. Just as transaction costs and possible monopsony power of the buyers hamper contracting in remote areas, agroecology or limited side selling opportunities work in favor of linking with farmers in remote areas. The case of CF in ginger in remote areas of Nepal shows that in the net, the positives happen to outweigh the negative, countervailing forces.

APPENDIX: SUPPLEMENTARY TABLES

Table A.1 Description of variables used in the analysis

Variable	Specification
Sociodemographic variables	
Ln(age of the household head)	Natural logarithm of age of the household head in years
Ln(household size)	Natural logarithm of number of persons in the household
Gender	= 1 if household headed by male, 0 otherwise
Ln(operational land)	Natural logarithm of land operated by household in hectares
Migration	= 1 if any household member migrated for work, 0 otherwise
Caste	
Dalit: base category	
General	= 1 if the household belongs to general caste, 0 otherwise
Tribal	= 1 if the household belongs to tribal caste, 0 otherwise
Education level (highest in the family)	
Illiterate: base category	
Primary	= 1 if any member of the household has 5 years of schooling, 0 otherwise
Middle	= 1 if any member of the household has 8 years of schooling, 0 otherwise
Secondary	= 1 if any member of the household has secondary or higher secondary level of education, 0 otherwise
Graduate	= 1 if any member of the household is a graduate or above, 0 otherwise
Economic variables	
Main occupation	= 1 if main occupation is agriculture, 0 otherwise
Experience in farming	Experience of household head in years
Cultivation of inferior variety	= 1 if household cultivates high-fiber seed variety of ginger
Cultivation of superior variety	= 1 if household cultivates low-fiber seed variety of ginger
Cultivation of both varieties	= 1 if household cultivates both high-fiber and low-fiber seed variety of ginger
Mobile phone	= 1 if household has mobile phone, 0 otherwise
Ln(distance of transportation)	Natural logarithm of distance covered to sell the produce

Source: Authors' calculation based on field survey (2014)

Table A.2 Particulars of cost of cultivation by farm size

Land size category	Contract	Noncontract	Difference	% difference
Yield (Q/ha)				
Marginal (< 0.5 ha)	85.9	77.3	8.5**	11.1
Small (0.5–1 ha)	85.0	90.8	-5.8	-6.4
Medium (1–2 ha)	100.5	97.3	3.1*	3.2
Large (≥ 2 ha)	100.8	110.7	-10.0	-9.0
All	91.0	90.8	0.3*	0.3
Price (NPR/Q)				
Marginal (< 0.5 ha)	5,431	4,678	752***	16.1
Small (0.5–1 ha)	5,427	4,834	593***	12.3
Medium (1–2 ha)	5,730	4,473	1,257***	28.1
Large (≥ 2 ha)	5,933	5,174	759**	14.7
All	5,576	4,768	808***	16.9
Value of production (NPR/ha)				
Marginal (< 0.5 ha)	483,853	369,581	114,272***	30.9
Small (0.5–1 ha)	478,362	438,326	40,036**	9.1
Medium (1–2 ha)	587,270	444,876	142,394***	32.0
Large (≥ 2 ha)	689,537	585,018	104,518	17.9
All	529,599	439,174	90,425***	20.6
Cost of cultivation (NPR/ha)				
Marginal (< 0.5 ha)	211,245	230,037	-18,792	-8.2
Small (0.5–1 ha)	216,465	222,312	-5,846	-2.6
Medium (1–2 ha)	223,507	208,043	15,465	7.4
Large (≥ 2 ha)	220,362	194,797	25,564	13.1
All	217,029	217,752	-724	-0.3
Cost of production (NPR/Q)				
Marginal (< 0.5 ha)	2,460	2,975	-515**	-17.3
Small (0.5–1 ha)	2,545	2,447	98	4.0
Medium (1–2 ha)	2,225	2,138	87*	4.1
Large (≥ 2 ha)	2,187	1,759	428	24.3
All	2,384	2,399	-15***	-0.6
Profit (NPR/ha)				
Marginal (< 0.5 ha)	272,608	139,543	133,064***	95.4
Small (0.5–1 ha)	261,897	216,015	45,882**	21.2
Medium (1–2 ha)	363,762	236,833	126,929***	53.6
Large (≥ 2 ha)	469,175	390,221	78,954	20.2
All	312,570	221,422	91,148***	41.2
Profit (NPR/Q)				
Marginal (< 0.5 ha)	3,174	1,804	1,370***	75.9
Small (0.5–1 ha)	3,080	2,378	701***	29.5
Medium (1–2 ha)	3,621	2,434	1,187***	48.8
Large (≥ 2 ha)	4,656	3,524	1,132**	32.1
All	3,434	2,440	994***	40.8

