Contract Farming: Opportunity Cost and Trade-Offs*

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Abstract

An important literature has established that participation in contract farming leads to higher incomes and has a number of other beneficial effects on the welfare of participating households. Yet no one has looked at the opportunity cost of and the various trade-offs involved in participating in contract farming. I look at the relationship between participation in contract farming and income from (i) livestock, (ii) labor markets, (iii) nonfarm businesses, and (iv) agricultural sources other than livestock and contract farming as well as (v) unearned income. Using data from Madagascar, I find that participation in contract farming is associated with a 79 percent decrease in how much income per capita the average household derives from labor markets and a 47 percent decrease in how much income per capita it derives from nonfarm businesses, but also with a 51 percent increase in how much income per capita the average household derives from agricultural sources other than livestock and contract farming, possibly due to technological spillovers. Thus, even though contract farming has been shown to improve welfare in multiple ways in this context, it looks as though those gains come at the cost of an "agricultural involution" on the part of participating households, who seem to turn away from non-agricultural activities. This has important implications for structural transformation narratives.

Keywords: Contract Farming, Outgrower Schemes, Grower-Processor Contracts, Agricultural Value Chains

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1. Introduction

The twin concepts of opportunity cost—what one must give up when making a given choice—and trade-off—the idea that making an optimal choice often involves a compromise between two things—are among the first things we teach students in principles courses. Yet no matter how simple those two concepts might appear at first, that apparent simplicity is deceiving, and even professional economists have a hard time understanding those concepts.[1]

But if the average professional economist has a hard time accurately figuring out the opportunity cost of a relatively simple choice or recognizing the trade-offs involved in making that choice, what chance does the average developing-country smallholder farmer have when it comes to making choices about how to allocate his time to various activities?

I look at the opportunity cost and trade-offs faced by smallholder farmers who participate in contract farming, and what this entails for development policy. In this context, participation in contract farming—the economic institution wherein a processing firm contracts out the production of an agricultural commodity to a grower household—has been shown to increase incomes (Bellemare, 2012), improve food security (Bellemare and Novak, 2017), and serve as a partial insurance mechanism against price risk (Bellemare et al., 2017).

[1] Ferraro and Taylor (2005) famously report the findings of a survey they conducted at the 2005 annual meetings of the American Economics Association, in which they asked their respondents—all professional economists—to answer the following simple question:

> "You won a free ticket to see an Eric Clapton concert (which has no resale value). Bob Dylan is performing on the same night and is your next-best alternative activity. Tickets to see Dylan cost $40. On any given day, you would be willing to pay up to $50 to see Dylan. Assume there are no other costs of seeing either performer. Based on this information, what is the opportunity cost of seeing Eric Clapton?"

Respondents were given four choices: (i) $0, (ii) $10, (iii) $40, or (iv) $50. The survey's sobering results indicate that the correct answer was the one least frequently given by respondents, as only 21.6% of respondents picked the right answer. Obviously, readers of this article have a superior grasp of economics, and will thus have already figured out that the correct answer is "(ii) $10."

But what most economists do know, however, is that there is no such thing as a free lunch, and so just as it is important to know how the institution benefits grower households, it is also important to know what they have to give up in order to take part in it, beyond the obvious input costs associated with the cultivation of contracted crops.

This article is motivated by a recent review of the contract farming literature by Otsuka et al. (2016), who note that

> [i]t is less clear ... how far [contract farming] improves farmers' welfare. Although many empirical studies found positive effects of [contract farming] on the income from contracted crops, such evidence is not conclusive, because crops and products under [contract farming] are usually labor-intensive so that income from other crop production or nonfarm activities might be sacrificed ... [I]ncome from other sources should be analyzed along with income from contracted production to identify the net income gain and the degree to which [contract farming] sacrifices other income ... To our knowledge, such a study is lacking ... (p.369)

On the one hand, there are many studies looking at the effects of participation in contract farming on income or some closely related measure such as farm revenue, and the vast majority of those studies find that participation in contract farming does lead to higher levels of income (Porter and Phillips-Howard, 1997; Singh, 2002; Warning and Key, 2002; Simmons et al., 2005; Maertens and Swinnen, 2009; Minten et al., 2009; Miyata et al., 2009; Rao and Qaim, 2011; Barrett et al., 2012; Bellemare, 2012; Michelson, 2013; Narayanan, 2014).[2]

[2] Appendix table A1 summarizes the outcomes of interests studied by and the findings of several studies in the empirical literature on contract farming. The reader interested in a more formal review of the literature should consult Bijman (2008) or Oya (2012).

