# The Effects of Marketing Contracts and Resource-providing Contracts:

## Comparisons in the Small Farm Sector in Ghana

Dissertation

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# Summary

Agri-food systems in developing countries are undergoing a rapid transformation, characterized by modernizing supply chains and the rising importance of higher-value products. Participation of smallholder farmers in the emerging modern and high-value marketing channels is considered a crucial contributor for rural development and poverty alleviation. However, market access for smallholders tends to be limited due to multiple market failures, while farm production is often associated with high risks and uncertainties. This leads to an under-investment of smallholders in profitable high-value crops, new technologies, and production inputs. Contract farming has emerged as an institutional response to market failures, with the potential to reduce risks and uncertainties, increase smallholder investments in more profitable crops, inputs and technologies, and thus contribute to higher productivity and income.

In the existing literature, various studies analyzed the effects of contract farming on farm production and household welfare. Recent review articles showed that the results are mixed, which may be due to differences in contract types. A major difference exists between simple marketing contracts that only offer a secure sales market, and resource-providing contracts that additionally provide inputs and other technical services through in-kind credits. Marketing contracts and resource-providing contracts address different constraints and thus can have different effects on the farmers' market access, risk, investment, and production behavior, but a comparison of effects across contract types has rarely been performed. The few existing studies find only minor differences in effects across contract types, potentially due to the relatively low investments required in the production of the particular crops investigated, mainly low-value annual staple foods.

The main contribution of this dissertation is a comparison of the effects of marketing contracts and resource-providing contracts in a perennial plantation crop sector with high investment requirements. Such a capital-intensive crop sector is more suited to investigate differences in contract types. Smallholder farmers face financial constraints for the adoption of high-value crops, and the establishment and maintenance of larger plantations. These financial constraints are directly addressed by resource-providing contracts. It thus has to be tested whether a marketing contract sufficiently incentivizes and enables farmers to increase production investments, or if a resource-providing contract is more suited in such a setting. To the best of

our knowledge there is no prior evidence on the effects of marketing contracts and resource-providing contracts in such a capital-intensive high-value crop sector.

We perform the analysis with data from the Ghanaian oil palm sector. Oil palm is one example of a capital-intensive high-value crop that has recently gained in importance among smallholders in different parts of the world. The increasing demand for vegetable oils worldwide has led to changes in the marketing channels for oil palm producers, also in West Africa, where palm oil was traditionally produced mainly for home consumption. In this setting, oil palm continues to gain in importance, and new contract farming schemes are being implemented to meet the rising demand.

The dissertation includes four papers, which are based on a farm household survey conducted in 2018. The survey includes oil palm producers with marketing contracts, with resource-providing contracts, and without any contracts. Beyond contributing to the existing literature through the contract comparison in a capital-intensive high-value crop sector, each of the four papers contributes in different ways, as explained below.

The first paper investigates the effects of marketing contracts and resource-providing contracts on farmers' input use, productivity, and longer-term cropping decisions. The objective is to analyze whether producing oil palm under contract has an effect on these dimensions, and whether the effects of resource-providing contracts differ from those of simple marketing contracts. The analysis sets itself apart from the available literature by providing evidence on long-term changes in land use, and by disaggregating the analysis by small-, medium-, and large-scale farmers to better understand distributional implications. The results show that the effects strongly differ across contract types. The marketing contract is insufficient in overcoming farmers' constraints and has no significant effect on almost all of the outcome variables. In contrast, the resource-providing contract has positive effects on production investments, yields, degrees of specialization and scale of production. Moreover, the farm size disaggregation suggests that investment constraints are particularly severe for small-scale farmers, who benefit most from the resource-providing contract.

The second paper analyzes the effects of both contracts on agricultural labor use, household labor allocation, and employment. Contract farming is commonly expected to increase labor use and to create employment opportunities, due to an intensified production and additional labor requirements under contract. This is consistent with the empirical findings of a few available studies. The objective of this paper is to illustrate that the existing findings from previous studies cannot be generalized, as contracts can sometimes also lead to the adoption of labor-saving procedures and technologies. To identify whose employment opportunities are affected, we disaggregate the analysis by gender and age. The findings suggest that agricultural labor use is significantly reduced under contract, which leads to a reallocation of farm household labor towards off-farm employment, but not to a reduction

of hired labor use. Moreover, we find heterogeneous effects for male, female, child, and youth labor. Interestingly, these labor use effects do not differ much by contract type.

The third paper analyzes the effects of both contracts on total farm household income and income by source. The objective of this paper is to examine the contract induced changes in household welfare in monetary terms, and to identify the mechanisms through which each contract leads to changes in household income. A disaggregation by income source allows for the identification of the underlying mechanisms and spillover effects, which were largely neglected in the existing literature. We find that both contracts lead to large positive effects on total household income in a similar magnitude, yet through different mechanisms. Farmers under the marketing contract use the increase in oil palm profits to transition out of agricultural production and into off-farm employment. Farmers under the resource-providing contract have a stronger dependency on income from oil palm, which is considerably more profitable under the contract.

The results of the first, second, and third paper illustrate that the resource-providing contract overcomes smallholders' investment and market access constraints and leads to a substantial increase in productivity and income, on average. Yet, additional questions on farmers' preferences and perceptions included in the survey reveal that most farmers actually regret their decision to participate in the contract scheme and would prefer to exit if they could. Thus, the fourth paper discusses problems and constraints of contract farming, as well as the farmers' complaints and concerns to provide additional insights on farmer satisfaction. The objective is to contribute to the limited understanding of farmer satisfaction and dropout behavior, which has not received much attention in the literature. We illustrate the importance of incomplete information and contract understanding among farmers. We also show that farmers mistrust the buying company due to lack of contract transparency, discuss potential determinants, and suggest directions for future research.

Overall, our findings illustrate that the effects of contract farming strongly depend on the type of contract. We identify sizeable differences in the effects between marketing contracts and resource-providing contracts, which illustrates that not all contracts are useful in every situation. Moreover, the mechanisms of the effects can vary greatly across types of contracts, which should not be ignored when designing contract farming policies and when estimating resulting effects.

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# Contents

# List of tables

# List of figures

# List of acronyms

| | |
|---|---|
| BOPP | Benso Oil Palm Plantation |
| CF | Control Function |
| GHS | Ghanaian Cedis |
| IPTW | Inverse Probability of Treatment Weighting |
| IV | Instrumental Variable |
| KM | Kernel Matching |
| MC | Marketing Contract |
| MoFA | Ministry of Food and Agriculture |
| NC | No Contract |
| NNM | Nearest Neighbor Matching |
| ODK | Open Data Kit |
| OLS | Ordinary Least Squares |
| RCT | Randomized Control Trial |
| RPC | Resource-providing Contract |
| TOPP | Twifo Oil Palm Plantation |
| WTP | Willingness-to-pay |

# Chapter 1

# General introduction

## 1.1 Background

Global agri-food systems are undergoing a rapid transformation, including a higher degree of coordination and integration along agricultural supply chains. The increasing trade in high-value products, the expansion of agricultural processing and retailing, as well as the increasing demand for quality and food safety have necessitated a tighter coordination and integration. This has led to substantial organizational and institutional changes along agricultural supply chains. One of the notable changes is the increasing use and importance of contract farming in developing countries (Minot and Sawyer, 2016; Reardon et al., 2009; Wang et al., 2014b).

Contract farming is an institutional tool to coordinate transactions between buying companies, such as processors or retailers, and farmers. Thereby, both parties enter a contractual agreement that pre-determines the terms of the sale, such as timing, price, quantity and quality (Eaton and Shepherd, 2001; Key and Runsten, 1999; Otsuka et al., 2016). Open market transactions imply high risk and transaction costs for companies, who often depend on a stable and continuous supply of produce. Both, risk and transaction costs, can be reduced through contractual agreements.

Alternatively, risk and transaction costs can be reduced through a full vertical integration, in which the companies execute all production steps on a large-scale, using their own land and hired labor. Large-scale production is associated with better information, improved market access, and higher risk tolerance. However, these advantages can be offset by diseconomies of scale, due to high monitoring costs and low incentives of hired laborers (Minot and Sawyer, 2016). Small-scale producers have lower monitoring costs, and production is mostly in the hands of family members who have higher incentives. Thus, contract farming is considered superior to a full vertical integration, as it combines the advantages of small-scale farming (e.g. improved incentives) with the advantages of large-scale production and marketing (e.g. higher risk tolerance, improved market access) (Grosh, 1994; Minot and Sawyer, 2016).

Beyond the coordination of agricultural transactions, contract farming has the potential to integrate smallholder farmers in higher-value markets. This participation is considered a crucial contributor for rural development and poverty alleviation. However, farmers in developing countries face a number of constraints that limit their participation (Barrett et al., 2012; Miyata et al., 2009). Contract farming has the potential to overcome these constraints and to include farmers in modern and higher-value markets (Eaton and Shepherd, 2001; Key and Runsten, 1999; Simmons et al., 2005; Wang et al., 2014a). As such, contract farming is promoted by donors and multilateral agencies, as well as by several developing countries' governments, as an integral part of their national development strategy (Bellemare and Bloem, 2018; Eaton and Shepherd, 2001; Ragasa et al., 2018).

## 1.2 Risk, market failure and contract farming

In developing countries, farmers face a number of constraints that limit their participation in higher-value markets, as well as their productivity. They face market risk, which stems from the uncertainty about future sales and market prices (Adams et al., 2019). The imperfect and asymmetric information between seller and buyer about product quality, variety, and timing contributes to this uncertainty for both parties (Grosh, 1994; Minot and Sawyer, 2016). This risk and uncertainty limits the farmers' risk taking and investment behavior.