Source: Authors' calculation based on field survey (2014).

Notes: ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively. ha = hectares; NPR = Nepalese rupees; Q = quintals.

Table A.3 The economics of cultivation of ginger by contract and noncontract farmers

Particulars of cost of cultivation (NPR/ha)	Contract	Noncontract
Labor	68,117	73,997
Inputs	123,511	119,308
Seed	117,396	112,844
Seed treatment	645	361
Manure	4,978	5,398
Pesticide	60	0
Rent for bullock pair / machinery*	7,691	8,369
Rental value of land	9,607	9,133
Transportation of produce to market**	8,110	6,946
Cost of cultivation	217,029	217,752

Source: Authors' calculation based on field survey (2014).
Note: ** and * represent significance at 5% and 10% levels, respectively. NPR = Nepalese rupees.

REFERENCES

Arumugam, N., F. M. Arshad, E. Chiew, and Z. Mohamed. 2011. "Determinants of Fresh Fruits and Vegetables (FFV) Farmers' Participation in Contract Farming in Peninsular Malaysia." *International Journal of Agricultural Management and Development* 1 (2): 65–71.

Barrett, C., M. Bachke, M. Bellemare, H. Michelson, S. Narayanan, and T. Walker. 2011. "Smallholder Participation in Contract Farming: Comparative Evidence from Five Countries." Unpublished, Cornell University, Ithaca, NY, US.

Barrett, C. B. 1997. "Food Marketing Liberalization and Trader Entry: Evidence from Madagascar." *World Development* 25 (5): 763–777.

Bellemare, M. F. 2008. "As You Sow, So Shall You Reap: The Welfare Impacts of Contract Farming?" Unpublished, Duke University, Durham, NC, US.

———. 2012. "As You Sow, So Shall You Reap: The Welfare Impacts of Contract Farming?" *World Development* 40 (7): 1418–1434.

Birthal, P. S., P. K. Joshi, and A. Gulati. 2005. *Vertical Coordination in High Value Food Commodities: Implication for Small Holders*. Markets, Trade and Institutions Discussion Paper 85. Washington, DC: International Food Policy Research Institute.

Cai, J., L. Ung, S. Setboonsarng, and P. Leung. 2008. *Rice Contract Farming in Cambodia: Empowering Farmers to Move beyond the Contract toward Independence.* Discussion Paper 109. Tokyo: Asian Development Bank Institute.

Fischer, E., and M. Qaim. 2012. "Linking Smallholders to Markets: Determinants and Impacts of Farmer Collective Action in Kenya." *World Development* 40 (6): 1255–1268.

FAO (Food and Agriculture Organization of the United Nations). 2015. FAOSTAT database. Accessed on December 15, 2015. http://faostat.fao.org/.

Ghosh, J. (2003). "Corporate Agriculture: The Implications for Indian Farmers." Unpublished, Economic Research Foundation, New Delhi. macroscan.org/fet/dec03/pdf/Corp_Agri.pdf.

Glover, D. 1994. "Contract Farming and Commercialisation of Agriculture in Developing Countries." In *Agricultural Commercialization, Economic Development, and Nutrition,* edited by J. von Braun and E. T. Kennedy, 166–175. Baltimore: Johns Hopkins University Press.