On the other hand, Otsuka et al. (2016) are right in noting that what must be sacrificed to participate in contract farming has so far not been studied by economists.[3]

To fill this gap, I use cross-sectional data on 1,200 households in rural Madagascar to look at the effect of participation in contract farming on various income sources. Though there are many studies looking at the impact of participation in contract farming on household income, the unique contribution of this study is to disaggregate household income per capita in five sources, viz. income per capita from (i) livestock, (ii) labor markets, (iii) nonfarm businesses, and (iv) agriculture other than livestock and contract farming as well as (v) unearned income, and to look at how participation in contract farming relates to those sources of income. Relying on the same frame field experiments that Bellemare (2012), Bellemare and Novak (2017), and Bellemare et al. (2017) use to control for household selection in contract farming, I find that although participation in contract farming appears to have positive spillovers on a participating households' agricultural income per capita from sources other than livestock and contract farming, it appears to have negative spillovers on their income from labor markets and from nonfarm businesses.

In a context where the turn to commercial agriculture, contract farming, and the development of modern agricultural value chains has drawn the attention of policy makers as a potential means of reducing poverty (FAO, 2001), the contribution of this article is to identify the opportunity costs of and the trade-offs involved in participating in contract farming. The findings that the households that participate in contract farming derive less income from labor market participation and from nonfarm businesses thus run counter to some structural transformation narratives (Haggblade and Hazell, 1989; Haggblade et al., 2010). Indeed, those narratives often posit that as rural areas of developing countries modernize, rural nonfarm employment will obtain, and rural labor-market participation rates will

[3] In fairness, Narayanan (2014) looks at the effect of participation in contract farming on profits, which takes into consideration some of the costs associated with contract farming.

increase. As such, the findings in this paper can inform more comprehensive agricultural development policy interventions.

The remainder of this article is organized as follows. In section 2, I give an overview of the data and discuss summary statistics. Section 3 presents the simple empirical framework I use to estimate and identify the effects of participation in contract farming on various sources of income. In section 4, I present and discuss my empirical results. Section 5 summarizes and concludes with policy implications and directions for future research.

2. Data and Descriptive Statistics

The data used in this article have often been used to study contract farming (Bellemare, 2012; Bellemare and Novak, 2017; Bellemare et al., 2017). Consequently, this section will keep the description of the data to a minimum.

A total of 1,200 households in rural Madagascar, about half of which participated in contract farming, were interviewed in the second half of 2008 for a study of the welfare impacts of contract farming commissioned by the World Bank through the Economic Development Board of Madagascar. Households were randomly selected from two sampling frames—one a list of households participating in contract farming, the other a list of households not participating in contract farming—in each of two villages across twelve communes distributed uniformly across six regions, with two communes per region. Given this wide geographical coverage, the data cover households contracting with more than seven different processing firms over more than 12 different commodities representing a mixture of cash and staple crops, viz. cotton, green beans, snow peas, leeks, barley, rice, leafy greens, tomatoes, maize, oats, tobacco, and other crops.

The contracts signed between the growers and processors in these data vary along several dimensions. Though in most cases the contracts are signed between the processor and individual

growers, one processor signs group contracts exclusively. The contracts signed are also a mix of verbal agreements, written contracts, or even written-and-notarized contracts. And though most contracts offer growers a fixed (i.e., pre-determined) price, there is a non-negligible proportion of floating-price contracts in the data. For a specific breakdown of crops and contract terms per region, see Bellemare (2012).

For the purposes of this article, total household income per capita is disaggregated in six distinct categories. Those categories are income per capita from

1. Livestock, which includes income from the sales of cattle, pigs, goats, poultry, and animal byproducts,
2. Labor markets, which includes income from agricultural, herding, state, and business labor as well as other wages,
3. Nonfarm businesses (NFBs), which includes income from crafts, trading, hunting and fishing, forestry, mining, transportation, and other nonagricultural sources,
4. Agricultural sources other than livestock and contract farming,
5. Unearned income, which includes income from pensions and transfers as well as rentals of land, livestock, and equipment, and
6. Income from contract farming.

Table 1 shows the value of total household income per capita for each income category considered in this paper for the 2007-2008 agricultural year. The average household in the data has a total income of about $1,050, or about $200 per person.[4]

[4] At the time of survey, US$1 ≈ Ar 2000.