Imperfect and failing factor markets pose additional constraints to the farmers. Capital markets in rural areas develop slowly and formal institutions limit and ration credit due to high information costs and unavailability of collateral. The capacity of local lenders is limited, as agricultural credit demand is highly seasonal and the risk of default is correlated among all borrowers. If one borrower defaults due to droughts or pests, it is likely that all other agricultural borrowers default (Grosh, 1994). Thus, farmers face financial constraints, due to imperfect credit markets, which limit their financial ability to adopt more profitable crops, technologies, and production inputs. Failing input markets further limit the availability of improved planting materials, inputs, and technologies. Due to these constraints farmers limit their production investments, rather than adopting or intensifying the production of high-value crops for an uncertain market, particularly if the production of the crops is capital-intensive. Thus, smallholder productivities and incomes remain low (Otsuka et al., 2016).

Contract farming is seen as a useful tool for poverty alleviation and rural development, because it has the potential to solve the stated constraints simultaneously (Key and Runsten, 1999). Under contract farming, farmers have a secure market to sell their produce, and firms often pay annual fixed prices, or make payments accord-

ing to a pre-defined price formula. This resolves the uncertainty about future sales and market prices, through a secure and pre-assured market access (Singh, 2002). It further resolves issues of asymmetric information about quality, variety and timing between the seller and the buyer, as product requirements and the timing of sales are usually specified within the contracts.

Contracts that solely specify the terms of the sale, such as price, quantity, quality, and timing, are referred to as marketing contracts. Under marketing contracts, farmers are expected to increase their risk taking behavior, as a response to the reduction in market risk and uncertainty (Otsuka et al., 2016). Thus, marketing contracts are expected to increase investments in new technologies and production inputs, and to incentivize the adoption of more profitable high-value crops. These changes in the farmers' production and investment behavior are expected to lead to higher productivities and incomes (Anbarassan et al., 2016; Bellemare, 2012).

Resource-providing contracts are a second type of contract. They specify the marketing conditions specified in marketing contracts, and additionally state the provision of production resources. The contracting company usually provides technical services and production inputs on credit, most commonly in the form of in-kind credits. Farmers repay the company through shares of the harvested produce and the commitment to sell to the company (Bijman, 2008). Here, the contracted crop can serve as collateral to the company, even in the absence of formal land titles (Grosh, 1994). Agroindustrial companies are better suited than formal banks to act as lenders in the rural context. They have a superior ability to monitor and enforce credits than formal banks, as they can extract the debt directly from the farmers' revenues (Key and Runsten, 1999). As such, resource-providing contracts additionally address and overcome credit and input market failures, through an interlinkage of credit, input and output markets.

## 1.3 Research gaps

### 1.3.1 The effects of marketing contracts and resource-providing contracts in a capital-intensive high-value crop sector

Contract farming has gained in importance over the last decades, stimulating a substantial body of literature on farm production and household welfare effects. Recent review articles revealed mixed results (Bellemare and Bloem, 2018; Ton et al., 2018), potentially due to differences in contracted commodities, study settings, and contracting companies. Differences in types of contracts may also play a role (Grosh, 1994; Narayanan, 2014; Ochieng et al., 2017).

One major difference in contract types exists between marketing contracts and resource-providing contracts, which address different constraints. Marketing con-

tracts address the farmers' risk taking and investment behavior, by reducing market risk and uncertainty. Resource-providing contracts additionally address problems of imperfect and failing factor markets, through the provision of technical services and production inputs in the form of (in-kind) credits. These constraints associated with failing factor markets usually remain for farmers under marketing contracts. Thus, both types of contracts can have different effects, especially in situations where technological upgrading requires larger investments and where access to credit and input markets is limited. However, comparisons of effects across contract types are scarce. Most existing studies investigate the effects of one type of contract in one particular setting. This approach cannot account for such differences in contract types (Grosh, 1994).

We are aware of three studies that investigate the effects of different types of contracts. These studies are focused on rice in Benin (Arouna et al., 2019), horticulture production in Kenya (Ashraf et al., 2009) and patty seed in Nepal (Mishra et al., 2016). All these studies only find minor differences between the contracts' effects, potentially due to the relatively low investments required in the production of the investigated crops. To the best of our knowledge there is no evidence on the effects of marketing contracts and resource-providing contracts in a capital-intensive high-value crop sector. Such a sector is potentially more suited to investigate these differences. Particularly high-value plantation crops have high set-up and input investment requirements, and without financial assistance, small-scale farmers might not be able to set-up and maintain their plantations (Key and Runsten, 1999). These financial constraints are more severe if the gestation period of the crop is long and exceeds that of traditional crops (Grosh, 1994). Indeed, the available literature suggests the effects of marketing contract are more diverse, and generally smaller in magnitude than the effects of resource-providing contracts. Positive effects of marketing contracts are commonly found for crops with low investment requirements (Andersson et al., 2015; Ashraf et al., 2009; Michelson, 2013; Rao et al., 2012), yet not for capital-intensive plantation crops. However, differences in effects have never been analyzed in such a sector, and thus require investigation. In particular, it should be analyzed whether the marketing contract sufficiently incentivizes farmers to undertake the required investments, or whether a resource-providing contract is more suited in such a setting. Identifying these effects is a crucial step towards suitable contract designs that can lead to higher productivities and incomes for smallholder farmers.

### 1.3.2 The effects of contract farming on agricultural labor use, household labor allocation, and hired labor demand

While various studies have analyzed the effects of contract farming on farm production and income, the effects of contract farming on agricultural labor use have

received much less attention. Contract farming is commonly expected to increase agricultural labor use and to lead to an employment creation, due to the intensification of production and the high labor requirements of the crops commonly adopted and produced under contract (Baumann, 2000; Bellemare, 2018; Khan et al., 2019; Narayanan, 2014; Otsuka et al., 2016). This expectation is consistent with the empirical findings of a few available studies. The empirical evidence of these effects is scarce, and solely considers contracts that entail additonal production steps for the farmers, such as additional weeding, harvesting, packaging or other types of post-harvest handling (Benali et al., 2018; Neven et al., 2009; Rao and Qaim, 2013). However, these results cannot be generalized. Contract farming may in fact lead to a reduction in agricultural labor use, when contracting involves labor-saving procedures and technologies. To the best of our knowledge, the labor effects of such a contract have never been analyzed.

Labor-reducing effects through contract farming may lead to a reduction in household labor and/or hired labor. If the use of household labor in the agricultural production is reduced, labor might be reallocated towards other on- or off- farm activities. Moreover, the reduction in labor use may affect male, female, child, and youth labor differently. These implications require thorough investigation. Employment is an important issue for sustainable rural development, especially in Africa where rural population growth is still quite large. Yet, to the best of our knowledge, such a comprehensive analysis does not exist.

### 1.3.3 Spillover effects of contract farming on other income sources

Whether contract farming improves household welfare for smallholders in developing countries is the central question in the existing literature on contract farming. Most studies answer this question by investigating the effects of contract farming on the revenues and profits of the contracted crops, or on agricultural incomes (Bolwig et al., 2009; Champika and Abeywickrama, 2014; Escobal and Cavero, 2012; Girma and Gardebroek, 2015; Hernández et al., 2007; Islam et al., 2019). Only a few studies also investigate the effects on household incomes (Andersson et al., 2015; Bellemare, 2012; Cahyadi and Waibel, 2013; Maertens and Swinnen, 2009). Yet existing analyses fail to investigate the mechanisms and spillover effects through which contract farming leads to changes in household welfare (Bellemare, 2018; Otsuka et al., 2016). Participation in contract farming is associated with changes in agricultural labor requirements and land use. Both can affect the incomes derived from other on- and off-farm activities, which affect household welfare. However, the effects of contract farming on other income sources have received little attention so far. Bellemare (2018) provides first evidence on these effects for contract farming in Madagascar. He finds that the increase in income from the contracted crops comes with high opportunity costs. Households turn away from nonfarm activities, due to

higher labor inputs in the production of the contracted crop. Little is known about these effects beyond the results of his study, which cannot be generalized because the effect is driven by higher labor requirements under contract farming. Thus, more empirical evidence is needed to understand the mechanisms through which contract farming changes household income.

### 1.3.4 Farmer satisfaction with contract farming

The economic literature provides empirical evidence that is largely in favor of contract farming. Farmers typically benefit through higher productivities, revenues, profits, and incomes (Champika and Abeywickrama, 2014; Islam et al., 2019; Jones and Gibbon, 2011; Khan et al., 2019; Wang et al., 2014a). In spite of this evidence, high dropout rates from contract farming can be observed in several cases (Euler et al., 2016; Minot and Ngigi, 2004; Minot and Sawyer, 2016; Narayanan, 2013; Narayanan, 2014; Ton et al., 2018), *inter alia* because farmers are dissatisfied and do not want to continue to produce under contract (Andersson et al., 2015; Gatto et al., 2017; Ochieng et al., 2017). This paradox stirs up the debate on the development potential of contract farming. To better understand this seeming contradiction, additional research on potentials and constraints beyond narrowly defined economic indicators is needed. In particular, farmers' satisfaction with contract farming is neither sufficiently understood, nor has it received much attention in the existing literature. Following classic economic theory, it is generally assumed that farmers continue to produce under contract, as long as they benefit economically. This assumption is not consistent with the observed dropout rates from contract farming schemes. In order to reduce dropouts and facilitate lasting partnerships between smallholder farmers and agribusiness companies, a deeper look into farmers' perceptions and levels of satisfaction is necessary.