Guo H., R. W. Jolly, and J. Zhu. 2005. "Contract Farming in China: Supply Chain or Ball and Chain." Paper presented at Minnesota International Economic Development Conference, Minneapolis, April 29–30.

Gupta, K., and D. Roy. 2012. "Gains from Coordination in Milk Fed Dairy in Punjab." *Journal of Agribusiness in Developing and Emerging Economies* 2 (2): 92–114.

Hu, W. 2012. "Effect of Contract Farming on the Farmers' Average Return: The Case of the Grain Industry in the USA." Paper presented at Agricultural and Applied Economics Association Annual Meeting, Seattle, August 12–14.

Ito, J., Z. Bao, and Q. Sun. 2012. "Distributional Effects of Agricultural Cooperatives in China: Exclusion of Smallholders and Potential Gains in Participation." *Food Policy* 37 (6): 700–709.

Kalamkar, S. S. 2012. "Inputs and Services Delivery System under Contract Farming: A Case of Broiler Farming." *Agricultural Economics Research Review* 25 (1): 515–521.

Katchova, A. L., and M. J. Miranda. 2004. "Two-Step Econometric Estimation of Farm Characteristics Affecting Marketing Contract Decisions." *American Journal of Agricultural Economics* 86 (1): 88–102.

Kulkarni, S., and S. Grethe. 2009. "Does Vertical Integration Benefit Farming Community? A Comparative Study of Contract and Non-contract Farmers in India." Abstract of paper presented at Conference on Tropical and Subtropical Agricultural and Natural Resource Management, Hamburg, October 6–8. tropentag.de/2009/abstracts/full/750.pdf.

Kumar, A., P. Shinoj, and Jee. 2013. "Do Dairy Co-operatives Enhance Milk Production, Productivity and Quality? Evidences from the Indo-Gangetic Plain of India." *Indian Journal of Agricultural Economics* 68 (3): 457–468.

Leung, P., S. Sethboonsarng, and A. Stefan. 2008. *Rice Contract Farming in Lao PDR: Moving from Subsistence to Commercial Agriculture*. Discussion Paper 90. Tokyo: Asian Development Bank Institute.

Manorom, K., D. Hall, X. Lu, S. Katima, M. Medialdia, S. Siharath, and P. Srisuphan. 2011. *Cross-border Contract Farming Arrangement: Variations and Implications in the Lao People's Democratic Republic.* Greater Mekong Subregion–Phnom Penh Plan for Development Management Research Report Series 1 (2). Manila: Asian Development Bank.

Michelson, H. C. 2013. "Small Farmers, NGOs, and a Walmart World: Welfare Effects of Supermarkets Operating in Nicaragua." *American Journal of Agricultural Economics* 95 (3): 628–649.

Miyata, S., N. Minot, and D. Hu. 2007. *Impact of Contract Farming on Income: Linking Small Farmers, Packers, and Supermarkets in China*. Discussion Paper 00742. Washington, DC: International Food Policy Research Institute.

——. 2009. "Impact of Contract Farming on Income: Linking Small Farmers, Packers, and Supermarkets in China." *World Development* 37 (11): 1728–1741.

Narrod, C., D. Roy, J. Okello, B. Avendao, K. Rich, and A. Thorat. 2009. "Public-Private Partnerships and Collective Action in High-Value Fruit and Vegetable Supply Chains." *Food Policy* 34: 8–15.

Nepal, Ministry of Agricultural Development. 2013. *Statistical Information on Nepalese Agriculture.* Kathmandu.

——. 2015. *Agriculture Development Strategy.* Kathmandu.

Pomareda, C. 2006. *Contract Agriculture: Lessons from Experiences in Costa Rica*. Santiago de Chile: Latin-American Center for Rural Development (RIMISP).

Ramaswami, B., P. S. Birthal, and P. K. Joshi. 2006. *Efficiency and Distribution in Contract Farming: The Case of Indian Poultry Growers*. Markets, Trade and Institutions Discussion Paper 91. Washington, DC: International Food Policy Research Institute.