That figure is disaggregated on average in about $28 (58,829 Ar) per person in income from livestock, $14 (27,925 Ar) per person in income from labor markets, $40 (72,778 Ar) per person in income from nonfarm businesses, $110 (162,691 Ar) in income from agricultural sources other than livestock and contract farming, $6 (12,610 Ar) per person in unearned income, and $21 (41,450 Ar) per person in income from contract farming.[5]

In addition, and consistent with the sampling strategy, almost exactly half of the households in the data participate in contract farming. For the remainder of the variables in table 1, which are included as controls in the analyses that follow, descriptive statistics are shown but not discussed in the interest of brevity; the interested reader can consult Bellemare (2012) or Bellemare and Novak (2017) for a discussion.[6]

Table 2 shows descriptive statistics for each income source split into whether a household participates in contract farming (column 1) or not (column 2), along with the results of balance tests aiming to determine whether the mean of each variable is statistically the same across treatment (i.e., contract farming participant) and comparison (i.e., contract farming non-participant) groups. Bearing in mind that this does not control for confounding factors, this allows taking a first look at whether there are systematic differences across income sources between treatment and comparisons households. The results in table 2 indicate that the households that participate in contract farming report lower levels of

[5] In the data, five households who report not participating in contract farming somehow report some income from contract farming. Because this is most likely due to measurement error due to respondent misunderstanding the income question, to an enumerator mis-recording the respondent's answer, or to an error during data entry, I impute a value of zero for income from contract farming to those households who report not participating in contract farming. Results are robust to whether I make this imputation or not.

[6] Fady days are days on which agricultural work is forbidden by custom. The number of such days can vary at the individual, household, clan, village, and other levels. See Ruud (1960) for a rich description of the complex system of taboos observed in Madagascar.

income from labor markets, but higher levels of income from agricultural sources other than livestock and contract farming.[7]

3. Empirical Framework

This section presents the equations estimated in this paper as well as the identification strategy I use in an attempt to identify the effect of participation in contract farming on the various sources of income reported by the households in the data.

3.1. Estimation Strategy

For each income category *j* in the data (i.e., income from livestock, labor markets, nonfarm businesses, and agriculture as well as unearned income),[8] the equation estimated is such that

$$\ln y_{ij} = \alpha_{0j} + \beta_{0j} x_i + \gamma_{0j} D_i + \epsilon_{0ij}, \tag{1}$$

where in a slight abuse of notation, $\ln y_{ij}$ denotes an inverse hyperbolic sine transformation of household *i*'s income from category *j*,[9] α is a constant, *x* is a vector of controls, *D* is a dummy variable for whether the household participates in contract farming, and ϵ is an error term with mean zero.

Estimating all $j = 5$ versions of equation 1—one for each income category—by ordinary least squares means that the coefficient γ_{0j} only represents the partial correlation between the treatment variable *D* and the outcome variable y_{ij}.[10]

[7] Due to the impossibility of incorporating sampling weights in these *t*-tests, the descriptive statistics in table 2 do not incorporate sampling weights.

[8] I do not run a fifth regression in which income from contract farming is the dependent variable, given that income from contract farming, at least at the extensive margin, is perfectly collinear with participating in contract farming.

[9] The inverse hyperbolic sine (IHS) transformation is a log-like transformation that allows retaining negative- and zero-valued observations and which is preferable to $ln(y+1)$ or some other variant of MaCurdy and Pencavel's (1986) old method. Specifically, $IHS(x) = ln(x + \sqrt{(x^2+1)})$. See Bellemare, Barrett, and Just (2013) for further discussion of and additional references on the IHS transformation.

[10] It is in theory possible to estimate all four equations represented by equation 1 by seemingly unrelated regression estimation (SURE). There are no advantages to doing so here, however, given that all four income categories are regressed on the same covariates, in which case SURE does not confer an advantage.

To help disentangle a causal relationship from that correlation, I estimate the following version of equation 1:

$$\ln y_{ij} = \alpha_{1j} + \beta_{1j} x_i + \gamma_{1j} D_i + \pi_1 w_i + \epsilon_{1ij} \quad (2)$$

for all $j = 5$ versions of equation 2 by ordinary least squares, wherein all variables are defined as previously, and where w is a vector of variables capturing the respondent's (i.e., the household head and primary decision maker) willingness to pay (WTP) for participation in a hypothetical contract farming agreement, which serves here as a proxy for the respondent's WTP to participate in contract farming. The hypothesis test of interest then involves the null hypothesis $H_0: \gamma_{1j} = 0$ versus the alternative hypothesis $H_A: \gamma_{1j} \neq 0$. Rejecting the null in favor of the alternative should then be interpreted as evidence that participation in contract farming has spillovers, positive or negative depending on the direction of rejection, on income from sources other than income from contract farming.