## 1.4 Research objectives and outline

The main objective of this dissertation is to analyze and compare the effects of marketing contracts and resource-providing contracts in a capital-intensive high-value crop sector. To do so, this thesis builds on data from smallholders in the Ghanaian oil palm sector, collected in 2018. Oil palm is one example of a capital-intensive high-value crop that has recently gained in importance among smallholders in different parts of the world. In West Africa, oil palm is native and was traditionally grown by small-scale farmers for home consumption or sales in local markets. During the last 20 years, worldwide vegetable oil consumption substantially increased, both for direct consumption and for processing in the food, fuel, and cosmetics industries. This increase in vegetable oil demand also took place in West Africa and

led to an increase of the local oil palm production to a commercial scale (Byerlee et al., 2017).

In Ghana, oil palm is currently one of the most important cash crops produced. Large national and international processing companies were established to process oil palm fruits into palm oil. Companies typically cultivate own plantations (nucleus estates) and additionally procure supply from small-scale farmers through different types of contractual agreements (Huddleston and Tonts, 2007; Ministry of Food and Agriculture, 2011). Yet, Ghana remains a net importer of palm oil. While agroecological factors are favorable (Rhebergen et al., 2016), limited adoption of modern technologies and low productivity remain important challenges for the sector. In comparison to other local crops, oil palm is more capital-intensive, for both plantation establishment and maintenance. Small-scale farmers face financial constraints and might not be able to set-up and maintain their plantations without financial assistance (Key and Runsten, 1999). Thus, this sector is well suited for the comparison of the effects of marketing contracts and resource-providing contracts. It will be tested, whether the marketing contract is sufficient to lead to increased productivities and incomes for producers, or whether a more direct support through the in-kind credit provision in resource-providing contracts is required. Investigating and comparing these effects is a crucial step towards designing suitable contracts that lead to higher productivity and household welfare for smallholder farmers.

The data cover the Central, Western, and Ashanti Regions in the southern parts of Ghana, where we identified five large palm oil processing companies. Out of these five companies, we selected two based on the differences in their contract characteristics and their geographical proximity to each other – both key criteria for meaningful evaluation and comparison of contract effects. The data include 463 households, out of which 193 produce with marketing contracts, 164 with resource-providing contracts, and 106 without any contract. With these data, we analyze and compare the effects of both types of contracts on (1) farm production, (2) agricultural labor use and employment, and (3) household income.

The first paper (chapter 2) presents an analysis of the effects of marketing contracts and resource-providing contracts on farmers' input use, yields, and longer-term cropping decisions. The objective is to examine whether any of the two contracts sufficiently incentivizes and enables farmers to increase production investments, and whether differences between the two contract types with regard to this potential exist. Beyond looking at average effects, we also distinguish between small-, medium-, and large-scale farmers to better understand distributional implications.

In the second paper (chapter 3), we analyze the effects of both contracts on agricultural labor use, household labor allocation, and employment. The first objective of this paper is to present empirical evidence on contracts that lead to the adoption of labor saving technologies and procedures. In the Ghanaian oil palm

sector, the production conditions between traditional supply chains without contracts and modern supply chains with contracts differ remarkably. Farmers without a contract do some of the post-harvest handling themselves and harvest in small amounts, due to the perishability of the produce and the lack of a secure sales market. Farmers with a contract sell the oil palm fruit bunches to the buying company immediately after harvest, and in bulk. Some of the contracted farmers also use labor-saving chemical inputs such as herbicides.

After having quantified the potential reduction in agricultural labor use for each contract separately, we investigate the resulting implications, as a secondary objective. To understand these implications, we quantify the effects of household and hired labor use separately, and investigate whether changes in household labor lead to a reallocation towards or away from off-farm employment. Moreover, male, female, child, and youth labor may be affected differently, thus we differentiate between male, female, and child labor. This differentiation is useful to better understand broader social implications. To the best of our knowledge, such a comprehensive analysis has not been performed before.

In the third paper (chapter 4), we analyze the effects of the two types of contracts on household income, both in terms of total income and by income source. The objective of this paper is to quantify the effects of both contracts on household income and to identify the mechanisms through which potential effects occur. We test how each type of contract affects oil palm profits, profits from other cash crops and livestock, income from off-farm wage employment and self-employment, and total household income. As such, we contribute to the existing literature through the contract comparison, and the investigation of the potential effect pathways.

In the fourth paper (chapter 5), we present the resource-providing contract as a case study to shed light on potential determinants of farmer satisfaction and dropout behavior. Despite of economic benefits, most farmers in our sample regret their decision to participate in the contract farming scheme and would prefer to exit if they could. Therefore, the objective of this paper is to demonstrate that economic effects insufficiently explain farmer satisfaction and dropout behavior, and that future analyses need to look beyond narrowly defined economic indicators. We further aim at highlighting the importance of contract understanding and transparency, and suggest directions for future research.

Overall, this dissertation includes the investigation of the effect heterogeneity of marketing contracts and resource-providing contracts on agricultural production patterns, yields, agricultural labor use, and hired labor demand, as well as household income. As such, it provides a comprehensive overview of the effects of both contracts and their effect pathways. To the best of our knowledge, such a study has not been performed before. In Chapter 6, the key findings of the dissertation are presented, and policy implications and limitations are discussed.

# Chapter 2

# Effects of marketing contracts and resource-providing contracts in the African small farm sector: Insights from oil palm production in Ghana


**Abstract**

Smallholder farmers in developing countries often suffer from high risk and limited market access. Contract farming may improve the situation under certain conditions. Several studies analyzed effects of contracts on smallholder productivity and income with mixed results. Most existing studies focused on one particular contract scheme. Contract characteristics rarely differ within one scheme, so little is known about how different contract characteristics may influence the benefits for smallholders. Here, we address this research gap using data from oil palm farmers in Ghana who participate in different contract schemes. Some of the farmers have simple marketing contracts, while others have resource-providing contracts where the buyer also offers inputs and technical services on credit. A comparison group cultivates oil palm without any contract. Regression models that control for selection bias show that resource-providing contracts increase farmers' input use and yield. Resource-providing contracts also incentivize higher levels of specialization and an increase in the scale of production. These effects are especially pronounced for small and medium-sized farms. In contrast, the marketing contracts have no significant effects on input use, productivity, and scale of production. The results suggest that resource-providing contracts alleviate market access constraints, while the marketing contracts do not.



**Keywords:** Contract farming, contract characteristics, agricultural production, specialization, production investments, oil palm, Ghana.

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This chapter is co-authored by Matin Qaim (MQ). The contributions of each author are as follows: AR developed the research idea, collected, analyzed, and interpreted the data. AR wrote the paper. MQ commented at all stages of the research and contributed to writing and revising the paper. All authors read and approved the final manuscript.

## 2.1 Introduction

Participation of smallholder farmers in modern supply chains is an important element of rural economic development and poverty reduction. However, market access for smallholders is often limited due to weak infrastructure, high risk, and other types of market failures (Barrett et al., 2012; Miyata et al., 2009). Market failures lead to under-investment in farm inputs, technologies, and profitable high-value crops (Otsuka et al., 2016; Wang et al., 2014b). Small farms are often more affected by market failures than large farms, which can perpetuate and further aggravate existing inequalities (Minot and Sawyer, 2016; Ton et al., 2018). Contract farming is an institutional response to market failures, which can help reduce production and marketing risk and thus increase smallholder investment, productivity, and income (Eaton and Shepherd, 2001; Key and Runsten, 1999; Simmons et al., 2005; Wang et al., 2014b).

Various studies analyzed effects of contracts on farm production and household welfare (Key and Runsten, 1999; Mishra et al., 2018; Rao et al., 2012; Simmons et al., 2005; Tripathi et al., 2005). Recent review articles revealed that the results are mixed, which may be due to differences in terms of the commodities produced or the broader socioeconomic and institutional conditions (Bellemare and Bloem, 2018; Ton et al., 2018). Differences in contract characteristics may also play a role (Ochieng et al., 2017). One major difference in contract characteristics exists between simple marketing contracts that only offer a secure sales market, and resource-providing contracts that additionally provide credit, inputs, and other technical services. Marketing contracts and resource-providing contracts can have differential effects on farmers' market access, risk, investment, and production behavior, but a comparison of effects has rarely been performed. Most existing studies only observed one type of contract in one setting. Comparison across such case studies from different settings is difficult because of many possible confounding factors that one cannot easily control for.

A few studies examined contracts involving several commodities (Miyata et al., 2009; Narayanan, 2014; Simmons et al., 2005) or several companies (Ragasa et al., 2018), yet mostly without explicitly analyzing the effects of varying contract characteristics. Two exceptions are Mishra et al. (2016) and Ashraf et al. (2009). Mishra et al. (2016) investigated effects of contracts on smallholder seed producers in Nepal, suggesting that resource-providing contracts may have larger effects than simple marketing contracts. However, in their study the number of farmers operating under the different contract types was relatively small. Ashraf et al. (2009) used a randomized controlled trial (RCT) to compare effects of contracts with and without credit in the Kenyan horticultural sector. They found that the provision of credit as part of the contract increased farmers' participation rates but had no additional effect on income. Effects on farmers' cropping patterns and longer-term investment

decisions were not analyzed, because the evaluation was conducted shortly after the RCT treatments.