Roy, D., and A. Thorat. 2008. "Success in High-Value Horticultural Export Markets for the Small Farmers: The Case of Mahagrapes in India." World Development 36 (10): 1874–1890.

Simmons, P., P. Winters, and I. Patrick. 2005. "An Analysis of Contract Farming in East Java, Bali, and Lombok, Indonesia." *Agricultural Economics* 33 (s3): 513–525.

Singh, S. 2002. "Contracting Out Solutions: Political Economy of Contract Farming in the Indian Punjab." *World Development* 30 (9): 1621–1638.

Sivramkrishna, S., and A. Jyotishi. 2008. "Monopsonistic Exploitation in Contract Farming: Articulating a Strategy for Grower Cooperation." *Journal of International Development* 20 (2): 280–296.

Tripathi, R. S., R. Singh, and S. Singh. 2005. "Contract Farming in Potato Production: An Alternative for Managing Risk and Uncertainty." *Agricultural Economics Research Review* 18 (Dec): 47–60.

Wainaina, P. W., J. J. Okello, and J. Nzuma. 2012. "Impact of Contract Farming on Smallholder Poultry Farmers' Income in Kenya." Paper Presented at triennial conference of International Association of Agricultural Economists, Foz do Iguacu, Brazil, August 18–24.

Wang, H. H., H. Yu, and B. Li. 2013. "Is Dairy Complex a Solution to Food Safety for Raw Milk? A Comparison of Farmers' Perceived and Realized Safety Effects." *China Agricultural Economic Review*–International Food Policy Research Institute Annual International Conference, Transforming China's Agricultural and Rural Sector: Challenges and Solutions, Wuhan, China, October 17–18.

Wang H. H., Y. Zhang, and L. Wu. 2011. "Is Contract Farming a Risk Management Instrument for Chinese Farmers? Evidence from a Survey of Vegetable Farmers in Shandong." *China Agricultural Economic Review* 3 (4): 489–505.

Warning, M., and N. Key. 2002. "The Social Performance and Distributional Consequences of Contract Farming: An Equilibrium Analysis of the *Arachide de Bouche* Program in Senegal." *World Development* 30 (2): 255–263.

Wong, G. Y., S. Darachanthara, and T. Soukkhamthat. 2014. "Economic Valuation of Land Uses in Oudomxay Province, Lao PDR: Can REDD+ Be Effective in Maintaining Forests?" *Land* 3: 1059–1074.

Xu, J., and X. Wang. 2009. "An Empirical Analysis of the Impact of Contract Farming and Its Organization Models on Farmers' Income." *Chinese Rural Economy* 2009 (4): 39–47.

Zhu, H. 2007. "An Assessment of the Effects of Adopting Contract Farming Structure in the Tomato Industry in Xinjiang." *Journal of Agrotechnical Economics* 3: 89–95.

Zhu, H., and X. Wang. 2007. "An Analysis on the Influencing Factors of Tomato Growers' Participation in Contract Farming in Xinjiang Autonomous Region." *Chinese Rural Economy* 7: 67–75.

RECENT IFPRI DISCUSSION PAPERS

For earlier discussion papers, please go to www.ifpri.org/pubs/pubs.htm#dp.
All discussion papers can be downloaded free of charge.

1523. *Effectiveness of food subsidies in raising healthy food consumption: Public distribution of pulses in India.* Suman Chakrabarti, Avinash Kishore, and Devesh Roy, 2016.

1522. *Findings across agricultural public expenditure reviews in African countries*. Stephen D. Mink, 2016.

1521. *Risk and sustainable crop intensification: The case of smallholder rice and potato farmers in Uganda.* Bjorn Van Campenhout, Emmanuel Bizimungu, and Dorothy Birungi, 2016.

1520. *Varietal integrity, damage abatement, and productivity: Evidence from the cultivation of Bt cotton in Pakistan.* Xingliang Ma, Melinda Smale, David J. Spielman, Patricia Zambrano, Hina Nazli, and Fatima Zaidi, 2016.