When it comes to the economic significance of the estimated coefficients, one small difficulty is that in order to recover the marginal effect of participation in contract farming on a given source of income *j*, the coefficient γ_{1j} must be transformed given the semi-logarithmic nature of equation 2. Kennedy (1981) showed that this marginal effect ξ is such that

$$\xi = exp\left\{\gamma_{1j} - \frac{1}{2} V(\gamma_{1j})\right\} - 1. \quad (3)$$

In what follows, I thus report both the estimated coefficient γ_{1j} for each source of income *j* as well as the marginal effect ξ_j of participating in contract farming on each source of income *j*. Because ξ involves a nonlinear transformation of γ_1, the standard errors I report for each coefficient ξ are computed using the delta method, but note that since those are only asymptotically valid, the standard error for γ_1 should prevail in cases where there is a discrepancy between the standard error for γ_1 and the standard error for ξ.

3.2. Identification Strategy

In this sub-section, I explain how these WTP variables allow controlling for household selection in contract farming. This selection-on-observables identification strategy is identical to that used by Bellemare and Novak (2017) to identify the effect of participation in contract farming on food security, and by Bellemare et al. (2017) to identify the effect of participation in contract farming on income variability.

Following Smith and Sweetman (2016), a household i will select into participating in contract farming if and only if

$$y_{1i} - y_{0i} > c_i \tag{3}$$

where y_{1i} is household *i*'s income if household *i* participates in contract farming, y_{0i} is household *i*'s income if household *i* does not participate in contract farming, and c_i is household *i*'s cost of participating in contract farming.

Obviously, we cannot observe both y_{1i} and y_{0i} together, as a household either participates or not in contract farming, but not both.

During fieldwork, every respondent was asked the hypothetical question "Would you participate in a contract farming agreement that would increase your income by 10 percent but would require an initial investment of \$$b_i$?," wherein the bid amount for respondent i, b_i, was randomly drawn from the throw of a regular (i.e., six-sided and fair) die from the bid set B={\$12.50, \$25.00, \$37.50, \$50.00, \$62.50, \$75.00}.[11] Each respondent's binary (i.e., yes or no) answer to the experimental question was recorded.

[11] Respondents were asked a question which stated these amounts in local currency. Numbers are presented here in US dollars for clarity. A total of six bids was used to as to be able to use a six-sided die to randomize during fieldwork to let respondents see how the bid was randomized and let them throw the die themselves. Bid values were determined in two steps. First, they were determined as numbers that would yield a good proportion of both yeses and noes. Second, they were validated during the pre-fieldwork piloting of the survey questionnaire. These bid levels were based on realistic investment costs.

Each respondent was only asked the experimental question for one of six possible amounts in bid set B, but each respondent's bid b_i, by virtue of being randomly assigned, is completely exogenous to respondent i's observable characteristics x. This means that it is possible to impute each respondent's answers to the five questions which he was not asked, imputing those answers off his observable characteristics.

For example, a subset of respondents were asked whether they would like to participate in a contract farming agreement which would raise their income by 10 percent, but which would require an initial investment of $50. It is possible to linearly project those respondents' binary answer *d* to the hypothetical question on those respondents' observables *x* to forecast what other respondents—those who were asked the same question, but for amounts different from $50—would have answered had they been asked the same question. In other words, for each bid level *b*, I estimate

$$d_i = \delta + \lambda x_i + \eta_i \tag{4}$$

on the subset of observations i who were asked about that bid level. Estimating equation 4, I obtain $\hat{\delta}$ and $\hat{\lambda}$. These estimate coefficients then allow me to forecast the probability that a respondent $-i$ who was not asked about a specific bid level *b* would have answered "Yes" for that bid level, i.e., $d_{-i} = \hat{\delta} + \hat{\lambda} x_{-i}$. For each respondent, then, the vector *w* in equation 2 encompasses six variables, each capturing the likelihood that the respondent would say "Yes" to each of the bid levels. For one of those bids—the one the respondent was actually asked about—that likelihood is either zero or one, since the respondent's answer was recorded; for all five other bids, that likelihood is a probability obtained from estimating equation 4 for each bid level.

Each bid level *b* is a (hypothetical) draw of c_i, the household's cost of participating in contract farming. But since the hypothetical question imposes on respondents that $y_{1i} = y_{0i}(1 + 0.10)$, i.e., it involves a sure income increase of 10 percent, the vector *w* in equation 2 is a proxy for a household's

willingness to pay to participate in an actual contract farming agreement. Ultimately, this means that the variables on the right-hand side of equation 2 account for selection into contract farming, which constitutes a selection-on-observables design.[12]

Indeed, the willingness to pay derived from the experiment just described is a proxy for a respondent's marginal utility from participating in contract farming. As such, it in principle captures everything, either observed or unobserved, which moves marginal utility from participating in contract farming around, such as a respondent's ambiguity or risk preferences, his entrepreneurial or technical ability, his expectations, and so on—all factors which are normally in the error term and which, if correlated with the variables on the RHS of equation 1, can bias γ_{0j}. It is thus because those typically unobserved factors are proxied for by willingness to pay here, and thus pulled out of the error term and into the RHS of equation 2, that the selection-on-observables design just discussed is adopted here.