We add to the research direction by evaluating and comparing the effects of marketing contracts and resource-providing contracts on farmers' input use, productivity, and longer-term cropping decisions in the palm oil sector of Ghana. In Ghana, as in several other countries of West Africa, oil palm recently gained in importance and is now one of the most important cash crops produced (Rhebergen et al., 2016). However, limited adoption of modern technologies and low productivity remain important challenges for the sector. Productivity increases are required to meet the rapidly rising demand for vegetable oil in West Africa. In comparison to other local crops, oil palm is relatively capital-intensive, especially for plantation establishment but also to pay for regular inputs. To overcome market limitations, increase production, and ensure stable supply, palm oil processing companies in Ghana have established various types of contractual arrangements with farmers.

We use survey data collected in Ghana in 2018 and different approaches to reduce issues of selection bias. The main research question is whether producing oil palm under a contract has effects on farmers' cropping patterns, investments, and yields and whether the effects of resource-providing contracts differ from those of simple marketing contracts. We analyze average effects and additionally also disaggregate by farm size to better understand distributional implications.

## 2.2 Conceptual framework

Contract farming involves a contractual arrangement between a buyer – typically a processing company – and the farmer as a seller. Contracts specify prices and quantities of the commodity produced prior to the harvest, and possibly other details related to the production process. Contracts can be beneficial for both the farmer and the company, as they reduce marketing and procurement risks (Eaton and Shepherd, 2001; Key and Runsten, 1999; Otsuka et al., 2016). However, different types of contracts can have different effects.

One major difference in terms of contract characteristics exists between simple marketing contracts and resource-providing contracts. Farmers with a simple marketing contract have a secure sales market with a specified price. High risk in the small farm sector is a major impediment for technology adoption and more intensified production. Hence, a contract that reduces marketing risk may increase technology adoption, input use, and thus also yield and income (Anbarassan et al., 2016; Bellemare, 2012). Several empirical studies confirmed positive effects of marketing contracts on farm productivity and income (Andersson et al., 2015; Henningsen et al., 2015; Michelson, 2013; Rao et al., 2012). However, there are also other stud-

ies that found no significant effects of marketing contracts, suggesting that a secure sales market alone may be insufficient to overcome failures in credit and input markets (Hernández et al., 2007; Mwambi et al., 2016). Such failures in credit and input markets are explicitly addressed in resource-providing contracts, where the buying company also supplies inputs and technical advice to farmers, usually deducting the cost of these services from farmers' sales. Indeed, many empirical studies found that resource-providing contracts increase farmers' input use, yield, and specialization on the contracted crop (Bolwig et al., 2009; Champika and Abeywickrama, 2014; Maertens and Velde, 2017; Miyata et al., 2009; Ragasa et al., 2018; Warning and Key, 2002). However, depending on the situation, resource-providing contracts can also be associated with problems of side-selling (Otsuka et al., 2016).

Marketing contracts and resource-providing contracts can have different effects, especially in situations where technological upgrading requires larger investments and where access to credit and input markets is limited. Indeed, the available literature suggests that the effects of marketing contracts are more diverse and smaller in magnitude than the effects of resource-providing contracts (Otsuka et al., 2016). And studies that found positive effects of marketing contracts were often related to the vegetable sector (Andersson et al., 2015; Ashraf et al., 2009; Michelson, 2013; Rao et al., 2012), where investment requirements are low or moderate. In plantation crops – such as tea, cocoa, or oil palm – where the initial establishment costs are higher, simple marketing contracts may have smaller effects than resource-providing contracts, although a comparison under otherwise similar conditions has not been made before.

For oil palm in Ghana, we hypothesize that marketing contracts have smaller effects on input use and yield than resource-providing contracts, as oil palm is a capital-intensive crop and credit and input market failures are commonplace outside of contractual arrangements. We also hypothesize that resource-providing contracts may incentivize farmers to specialize more on oil palm at the expense of other cash crops for which no contracts are available. In the study region in Ghana, land is often not the most limiting factor. Farmers typically have more land available than what they can cultivate given their capital and labor constraints. Hence, some of the farmers' land remains uncultivated. Against this background, resource-providing contracts, which help to ease farmers' capital constraints, may lead to more land being cultivated and a larger scale of production. The same effects are not expected for simple marketing contracts.

These hypotheses are tested empirically below. In addition to looking at average effects of marketing and resource-providing contracts, we will also carry out the analysis for different subsamples, distinguishing between small-, medium-, and large-scale farmers. Small farms usually suffer most from market access constraints, so we hypothesize that they may also benefit more from resource-providing contracts

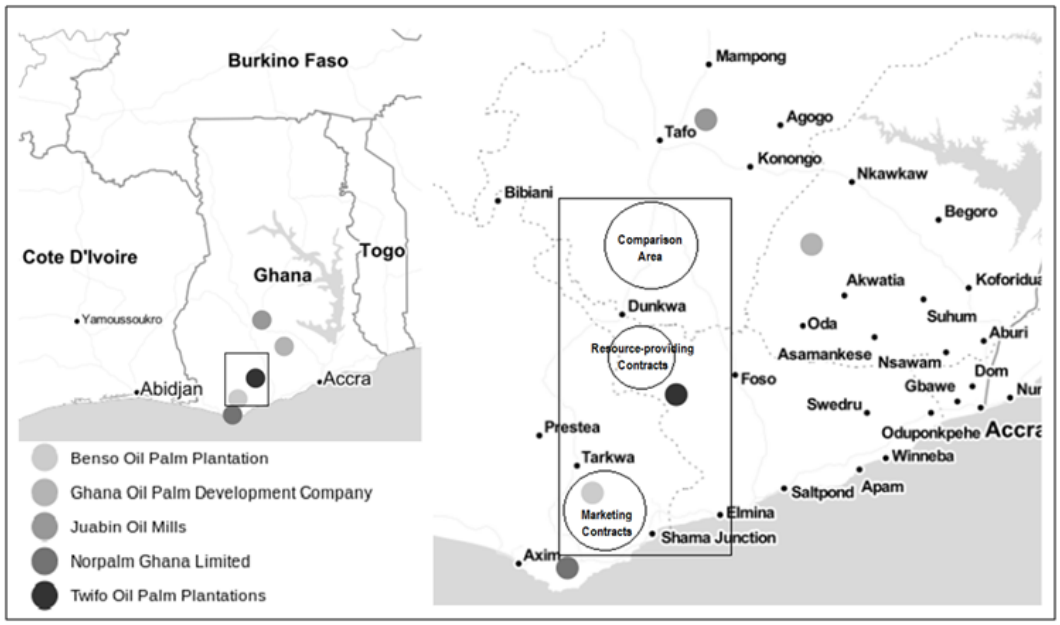
than large farms.

## 2.3 Survey and sampling design

### 2.3.1 Survey area and contract types

This study uses cross-sectional data from a survey of oil palm farmers conducted in Ghana in 2018. The survey covers the Central, Western, and Ashanti Regions in the southern parts of Ghana. Oil palm is native to West Africa and has been grown by local farmers on a small scale since long. Traditionally, farmers have milled the oil palm fruits at home, in order to use the oil for home consumption or for sales in local markets (Byerlee et al., 2017). However, the demand for vegetable oil has increased considerably during the last 20 years, both for direct consumption and for processing in the food and cosmetics industries, so that larger processing plants were gradually established. We identified five large palm oil processing companies in the study area in southern Ghana, namely Benso Oil Palm Plantation, Ghana Oil Palm Development Company, Juabin Oil Mills, Norpalm Ghana Limited, and Twifo Oil Palm Plantation (Figure 2.1). Out of these four companies, we selected two based on differences in their contract characteristics and geographical proximity – both key criteria for meaningful evaluation and comparison of contract effects.

Figure 2.1: Map of study area in Ghana




Source: Authors' own presentation using tools provided in Kahle and Wickham (2013).

Table 2.1 provides an overview of the two selected companies and their contract characteristics. Benso Oil Palm Plantation (BOPP) is a subsidiary of Wilmar International Limited, whereas Twifo Oil Palm Plantation (TOPP) is owned by Unilever. Both companies operate a centrally managed, nucleus estate oil palm plantation. However, as the processing capacities are larger than what the nucleus estate plantations produce, both companies also contract smallholder oil palm producers[1]. BOPP is using simple marketing contracts, whereas TOPP is using resource-providing contracts. Both companies have been active in the region with the same types of contracts for more than 10 years. Hence, we are able to analyze possible short-term and longer-term effects on farmers' investment decisions and outcomes. The companies buy fresh oil palm fruit bunches from farmers without any quality differentiation.

Table 2.1: Company and contract characteristics

| | Marketing contract (Western Region) | Resource-providing contract (Central Region) |
|---|---|---|
| Company name | Benso Oil Palm Plantation (BOPP) | Twifo Oil Palm Plantation (TOPP) |
| Company owner | Wilmar International Limited | Unilever |
| Location | Western Region | Central Region |
| Size of nucleus estate | 4700 hectares | 4300 hectares |
| Processing capacity | 20 tons per hour | 30 tons per hour |
| Contract | Verbal | Written |
| Resources provided on credit | None | Plot setup, agrochemicals, tools, labor |
| Average price per ton | 335 Ghanaian Cedis (GHS) | 310 Ghanaian Cedis (GHS) |

The BOPP marketing contracts are agreements between the company and farmers in which only the price is fixed. Farmers harvest and sell from their own-established oil palm plots without receiving inputs or production-related services from the company. Even though the contracts are verbal in nature, farmers clearly perceive BOPP as a secure market, as they can always sell the quantities harvested to the company at the specified price. The company depends on farmers' regular sales to be able to operate at full processing capacity.