1519. *Institutional arrangements to make public spending responsive to the poor—(where) have they worked?: Review of the evidence on four major intervention types.* Tewodaj Mogues and Alvina Erman, 2016.

1518. *A poverty-sensitive scorecard to prioritize lending and grant allocation: Evidence from Central America.* Manuel A. Hernandez and Maximo Torero, 2016.

1517. *Can information help reduce imbalanced application of fertilizers in India?: Experimental evidence from Bihar.* Ram Fishman, Avinash Kishore, Yoav Rothler, Patrick S. Ward, Shankar Jha, and R. K. P. Singh, 2016.

1516. *Pakistan's fertilizer sector: Structure, policies, performance, and impacts.* Mubarik Ali, Faryal Ahmed, Hira Channa, and Stephen Davies, 2016.

1515. *Agriculture-nutrition linkages and child health in the presence of conflict in Nepal.* Elizabeth Bageant, Yanyan Liu, and Xinshen Diao, 2016.

1514. *"As a husband i will love, lead, and provide": Gendered access to land in Ghana*. Isabel Lambrecht, 2016.

1513. *Formal versus informal: Efficiency, Inclusiveness, and financing of dairy value chains in India.* Pratap S. Birthal, Ramesh Chand, P. K. Joshi, Raka Saxena, Pallavi Rajkhowa, Md. Tajuddin Khan, Mohd Arshad Khan, and Khyali R. Chaudhary, 2016.

1512. *Measuring women's disempowerment in agriculture in Pakistan*. Nuzhat Ahmad and Huma Khan, 2016.

1511. *The impact of conditional cash transfer programs on indigenous households in Latin America: Evidence from PROGRESA in Mexico*. Esteban J. Quiñones and Shalini Roy, 2016.

1510. *Why some are more equal than others: Country typologies of food security.* Eugenio Díaz-Bonilla and Marcelle Thomas, 2016.

1509. *Empowerment and agricultural production: Evidence from rural households in Niger.* Fleur Wouterse, 2016.

1508. *Is access to tractor service a binding constraint for Nepali Terai farmers?* Hiroyuki Takeshima, Rajendra Prasad Adhikari, and Anjani Kumar, 2016.

1507. *Determinants of chemical fertilizer use in Nepal: Insights based on price responsiveness and income effects.* Hiroyuki Takeshima, Rajendra Prasad Adhikari, Basu Dev Kaphle, Sabnam Shivakoti, and Anjani Kumar, 2016.

1505. *Volatile volatility: Conceptual and measurement issues related to price trends and volatility.* Eugenio Díaz-Bonilla, 2016.

1504. *Changes in Ghanaian farming systems: Stagnation or a quiet transformation?* Nazaire Houssou, Michael Johnson, Shashidhara Kolavalli, and Collins Asante-Addo, 2016.

1503. *Returns to agricultural public spending in Ghana: Cocoa versus Noncocoa subsector.* Samuel Benin, 2016.

1501. *Challenges in implementing a small-scale farmers' capacity-building program: The case of the food production, processing, and marketing project in the Democratic Republic of Congo.* Catherine Ragasa, Ephraim Nkonya, John Ulimwengu, and Josée Randriamamonjy, 2016.

1500. *Leveling the field for biofuels: Comparing the economic and environmental impacts of biofuel and other export crops in Malawi.* Franziska Schuenemann, James Thurlow, and Manfred Zeller, 2016.

1499. *Farm transition and indigenous growth: The rise to medium- and large-scale farming in Ghana.* Nazaire Houssou, Antony Chapoto, and Collins Asante-Addo, 2016.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

www.ifpri.org

IFPRI HEADQUARTERS

2033 K Street, NW
Washington, DC 20006-1002 USA
Tel.: +1-202-862-5600
Fax: +1-202-467-4439
Email: ifpri@cgiar.org

IFPRI NEW DELHI

NASC, DPS Road, Opp Todapur, Pusa
New Delhi 110-012 India
Tel.: 91 11 2584-6565
Fax: 91 11 2584-8008 / 2584-6572
Email: ifpri-newdelhi@cgiar.org