4. Estimation Results and Discussion

Table 3 presents estimation results for the specifications in equation 1, and table 4 presents estimation results for the specifications in equation 2. For each dependent variable, I conduct a Hausman test pitting the specification in table 4 against that in table 3. In no case is the null of the Hausman test rejected. In principle, this means that the null of exogeneity of the treatment variable is not rejected. In practice, I show both the specifications with and without the vector w, since the specifications in table 4 are meant to account for selection.

One the one hand, the marginal effects reported at the bottom of table 3 show that participation in contract farming is associated with a 42-percent increase in total income, a 79-percent decrease in

[12] One reviewer noted that conformity bias (Harrington, 1999; Cordes and Schwesinger, 2014) might have played a role in how respondents answered the WTP question if contract farming is perceived well in his or her village. This is in principle possible, and the design of the experiment does not allow controlling for this. With that said, the degree of desirability of contract farming in each village is controlled for by the village fixed effects included in all specifications below.

income from labor markets, and a 41-percent decrease in income from nonfarm businesses. On the other hand, the marginal effects reported at the bottom of table 3 also show that participation in contract farming is associated with no statistically significant change in income from livestock or income from agricultural sources other than livestock and contract farming.

Qualitatively, the results of interest in table 4 are almost identical to those in table 3, except for the effect of participation in contract farming on income from agricultural sources other than livestock and contract farming, whose coefficient is significant but whose marginal effect is statistically insignificant.[13]

In this case, participation in contract farming appears to lead to a 41-percent increase in total income, a 79-percent decrease in income from labor markets, a 47-percent decrease in income from nonfarm businesses, and a 51-percent increase in income from agricultural sources other than livestock and contract farming.

In sum, it looks as though there are significant spillover effects—both positive and negative—from participation in contract farming to other sources of income. The most robust such findings are for income from labor markets and income from nonfarm businesses. The findings for income from agricultural sources other than livestock and contract farming are less robust, but they suggest that this source of income might increase in response to a household participating in contract farming. This possibly due to technological spillovers from contracted to non-contracted crops.[14]

Taken together, these findings paint a clear picture of the opportunity costs and trade-offs of participation in contract farming. Though the results in column 1 of tables 3 and 4 and the findings in

[13] Recall that since the standard errors for the estimated marginal effects are only asymptotically valid, the standard error for the estimated base coefficient should prevail in cases where there is a discrepancy between their respective standard errors.

[14] Alternatively, this could be due to the diversion of processor-provided inputs from contracted to non-contracted crops. Bellemare (2010), however, shows that processors send out technical agents to visit growers to curb this kind of opportunistic behavior.

Bellemare (2012) suggest that participation in contract farming raises the income of participating households, those gains come at the cost of having to forgo income from labor-market participation and from nonfarm businesses. Thus, it looks as though Otsuka et al.'s (2016) conjecture—because contract farming is typically labor-intensive, participating households have to sacrifice income from nonfarm activities to realize the gains from it—is supported in these data.

This suggests two things, the precise analysis of both of which is beyond the scope of this paper and beyond what one can ask of the data at hand. The first is that as the relative returns to on-farm labor increase, households reallocate their labor time away from labor markets and toward their contracted plots and crops (Barrett et al., 2008; McCullough, 2017). The second is that as the relative returns to on-farm labor increase, one would expect households to hire in agricultural labor to maintain their participation in the labor market. That they do not appear to do so is suggestive of labor market failures in this context,[15] though it is impossible to tell what kind of market failure might be involved. One possible scenario is that hired agricultural labor must be supervised to avoid moral hazard problems, which can be costly (Feder, 1985; Frisvold, 1994). Another possible scenario is one which, anecdotally at least, appears to hold in Madagascar, and which involves a certain distaste Malagasy peasants have for working for other farmers, which they see as akin to slavery. This points to an important limitation of the findings in this paper, viz. the impossibility of pinpointing the precise mechanisms whereby participation in contract farming might have spillover effects onto other sources of income.

5. Summary and Concluding Remarks

Starting from an observation made by Otsuka et al. (2016), this article has explored the effects of participation in contract farming on sources of income other than income from contract farming.

[15] This stems from the empirical results. If the households that participate in contract farming decrease their labor market participation (as suggested by the negative association between participation in contract farming and income from labor markets), it is likely because (i) the contracted crops need to be worked on, and (ii) they do not hire additional labor to do so.