The TOPP resource-providing contracts are long-term written agreements between the company and farmers. These contracts involve the establishment of new oil palm plots on the farmers' land. Farmers dedicate a particular piece of their land to the contract and are assisted by the company in the setup of the oil palm plantation. Farmers can also obtain labor services, tools, and regular inputs – such as fertilizer and pesticides – from the company on credit, if they wish. However, after the plot is established farmers make their own decisions about input use and

[1]Such combinations of nucleus estate and smallholder contract schemes are also observed in Southeast Asia's palm oil sector (Gatto et al., 2017).

intensities. The credits obtained from the company are repaid through a fraction of the harvest. Farmers are obligated to sell all the fruit bunches harvested on the contracted plot to TOPP. Side-selling is sanctioned, but seems to be a rare phenomenon in this context because different processing companies do not procure in the same villages.

### 2.3.2 Sampling design

The two companies with different types of contracts operate in different but neighboring regions of Ghana, namely the Western and Central Regions (Table 2.1). To keep transaction costs low, both companies cluster their procurement in certain villages. Within these villages, the companies accept all farmers willing to supply oil palm bunches on a regular basis into the contract scheme; that is, the companies do not use specific selection criteria. Farmers in these villages can choose between participating or not participating in the contract offered, but – as only one type of contract is offered in each village and region – they have no choice between the different contract types. We randomly selected contracted farmers in the procurement villages in both regions, as explained in more detail below.

In addition to the contracted farmers, we need a group of comparison farmers producing oil palm without any contract. While there are farmers in the same procurement villages in the Western and Central Regions that produce oil palm without a contract, many of them only have a few oil palms that they primarily grow and harvest for home consumption. Even if these non-contracted farmers are more commercially oriented, they made a deliberate decision not to participate in a contract scheme, which could easily lead to non-random selection problems in our impact evaluation. Similarly, sampling comparison farmers from other villages in the same regions could also lead to selection problems, because the companies did not select their procurement villages on a random basis. Against this background, we decided to sample the group of comparison farmers from a third region, namely the Ashanti Region, where farmers produce oil palm commercially, but where no contract scheme was yet operating at the time of the survey. Commercial oil palm farmers in the Ashanti Region sell their harvest on the spot market. Often, they also process the fruits manually in order to sell the palm oil on the spot market. While the fresh fruits are perishable, the processed palm oil has a longer shelf-life, which is an advantage when the output market is insecure.

We chose the Ashanti Region (Figure 2.1) because it is very similar to the Central and Western Regions in terms of agroecological conditions. All three regions are located within the green belt that is particularly suitable for the cultivation of oil palm (Rhebergen et al., 2016). Table 2.2 shows that there are no systematic differences in temperature and rainfall between the three regions. While oil palm

contracts did not exist in the Ashanti region in 2018, we knew from the local Ministry of Food and Agriculture (MoFA) that a company was planning to build a new oil palm processing facility and procure from a number of villages in this region through marketing contracts. Farmers were not aware of these plans when we carried out the survey. But the information about the upcoming contract scheme helped us to select comparison villages and farmers that are similar to those in the two contract groups.

Table 2.2: Regional characteristics

| | Marketing contract (Western Region) | Resource-providing contract (Central Region) | Comparison (Ashanti Region) |
|---|---|---|---|
| Climate classification | Tropical savanna | Tropical savanna | Tropical savanna |
| Highest temperature | 28.9°C | 28.7°C | 28.6°C |
| Lowest temperature | 25.1°C | 25.3°C | 25.2°C |
| Mean temperature | 27.2°C | 27.2°C | 27.0°C |
| Average annual rainfall | 1268mm | 1249mm | 1246mm |

Note: Temperature and rainfall data are derived from the World Bank Climate Change Knowledge Portal and refer to monthly averages between 1991 and 2015. Temperature data refer to monthly averages.

To select farmers for the survey, we used a two-stage sampling procedure. The first stage was the random selection of procurement or future procurement villages using village lists that we obtained from the two companies in the Central and Western Regions and from MoFA in the Ashanti Region. We cross-checked the completeness of these village lists together with local agricultural extension officers on the ground. We randomly selected nine villages each in the Central and Ashanti Regions. In the Western Region, we randomly sampled 13 villages, because the average number of farmers per village participating in the resource-providing contract was lower than in the marketing contract. In the second sampling stage, we randomly selected commercial oil palm farmers in each of the 31 selected villages. In the Central and Western Regions, we randomly selected 75% of all contracted farmers. In the Ashanti Region, commercial oil palm farmers were selected randomly based on lists that we prepared together with the village chief.

The total sample includes 463 households. A breakdown by contract scheme and farm size is shown in Table 2.3. These households were interviewed, using a carefully prepared and pre-tested questionnaire programmed into tablet computers[2]. The interviews captured structured data at the household level (general socioeconomic variables), the oil palm plot level (inputs, outputs, plot characteristics), and the farmer level (age, education etc.). Some of the farms have more than one oil palm plot. We captured data for all oil palm plots owned and managed by the farmer, so that the number of plot observations is somewhat higher than the number of household observations (Table 2.3)[3]. In addition to the household interviews,

[2]The paper version of the household questionnaire is attached in Appendix B.1.

[3]For farmers in the resource-providing contract, only oil palm plots registered under this scheme were included in the analyses.

we had prepared a village-level questionnaire that was administered with the village chief to capture additional information on village infrastructure, population, and other relevant village-level variables[4].

Table 2.3: Number of observations by contract type and farm size

| | Total | Marketing contract (Western Region) | Resource-providing contract (Central Region) | Comparison (Ashanti Region) |
|---|---|---|---|---|
| | | | *Household observations* | |
| Total sample | 463 | 193 | 164 | 106 |
| Small-scale (<10 acres) | 182 | 86 | 51 | 45 |
| Medium-scale (10–20 acres) | 177 | 76 | 60 | 41 |
| Larger-scale (>20 acres) | 104 | 31 | 53 | 20 |
| | | | *Plot observations* | |
| Total sample | 551 | 225 | 205 | 121 |
| Small-scale (<10 acres) | 191 | 93 | 53 | 45 |
| Medium-scale (10–20 acres) | 211 | 88 | 78 | 45 |
| Larger-scale (>20 acres) | 149 | 44 | 74 | 31 |

Note: Farm size refers to the land available to farmers, which may be larger than the land actually cultivated.

## 2.4 Statistical approaches

### 2.4.1 Outcome variables

We want to analyze and compare the effects of marketing contracts and resource-providing contracts on farmers' short-term and longer-term production decisions. Short term production decisions are especially decisions related to input use, which is best captured at the plot level. The two most important external inputs in oil palm production are chemical fertilizer and herbicides. Nevertheless, many farmers in Ghana do not use these inputs on a regular basis. Therefore, rather than looking at input quantities, we measure whether or not farmers used any chemical fertilizer and herbicides on their oil palm plot during the 12 months prior to the survey with two separate dummy variables. In addition to the inputs used, we are interested in the effects of the contracts on crop productivity, which we measure in terms of oil palm yields per acre (fresh fruit bunches harvested during the 12 months prior to the survey).

Longer-term production decisions are related to the scale of production and the degree of specialization. Effects on such longer-term outcomes can be evaluated with our data, because the farmers in our sample had entered the contract schemes already more than 10 years ago. As mentioned, farmers in the study regions often have more land available than they actually cultivate, the difference mostly occur-

[4]The paper version of the village questionnaire is attached in Appendix B.2.

ring due to capital and labor constraints. The oil palm contracts may reduce the capital and labor constraints, so the scale of production may possibly increase. We measure the scale of production as the land area that a farmer cultivates with commercial crops (those not primarily grown for home consumption) relative to the total land available to the household. Hence this variable ranges between zero and one. Crops cultivated primarily for home consumption are excluded from this calculation, because these are usually less affected by capital constraints, meaning that effects of oil palm contracts can hardly be expected.

Oil palm contracts reduce risk and could therefore also increase the farmers' level of specialization. We measure specialization as the proportion of the commercial crop area that a household cultivates with oil palm. This variable ranges between zero and one. As a second indicator, we count the number of cash crops other than oil palm that the household produces. This indicator of cash crop diversity can take non-negative integer numbers and is negatively related to specialization on oil palm. Hence, we would expect a positive effect of contracts on specialization and a negative effect on cash crop diversity.

### 2.4.2 Regression models

The effects of marketing contracts and resource-providing contracts on input use and yields in oil palm production are estimated at the plot level with models of the following type:

$$Y_{ihj} = \beta_0 + \beta_1 MC_i + \beta_2 RPC_i + \beta_3 C_i + \beta_4 C_h + \beta_5 C_j + \epsilon_{ihj} \tag{2.1}$$

where $Y_{ihj}$ is the outcome variable of interest on plot $i$ of household $h$ in village $j$. We estimate separate regressions for chemical fertilizer use, herbicide use, and yield. $MC$ and $RPC$ are dummy variables for the marketing contract and the resource-providing contract. These are our main variables of interest. Positive coefficients for $\beta_1$ and $\beta_2$ would indicate that the contracts increase input use and yield. Our hypothesis that resource-providing contracts have larger effects than simple marketing contracts would imply $\beta_2 > \beta_1$.

$C_i$, $C_h$, and $C_j$ in equation (2.1) are plot-level, household-level, and village-level control variables, and $\epsilon_{ihj}$ is a random error term clustered at the village level. At the plot level, we control for factors such as soil quality, plantation age, and irrigation, which may have independent effects on the outcome variables. At the household level, we control for socioeconomic characteristics of the farmer responsible for cultivating the plot, including gender, education, and experience in oil palm farming. We also use a dummy for whether or not the household is also involved in cocoa production. Cocoa is generally produced with higher input-intensities than oil palm in Ghana, which may possibly lead to spillover effects across crops within

the same household. At the village level, we control for distance to input suppliers.

The effects of the contracts on the scale of production, specialization, and cash crop diversity are estimated at the household level with models of the following type:

$$S_{hj} = \gamma_0 + \gamma_1 MC_h + \gamma_2 RPC_h + \gamma_3 X_h + \gamma_4 X_j + u_{hj} \tag{2.2}$$

where $S_{hj}$ is the outcome variable of interest for household $h$ in village $j$. $X_h$ and $X_j$ are household-level and village-level controls, which are similar to those in equation (2.1) with only a few differences. For instance, we use socioeconomic characteristics of the household head, which may be the farmer cultivating oil palm plot $i$ or also a different person. We also control for total land availability of the household. As current land availability may potentially be influenced by the contracts, we use land availability in 2008, when most of the contracted farmers were just entering a contract scheme. This historical land availability was obtained through recall questions during the survey.

At the village level, in addition to market access, we also control for local shocks that occurred during the five years prior to the survey, including droughts, floods or unusually heavy rainfall, or heavy pest and disease infestations affecting crop and livestock production. As such shocks are expected to influence farmers' cropping and investment decisions and could also be spatially correlated with participation in the different contract schemes, not controlling for shocks could result in omitted variable bias. Finally, we control for the average land rent in the village, which is an indicator of local land scarcity.

The models in equations (2.1) and (2.2) are estimated for the sample as a whole, with all plot and household observations, as well as separately with observations from the subsamples for the three farm size categories (small-, medium-, and large-scale farmers). We use ordinary least-squares (OLS) estimators for the models with continuous outcome variables and probit estimators for the input use models with binary outcome variables.

### 2.4.3 Dealing with selection bias

The main explanatory variables in our models, namely farmers' participation in marketing and resource-providing contracts, may be endogenous due to non-random self-selection into a contract scheme. Endogeneity would lead to correlation with the error term and biased estimates of the contract effects (Angrist and Pischke, 2008). We use various approaches to reduce issues of endogeneity and selection bias.

First, the sampling strategy, which was already described in section 2.3.2, is integral part of the identification strategy. The farmers with marketing contracts, resource-providing contracts, and without any contracts were sampled from three

different regions. This helps to reduce issues of farmers' self-selection within each region. Moreover, the three regions are very similar in terms of climatic conditions and attractiveness for the palm oil industry to establish contract schemes with smallholders. Differences in terms of soil conditions, land scarcity, market access, and specific shocks, which may occur between and within regions, are controlled for in the model specifications (see equations 2.1 and 2.2 above). We also control for a number of observed farmer and household characteristics.

Second, to address issues of unobserved heterogeneity between farmers with and without contracts we use a variable that measures individual willingness-to-pay (WTP) to participate in a contract scheme as an additional covariate in the regression models. WTP was estimated based on a set of hypothetical contract offers. In the interviews, each respondent was asked: "Would you be willing to enter a contract agreement with a firm that would increase your annual income from oil palm production by setting-up an entire acre of oil palm plantation, but would necessitate an initial investment of Z Ghanaian Cedis (GHS)?" Depending on the answer (yes/no), the investment amount Z was increased or reduced[5]. WTP is the highest amount, for which a "yes" answer was recorded. While the hypothetical contract offers were quite general, we still expect that the WTP estimates are correlated with unobserved characteristics such as the respondents' risk behavior and entrepreneurial attitudes[6]. Hence, including the WTP estimate as an additional covariate controls for relevant unobserved heterogeneity. The same approach was also used by Bellemare and Novak (2017) in a recent study of the effects of contract farming among smallholders in Madagascar.

As a third approach to test and control for endogeneity, we use instrumental variable (IV) estimators. As we have two potentially endogenous variables ($MC$ and $RPC$), we need at least two instruments that are correlated with participation in a contract scheme but uncorrelated with the outcome variables. Participation in the marketing contract scheme is instrumented with a variable that measures the share of commercial oil palm producers relative to the total village population ('village share'). Palm oil companies are more likely to procure from villages with a high share of commercial oil palm producers, in order to keep transport and transaction costs low. Participation in the resource-providing contract scheme is instrumented with a dummy variable that equals one if the village chief cultivates oil palm commercially ('village chief'). The village chief typically acts as a mediator between the company and the oil palm farmers in the village, and the contract scheme can hardly

[5]Question and initial investment amounts are shown in the household questionnaire in Appendix B.1, question 76.

[6]When farmers enter a new contract, they often do not know or fully understand the complete details of the agreement. Hence, our hypothetical contract offers are not so different from the actual offers that farmers may get in a new contract scheme. In the plot-level models (equation 2.1), we use the WTP estimate for the farmer managing the plot. For the household-level models (equation 2.2), we use the WTP estimate for the household head.

start in the village without the chief's approval. Hence, contracts are more likely to be initiated in a village when the village chief is a commercial oil palm farmer himself/herself.

In principle, the two identified instruments might also be correlated with the outcome variables. For instance, the share of commercial oil palm farmers in the village could be positively associated with local soil quality or market access, which could also influence input use, yields, and cropping portfolios. Similarly, the village chief being a commercial oil palm grower might possibly affect farmers' access to information, which could also lead to direct correlation with the outcome variables. We tested for such direct correlation using the subsample of comparison farmers, where no indirect effects through the contract pathway may occur. These tests for both instruments and all outcome variables are shown in Tables A.1.1 and A.1.2 in Appendix A.1. None of the correlation coefficients is statistically significant, which is an indication of instrument exogeneity. Tables A.1.3-A.1.5 in Appendix A.1 show first-stage results of the plot-level and household-level IV models. As expected, the instruments are significantly correlated with participation in the contract schemes, so that all criteria for instrument validity seem to be fulfilled. It should be stressed that proving instrument validity is difficult, especially with cross-sectional data. However, as we use different approaches to deal with endogeneity, cautious causal inference should be in order, especially when the different approaches lead to the same conclusions.

## 2.5 Results

### 2.5.1 Descriptive statistics

Table 2.4 shows selected welfare characteristics of households in the total sample and disaggregated by farm size to provide a better understanding of the socioeconomic situation of oil palm farmers in Ghana. The average household has a landholding of 18 acres, with small-scale farmers having about 6 acres and large-scale farmers around 40 acres. Average annual per capita expenditures are 2800 GHS, which is more than twice the national poverty line of 1314 GHS. Clearly, commercial oil palm farmers do not belong to the poorest of the poor in rural Ghana. Nevertheless, around 13% of the sample farmers live below the poverty line. The share of poor households is much higher among small-scale farmers (16%) than among large-scale farmers (7%).

Table 2.4: Household welfare characteristics for total sample and by farm size category

| | Total sample | Small-scale | Medium-scale | Larger-scale |
|---|---|---|---|---|
| Land availability (in acres) | 18.33 | 6.13 | 14.42 | 39.54 |
| | (18.96) | (2.22) | (2.84) | (25.56) |
| Per capita expenditure (in GHS per year) | 2800 | 2510 | 2841 | 3104 |
| | (2084) | (1496) | (2168) | (2521) |
| Share of farmers below poverty line [a] | 0.13 | 0.16 | 0.14 | 0.07 |
| | (0.33) | (0.37) | (0.35) | (0.26) |

Note: Mean values are shown with standard deviations in parentheses. [a] The national poverty line is 1314 GHS per year, equivalent to $1.83 per capita and day in purchasing power parity terms (Cooke et al., 2016).

Table 2.5 shows descriptive statistics of the outcome and control variables by contract type. For the outcome variables, we find significant differences especially between the households with resource-providing contracts and the other two groups. Differences between the households with simple marketing contracts and those without any contracts are less sizeable and partly statistically insignificant. For the control variables, we find significant differences between contract types for experience in oil palm farming, market access, average land rents, and willingness to participate in contracts. Interestingly, farmers without contracts have a higher WTP than contracted farmers. This is actually plausible, because those farmers holding a contract already benefit from reduced marketing risk. We do not observe differences between the groups in terms of farm size, gender, education, soil quality, and irrigation, supporting our argument that the farms and households with different contract status are similar in terms of many relevant characteristics.