Looking at the relationship between participation in contract farming and income from (i) livestock, (ii) labor markets, (iii) nonfarm businesses, and (iv) agricultural sources other than livestock and contract farming as well as (v) unearned income, it looks as though participation in contract farming, although it appears to have positive spillovers on income from agricultural sources other than livestock and contract farming, is negatively associated with income from labor-market participation and income from nonfarm businesses.

Thus, even though the contract farming arrangements in these data have been shown to lead to higher income levels (Bellemare, 2012), shorter hungry seasons (Bellemare and Novak, 2017), and to serve as partial insurance mechanisms (Bellemare et al., 2017), it looks as though all those gains come at the cost of a kind of "agricultural involution" on the part of participating households (Geertz, 1963), who appear to turn away from non-agricultural activities.

The findings in this paper are potentially important for development policy. Indeed, if the goal of policy makers is to spur rural nonfarm employment or foster entrepreneurship in rural areas of developing countries, those policy makers should pay attention to where contract farming activities locate, as the presence of contract farming might undermine efforts to diversify economic activity away from agriculture. Alternatively, if the goal of policy makers is to foster both a more modern agricultural sector as well as rural nonfarm employment, policies aimed at encouraging the development of a more modern agricultural sector in developing countries should perhaps be accompanied by measures aimed at helping develop rural labor markets and rural businesses.

That said, the data and methods used in this paper cannot identify the mechanisms whereby participation in contract farming spills over onto other activities (i.e., labor-market participation, nonfarm businesses, and agricultural activities other than animal husbandry or contract farming). To properly do so is beyond the scope of this paper, as each such other activity would require its own

analysis and, possibly, the estimation of a structural model of how the household allocates its time between various activities. Though the data allow the estimation of such a structural model, I leave that endeavor to future research.

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Table 1. Summary Statistics (n=1,178)

Variables	Mean
Total Income Per Capita (1,000 Ar)	376.473***
	(23.841)
Income from Livestock Per Capita (1,000 Ar)	58.829***
	(4.871)
Income from Wages Per Capita (1,000 Ar)	27.925***
	(2.789)
Income from Nonfarm Businesses Per Capita (1,000 Ar)	72.778***
	(11.073)
Income from Agriculture Per Capita (1,000 Ar)	162.691***
	(15.272)
Unearned Income Per Capita (1,000 Ar)	12.610***
	(2.545)
Income from Contract Farming Per Capita (1,000 Ar)	41.450***
	(5.406)
Contract Farming Participant (Dummy)	0.498***
	(0.016)
Household Size (Individuals)	5.571***
	(0.075)
Dependency Ratio	0.449***
	(0.008)
Household Head Single (Dummy)	0.124***
	(0.011)
Household Head Female (Dummy)	0.088***
	(0.010)
Migrant (Dummy)	0.125***
	(0.011)
Age (Years)	43.274***
	(0.431)
Education (Completed Years)	5.682***
	(0.106)
Agricultural Experience (Years)	20.621***
	(0.433)
Household Head Member of a Farm Organization (Dummy)	0.222***
	(0.014)
Household Head Fady Days	22.204***
	(1.105)
Productive Assets (100,000 Ar)	4.440***
	(0.522)
Nonproductive Assets (100,000 Ar)	13.965***
	(0.876)
Household Landholdings (Ares, or 100 m^2)	145.569***
	(10.138)

Note: Means are weighted using sampling weights. Standard errors in parentheses.

Table 2. Balance Tests

	Contract Farming		
Variables	**Participant**	**Non-Participant**	**Difference**
Total Income Per Capita (100,000 Ar)	5.360	3.459	***
	(0.509)	(0.250)	
Income from Livestock Per Capita (1,000 Ar)	62.832	51.120	
	(5.687)	(4.866)	
Income from Labor Markets Per Capita (1,000 Ar)	18.252	38.707	***
	(2.087)	(4.674)	
Income from NFBs Per Capita (1,000 Ar)	93.482	69.275	
	(19.466)	(9.792)	
Income from Agriculture Per Capita (1,000 Ar)	267.906	173.183	**
	(33.732)	(19.506)	
Unearned Income Per Capita Per Capita (1,000 Ar)	10.763	13.407	
	(2.524)	(3.072)	
Income from Contract Farming Per Capita (1,000 Ar)	82.793	0.000	***
	(342.403)	(0.000)	

Note: Last column reports the results of t-tests of whether the mean is the same between participants and non-participants. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3. OLS Results for Different Income Categories Ignoring Selection