Table 2.5: Descriptive statistics by contract type

| | Mean | | | Difference | | |
|---|---|---|---|---|---|---|
| | Marketing contract (MC) | Resource-providing contract (RPC) | No contract (NC) | MC-RPC | MC-NC | RPC-NC |
| *Outcome variables* | | | | | | |
| Chemical fertilizer application (dummy) | 0.07 | 0.20 | 0.03 | *** | | *** |
| | (0.02) | (0.03) | (0.02) | | | |
| Herbicide application (dummy) | 0.44 | 0.64 | 0.50 | *** | | ** |
| | (0.03) | (0.03) | (0.05) | | | |
| Yield (t/acre) | 3.10 | 6.65 | 3.82 | *** | | *** |
| | (0.15) | (0.40) | (0.70) | | | |
| Scale of production (0-1) | 0.79 | 0.87 | 0.84 | *** | ** | |
| | (0.01) | (0.01) | (0.02) | | | |
| Specialization (0-1) | 0.53 | 0.58 | 0.50 | * | | *** |
| | (0.02) | (0.02) | (0.02) | | | |
| Cash crop diversity (number) | 1.20 | 1.29 | 1.74 | | *** | *** |
| | (0.06) | (0.07) | (0.12) | | | |
| *Control variables* | | | | | | |
| Cocoa cultivation (dummy) | 0.12 | 0.13 | 0.13 | | | |
| | (0.02) | (0.02) | (0.03) | | | |
| Land availability (acres in 2008) | 13.23 | 14.91 | 12.37 | | | |
| | (0.93) | (1.31) | (1.50) | | | |
| Female household head (dummy) | 0.15 | 0.20 | 0.15 | | | |
| | (0.03) | (0.03) | (0.03) | | | |
| Education of household head (years) | 7.65 | 6.86 | 7.03 | | | |
| | (0.32) | (0.37) | (0.38) | | | |
| Experience of household head (years) | 19.56 | 15.65 | 16.74 | *** | *** | |
| | (0.61) | (0.74) | (0.77) | | | |
| Female farmer (dummy) | 0.25 | 0.28 | 0.23 | | | |
| | (0.03) | (0.03) | (0.04) | | | |
| Education of farmer (years) | 7.52 | 7.10 | 7.16 | | | |
| | (0.31) | (0.33) | (0.34) | | | |
| Experience of farmer (years) | 20.23 | 15.32 | 17.20 | *** | *** | * |
| | (0.58) | (0.66) | (0.73) | | | |
| Willingness to pay (in 500 GHS) | 2.06 | 2.13 | 2.73 | | *** | ** |
| | (0.12) | (0.15) | (0.19) | | | |
| Number of palms per acre | 68.85 | 63.96 | 63.10 | | | |
| | (2.99) | (2.22) | (1.22) | | | |
| Age of palms (years) | 12.89 | 9.33 | 14.87 | *** | *** | *** |
| | (0.45) | (0.06) | (0.43) | | | |
| Irrigation (dummy) | 0.32 | 0.33 | 0.25 | | | |
| | (0.03) | (0.03) | (0.04) | | | |
| Good soil (dummy) | 0.66 | 0.73 | 0.73 | | | |
| | (0.03) | (0.03) | (0.04) | | | |
| Market access (km) | 0.85 | 1.12 | 0.12 | | *** | *** |
| | (0.15) | (0.14) | (0.05) | | | |
| Distance to input provider (km) | 0.66 | 4.34 | 1.80 | *** | *** | *** |
| | (0.09) | (0.59) | (0.25) | | | |
| Average land rent (GHS per acre) | 152.54 | 18.33 | 95.57 | *** | *** | *** |
| | (11.07) | (4.46) | (11.75) | | | |
| Shocks (number in last 5 years) | 0.22 | 0.58 | 1.15 | *** | *** | *** |
| | (0.04) | (0.13) | (0.13) | | | |

Note: Mean values are shown with standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

### 2.5.2 Regression results

We compared all models with and without IVs to test the null hypothesis that the contract variables are exogenous. This null hypothesis could not be rejected in any of the models (Tables A.1.6 and A.1.7 in Appendix A.1), which suggests that the estimators without IVs are consistent and that the effects of the contracts estimated with these models do not suffer from selection bias. This is plausible given that the sampling framework used helped to reduce selection issues. Nevertheless, we also report the IV results next to the probit and OLS results. The IV estimates support the same conclusions, only that they are somewhat less efficient than the estimates without IVs.

Table 2.6 summarizes the estimated effects of contracts on the plot-level outcome variables (full model estimates are shown in Tables A.1.8 and A.1.9 in Appendix A.1). The results suggest that the marketing contract has no significant effects on input use and yield. This is quite different for the resource-providing contract where we observe positive and statistically significant effects on fertilizer use and yield. The resource-providing contract increases the probability of chemical fertilizer use by 18 percentage points. It also increases oil palm yield by 2.9 t/acre, which is a gain of 75% when compared to the mean yield of non-contracted farmers. The effect of the resource-providing contract on herbicide use is positive but not statistically significant. These results clearly suggest that the resource-providing contract contributes to more intensified production patterns and higher land productivity. This does not seem to be the case for the marketing contract.

Table 2.6: Summary of contract effects on plot-level outcomes (total sample)

| | Chemical fertilizer use (dummy) | | Herbicide use (dummy) | | Yield (t/acre) | |
|---|---|---|---|---|---|---|
| | Probit | IV probit | Probit | IV probit | OLS | IV |
| Marketing contract | 0.0508 | 0.0202 | -0.0117 | -0.1323 | -0.7664 | 0.0677 |
| | (0.06) | (0.11) | (0.11) | (0.28) | (0.84) | (1.62) |
| Resource-providing contract | 0.1797*** | 0.1462 | 0.1211 | 0.0952 | 2.9182*** | 2.4741 |
| | (0.05) | (0.12) | (0.09) | (0.27) | (0.87) | (1.80) |
| Control variables included | Yes | Yes | Yes | Yes | Yes | Yes |
| WTP included | Yes | No | Yes | No | Yes | No |
| Number of observations | 551 | 551 | 551 | 551 | 551 | 551 |

Note: Average marginal effects are shown with cluster-corrected standard errors in parentheses. WTP, willingness-to-pay. Full model results are shown in Tables A.1.8 and A.1.9 in Appendix A.1. * p<0.1, ** p<0.05, *** p<0.01.

Table 2.7 summarizes the estimated effects of the contracts on the household-level outcomes (full model estimates are shown in Table A.1.10 in Appendix A.1). The marketing contract has no significant effect on the scale of production and on specialization in terms of the area share of oil palm. However, producing under the marketing contract reduces the number of other cash crops produced by 0.5

on average, suggesting that some specialization on oil palm occurs. In comparison, the resource-providing contract has statistically significant effects on all three household-level outcomes. It increases the scale of production by 4 percentage points and the share of the commercial area planted with oil palm by almost 10 percentage points. Producing under a resource-providing contract also reduces the number of other cash crops produced by 0.5 on average.

Table 2.7: Summary of contract effects on household-level outcomes (total sample)

| | Scale of production (0-1) | | Specialization (0-1) | | Cash crop diversity (number) | |
|---|---|---|---|---|---|---|
| | OLS | IV | OLS | IV | OLS | IV |
| Marketing contract | -0.0196 | -0.0354 | -0.0123 | -0.0260 | -0.5093*** | -0.6662** |
| | (0.02) | (0.05) | (0.03) | (0.10) | (0.12) | (0.26) |
| Resource-providing contract | 0.0417** | -0.0057 | 0.0961*** | 0.0157** | -0.5229*** | -0.7189** |
| | (0.02) | (0.05) | (0.02) | (0.08) | (0.13) | (0.30) |
| Control variables included | Yes | Yes | Yes | Yes | Yes | Yes |
| WTP included | Yes | No | Yes | No | Yes | No |
| Number of observations | 463 | 463 | 463 | 463 | 463 | 463 |

Note: Marginal effects are shown with cluster-corrected standard errors in parentheses. WTP, willingness-to-pay. Full model results are shown in Table A.1.10 in Appendix A.1. * p<0.1, ** p<0.05, *** p<0.01.

These estimation results confirm that contracts can increase the intensity and productivity of production and also lead to higher investments and specialization on the contracted crop. However, as hypothesized, the effects can vary with the type of contract offered and are larger for the resource-providing contract than for the simple marketing contract. In fact, we did not observe any effects of the simple marketing contract on most of the outcome variables considered. It seems that the reduced marketing risk alone is insufficient to overcome problems of access to credit and input markets. In addition to the regular inputs (fertilizer and herbicides) analyzed here, farmers under the resource-providing contract also have much better access to high-quality planting material for oil palms, which is costly but important for vigorous plant growth and higher yields throughout the plantation cycle.

### 2.5.3 Effects by farm size category

We now analyze the effects of the contracts separately for small-, medium-, and large-scale farmers. The results of the plot-level models are summarized in Table 2.8 (full model results are shown in Tables A.1.11 and A.1.12 in Appendix A.1). We do not find significant effects of the marketing contract on input use and yield for any of the farm size categories. However, we do observe positive and significant effects of the resource-providing contract.

The resource-providing contract increases input use and yield, especially among small-scale farmers. For small-scale farmers, the probability of fertilizer and herbi-

cide use is increased by 19 and 32 percentage points, respectively. These effects are larger than what we observed for the full sample in Table 2.6, where the effect on herbicide use was not statistically significant. The resource-providing contract increases the oil palm yield of small-scale farmers by about 4 t/acre, which means more than a doubling of yields when comparing to the mean yield of non-contracted farmers. The resource-providing contract also increases fertilizer use and yield among the medium-scale farmers, whereas for large-scale farmers the only significant effect is an increase in the use of fertilizer. These are interesting findings that support our hypothesis that credit and input market imperfections outside of contracts are more constraining for smallholders than for large-scale producers.