Variables	(1) Total	(2) Livestock	(3) Labor	(4) NFB	(5) Agriculture	(6) Unearned
	Dependent Variable: Log of Income by Category					
Contract Farming Participant	0.349***	0.466	-1.530***	-0.478	0.478**	0.162
	(0.051)	(0.299)	(0.305)	(0.336)	(0.241)	(0.209)
Household Size	-0.131***	0.231***	0.122*	0.172**	-0.056	-0.176***
	(0.012)	(0.072)	(0.073)	(0.081)	(0.058)	(0.050)
Dependency Ratio	-0.425***	-0.360	-1.255*	-0.583	-0.167	0.709
	(0.124)	(0.725)	(0.741)	(0.817)	(0.584)	(0.507)
Single	-0.030	-0.837	1.179	0.752	-0.390	0.419
	(0.122)	(0.711)	(0.727)	(0.801)	(0.573)	(0.497)
Female	-0.392***	0.640	-1.176	-1.578*	0.443	-0.124
	(0.139)	(0.813)	(0.831)	(0.916)	(0.655)	(0.568)
Migrant	0.110	0.572	-0.220	0.893*	-0.897**	0.183
	(0.080)	(0.464)	(0.475)	(0.523)	(0.374)	(0.325)
Age	0.003	-0.061***	-0.025	-0.073***	0.008	0.129***
	(0.004)	(0.022)	(0.022)	(0.025)	(0.018)	(0.015)
Education	0.067***	-0.064	0.087*	0.102*	0.066*	0.015
	(0.008)	(0.048)	(0.049)	(0.054)	(0.039)	(0.033)
Agricultural Experience	-0.000	0.071***	-0.041*	0.012	-0.026	-0.060***
	(0.004)	(0.022)	(0.022)	(0.025)	(0.018)	(0.015)
Farm Organization	0.099	0.051	-0.289	-0.643	0.639**	-0.231
	(0.063)	(0.370)	(0.378)	(0.417)	(0.298)	(0.259)
Fady Days	-0.001	0.002	-0.017***	0.011*	-0.012***	0.001
	(0.001)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)
Working Capital	0.006***	-0.025***	-0.010	0.007	0.002	0.016***
	(0.001)	(0.007)	(0.007)	(0.008)	(0.006)	(0.005)
Assets	0.007***	0.027***	-0.021***	-0.011	0.003	0.003
	(0.001)	(0.006)	(0.006)	(0.007)	(0.005)	(0.004)
Landholdings	0.001***	0.001	0.001	-0.001	0.002***	-0.001
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)

Constant	12.581***	8.717***	8.958***	6.769***	8.149***	-2.443***
	(0.158)	(0.921)	(0.942)	(1.038)	(0.742)	(0.644)
Marginal Effects	0.416***	0.523	-0.793***	-0.414**	0.567	0.150
	(0.073)	(0.455)	(0.063)	(0.197)	(0.377)	(0.240)
Observations	1,178	1,178	1,178	1,178	1,178	1,178
Village Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.532	0.094	0.153	0.112	0.288	0.102

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. OLS Results for Different Income Categories Accounting for Selection

Variables	(1) Total	(2) Livestock	(3) Labor	(4) NFB	(5) Agriculture	(6) Unearned
	Dependent Variable: Log of Income by Category					
Contract Farming Participant	0.345***	0.394	-1.503***	-0.579	0.440*	0.345***
	(0.050)	(0.298)	(0.315)	(0.354)	(0.242)	(0.050)
Household Size	-0.127***	0.163**	0.101	0.092	-0.048	-0.127***
	(0.015)	(0.082)	(0.084)	(0.090)	(0.068)	(0.015)
Dependency Ratio	-0.405**	0.449	-1.237	0.183	-0.192	-0.405**
	(0.159)	(0.883)	(0.834)	(0.918)	(0.682)	(0.159)
Single	-0.001	-0.818	1.092	0.775	-0.121	-0.001
	(0.151)	(0.809)	(0.773)	(0.814)	(0.698)	(0.151)
Female	-0.388**	0.396	-1.486*	-1.626*	0.368	-0.388**
	(0.189)	(0.923)	(0.886)	(0.917)	(0.780)	(0.189)
Migrant	0.096	0.016	-0.259	0.598	-1.095**	0.096
	(0.100)	(0.558)	(0.546)	(0.622)	(0.490)	(0.100)
Age	0.015**	-0.046	-0.077**	-0.069*	0.048*	0.015**
	(0.007)	(0.036)	(0.036)	(0.037)	(0.027)	(0.007)
Education	0.068***	-0.081	0.082	0.100*	0.076*	0.068***
	(0.010)	(0.051)	(0.055)	(0.059)	(0.041)	(0.010)
Agricultural Experience	-0.011*	0.072**	0.012	0.020	-0.061**	-0.011*
	(0.007)	(0.033)	(0.036)	(0.037)	(0.026)	(0.007)
Farm Organization	0.107	-0.101	-0.294	-0.615	0.691**	0.107
	(0.068)	(0.411)	(0.455)	(0.448)	(0.306)	(0.068)
Fady Days	-0.002*	-0.006	-0.013*	0.007	-0.016***	-0.002*
	(0.001)	(0.007)	(0.007)	(0.008)	(0.006)	(0.001)
Working Capital	0.010***	-0.020	-0.027*	0.015	0.014	0.010***
	(0.003)	(0.013)	(0.014)	(0.016)	(0.010)	(0.003)
Assets	0.009***	0.024**	-0.027***	-0.014*	0.007	0.009***
	(0.002)	(0.009)	(0.008)	(0.008)	(0.007)	(0.002)
Landholdings	0.000	0.001	0.001	-0.000	0.002**	0.000
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)

Yes to $12.50 Investment (Imputed)	-0.009	0.611	0.409	-0.023	-0.277	-0.009
	(0.160)	(0.959)	(0.954)	(1.036)	(0.604)	(0.160)
Yes to $25.00 Investment (Imputed)	0.117	0.341	0.268	1.015	-0.152	0.117
	(0.121)	(0.815)	(0.817)	(0.919)	(0.585)	(0.121)
Yes to $37.50 Investment (Imputed)	0.073	0.109	-0.928	0.527	1.165	0.073
	(0.138)	(0.839)	(0.847)	(0.867)	(0.782)	(0.138)
Yes to $50.00 Investment (Imputed)	-0.117	0.835	-0.142	1.150	-0.231	-0.117
	(0.133)	(0.742)	(0.805)	(0.849)	(0.537)	(0.133)
Yes to $62.50 Investment (Imputed)	0.540*	0.754	-2.257*	0.064	1.764*	0.540*
	(0.297)	(1.263)	(1.302)	(1.426)	(1.030)	(0.297)
Yes to $75.00 Investment (Imputed)	-0.118	1.396	1.087	0.555	-0.022	-0.118
	(0.170)	(0.911)	(0.976)	(1.128)	(0.624)	(0.170)
Constant	11.759***	4.970*	12.061***	3.848	4.794**	11.759***
	(0.558)	(2.622)	(2.723)	(2.978)	(2.075)	(0.558)
Marginal Effects	0.410***	0.421	-0.787***	-0.474**	0.510	0.152
	(0.076)	(0.414)	(0.064)	(0.187)	(0.359)	(0.231)
Observations	1,178	1,178	1,178	1,178	1,178	1,178
Village Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.535	0.097	0.157	0.115	0.292	0.102

Bootstrapped standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix

Table A1. Summary of the Findings in the Empirical Literature on Contract Farming

Study	Outcome Variable	Relationship between Contract Farming and Outcome
Bellemare (2012)	Income	+
Bellemare and Novak (2017)	Duration of the hungry season	-
Bellemare et al. (2017)	Income variability	-
Bolwig et al. (2009)	Farm revenue	+
Brambilla and Porto (2011)	Yield	+
Briones (2015)	Net farm income	+
Dedehouanou et al. (2013)	Self-reported happiness and well-being	+
Glover (1990)	Income	+
Jones and Gibbon (2011)	Net household income	+
Kumar and Kumar (2008)	Income	+
Maertens and Swinnen (2009)	Income	+ for mangoes, - or no effect for bean
Maertens and Swinnen (2012)	Gender inequality	+
Minten et al. (2007)	Rice productivity	+
Minten et al. (2009)	Welfare, income stability, duration of hungry season, technology adoption, and staple crop productivity	+ for welfare, + for income stability, and - for duration of the hungry season, + for technology adoption, and + for staple crop productivity
Miyata et al. (2009)	Income	+
Narayanan (2014)	Net profit per acre	+ (papayas and broilers), - (marigolds), or mixed findings (gherkins)
Raynolds (2002)	Demand for female labor; women's wages	+ and +
Sharma (2008)	Income	+
Simmons et al. (2005)	Gross margins	+

Singh (2002a)	Income; Employment opportunities for labor, especially women.	+
Singh (2002b)	Income; Employment opportunities for labor, especially women.	+ for avocado income, no effect on total income
Trifkovic (2014)	Per capita consumption expenditures	+
Wang et al. (2014a)	Income; productivity/efficiency	+ and +
Wang et al. (2014b)	Income	No effect
Warning and Key (2002)	Income	+