Table 2.8: Summary of contract effects on plot-level outcomes by farm size category (subsample analyses)

| | | Chemical fertilizer use (dummy) | Herbicide use (dummy) | Yield (t/acre) |
|---|---|---|---|---|
| Marketing contract | Small-scale | 0.0677 | 0.0716 | -0.2379 |
| | | (0.08) | (0.10) | (0.69) |
| | Medium-scale | 0.0485 | -0.1448 | 0.1732 |
| | | (0.09) | (0.14) | (0.50) |
| | Large-scale | 0.0337 | 0.0975 | -2.0271 |
| | | (0.12) | (0.12) | (1.72) |
| Resource-providing contract | Small-scale | 0.1909*** | 0.3231*** | 4.0295*** |
| | | (0.06) | (0.12) | (0.91) |
| | Medium-scale | 0.1813** | -0.0454 | 4.3482*** |
| | | (0.08) | (0.13) | (0.53) |
| | Large-scale | 0.1712* | 0.1403 | 0.6007 |
| | | (0.01) | (0.11) | (2.18) |
| Control variables included | | Yes | Yes | Yes |
| WTP included | | Yes | Yes | Yes |

Note: Average marginal effects are shown with cluster-corrected standard errors in parentheses. WTP, willingness-to-pay. Full model results are shown in Tables A.1.11 and A.1.12 in Appendix A.1. * p<0.1, ** p<0.05, *** p<0.01.

The results of the household-level models are summarized in Table 2.9 (full model results are shown in Table A.1.13 in Appendix A.1). Surprisingly, the marketing contract seems to have a negative effect on the scale of production among small-scale farmers. At the same time, the marketing contract seems to incentivize small- and medium-scale farmers to reduce the number of other cash crops produced. For large-scale farmers, the marketing contract has no significant effects on the scale of production or on oil palm specialization.

The resource-providing contract increases oil palm specialization among small- and medium-scale farmers. Among medium-scale farmers, we also observe a positive effect on the scale of production. The resource-providing contract has no effects on large-scale farmers.

In summary, the disaggregated analyses clearly show that the effects of contracts can vary not only by contract type but also by farm size category. Large-scale farmers are mostly unaffected by both types of contracts. In contrast, small- and medium-scale farmers benefit from the resource-providing contract in terms of higher investments, higher yields, and higher levels of specialization on the oil palm crop.

Table 2.9: Summary of contract effects on household-level outcomes by farm size category (subsample analyses)

| | | Scale of production (0-1) | Specialization (0-1) | Cash crop diversity (number) |
|---|---|---|---|---|
| Marketing contract | Small-scale | -0.0497** | 0.0601 | -0.4599* |
| | | (0.02) | (0.05) | (0.25) |
| | Medium-scale | -0.0033 | -0.0113 | -0.7148*** |
| | | (0.03) | (0.04) | (0.18) |
| | Large-scale | 0.0563 | -0.0846 | -0.0242 |
| | | (0.07) | (0.07) | (0.24) |
| Resource-providing contract | Small-scale | 0.0156 | 0.1284** | -0.4754** |
| | | (0.02) | (0.05) | (0.22) |
| | Medium-scale | 0.0426* | 0.0887* | -0.8036*** |
| | | (0.02) | (0.04) | (0.18) |
| | Large-scale | 0.0730 | 0.0310 | -0.1705 |
| | | (0.06) | (0.07) | (0.24) |
| Control variables included | | Yes | Yes | Yes |
| WTP included | | Yes | Yes | Yes |

Note: Marginal effects are shown with cluster-corrected standard errors in parentheses. WTP, willingness-to-pay. Full model results are shown in Table A.1.13 in Appendix A.1. * p<0.1, ** p<0.05, *** p<0.01.

## 2.6 Conclusion

In this article, we have analyzed and compared the effects of marketing and resource-providing contracts on agricultural investments and productivity in the small farm sector of Ghana. Previous studies had evaluated the effects of contracts in different settings, but very few studies had compared the effects of different contract types in the same setting, as we have done here. Our results can contribute to better understand what type of contracts can be useful for smallholder farmers and for agricultural development in what situations. We have collected and used survey data of oil palm farmers in the southern parts of Ghana. A sampling framework specifically designed for this study has helped us to reduce issues of selection bias in the evaluation of contract effects. Furthermore, we have used IV models and also included WTP estimates as an additional control variable to deal with unobserved heterogeneity between contracted and non-contracted farmers. The results support two main conclusions.

The first conclusion is that contracts can reduce risks and other market failures and thus contribute to agricultural growth in the small farm sector, but that the actual results depend on the contract characteristics. Not all contracts are useful in every situation. We have found sizeable effects of the resource-providing contract on input use, oil palm yield, specialization, and the scale of production. In the resource-providing contract scheme, farmers have a secure market for their output. In addition, the contracting company offers various inputs, technologies, and technical services on credit. In contrast, we have found no significant effects of the simple marketing contract on input use or on any of the other outcome variables considered. We conclude that a secure output market alone is insufficient to increase farm investments and productivity in a setting with severe credit and input market failures. This is especially true for high-value crops – such as oil palm and other plantation crops – that require relatively large upfront investments.

A few previous studies showed that simple marketing contracts can contribute to productivity growth in the small farm sector (Henningsen et al., 2015; Rao et al., 2012). These studies referred to vegetables or other annual crops in situations where the required upfront investment was either low or where credits and inputs were accessible to farmers also when not offered as part of the contract. Other studies that referred to different crops and different countries did not find significant effects of simple marketing contracts (Henningsen et al., 2015; Mwambi et al., 2016), possibly because the required investments for technological upgrading were larger, or credit and input market failures more severe, as in our case. For comparison: most studies that analyzed resource-providing contracts found positive effects on smallholder investments and productivity (Champika and Abeywickrama, 2014; Maertens and Velde, 2017; Ragasa et al., 2018). Our study with both marketing and resource-providing contracts examined and compared in the same setting and for the same crop helps to explain some of the impact heterogeneity observed in the previous literature.

The second main conclusion from our study is that the effects of contracts cannot only vary with contract characteristics, but also between different farm size categories. Resource-providing contracts seem to be particularly beneficial for small- and medium-scale farmers, whereas the effects of both types of contracts on large-scale farmers were mostly insignificant. These pro-poor distributional effects are welcome and can be explained by the fact that small- and medium-scale farmers often suffer most from imperfections in input and output markets. Hence, if these small- and medium-scale farmers have access to contracts that help reduce some of the market imperfections, they may benefit more than large-scale farmers, who often have better market access anyway.

Of course, the concrete findings are specific to the palm oil sector in Ghana and should not be generalized. In Ghana, small-scale farmers have access to con-

tracts with palm oil companies, because the demand for palm oil is growing rapidly and companies cannot source sufficient quantities when relying on the supply of large-scale farmers alone. In many other situations, small-scale farmers find it more difficult to enter a contract scheme, because companies often prefer to deal with larger farms in order to keep transaction costs low. Especially for resource-providing contracts, side-selling can also be an issue and is not always easy to monitor and sanction when dealing with a large number of smallholders (Otsuka et al., 2016). Side-selling is not yet much of an issue in Ghana's palm oil sector, because the contracting companies buy fresh fruit bunches, whereas larger sales on the open market usually require own processing by farmers. Own processing is labor-intensive and needs to be done immediately after the harvest, because of the perishability of the fresh oil palm fruits. However, in spite of these specific conditions, the general findings that contract characteristics matter and that resource-providing contracts are more suitable to reduce market failures in the small farm sector than simple marketing contracts probably also hold in other situations.

In closing, two limitations of our study shall be mentioned. First, we used cross-section observational data to evaluate the effects of contracts. While we used different approaches to reduce issues of selection bias and obtained consistent results, possible endogeneity of contract participation remains a concern that is difficult to fully address with cross-section data. Studies with panel data or with experimental approaches in a more controlled setting could further strengthen the identification of causal effects. Second, the focus of our study was on the effects of contracts on farm investments, input intensity, and productivity. While these outcomes are important indicators of agricultural growth and development, they do not necessarily measure farm household welfare. Analyzing the effects of contracts on farm household livelihoods more explicitly would require other outcome variables, such as income, health, and nutrition. These are interesting directions for follow-up research.

# Chapter 3

# New evidence regarding the effects of contract farming on agricultural labor use


**Abstract**

Contract farming recently gained in importance in many developing countries. Various studies analyzed effects of contracting on productivity and income in the small farm sector. A few studies also looked at effects on agricultural labor use, suggesting that contracting tends to increase labor intensity, thus generating additional farm employment. An increase in the use of farm labor is plausible when contracting involves additional work in production, harvesting, and post-harvest handling. However, we argue that the opposite may also be true, namely when contracting involves labor-saving procedures and technologies. We use primary data from the oil palm sector in Ghana and show that farmers with a contract use significantly less labor per unit of land than farmers without a contract. We also analyze whose labor input is reduced. Household labor is reduced more than hired labor. Especially male household members reallocate time to off-farm employment. Contracts also reduce the likelihood of using child labor in farm production. This is the first study to show that contract farming reduces agricultural labor use in certain situations.



**Keywords:** Contract farming, oil palm, agricultural labor use, rural employment, gender, child labor.

**JEL codes:** J23; J43; O13; Q12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This chapter is co-authored by Matin Qaim (MQ). The contributions of each author are as follows: AR developed the research idea, collected, analyzed, and interpreted the data. AR wrote the paper. MQ commented at all stages of the research and contributed to writing and revising the paper. All authors read and approved the final manuscript.

## 3.1 Introduction

Contract farming recently gained in importance in developing countries (Bellemare, 2018; Meemken and Bellemare, 2020; Otsuka et al., 2016). Many studies analyzed the effects of contracts on agricultural productivity and income in the small farm sector (Arouna et al., 2019; Ashraf et al., 2009; Barrett et al., 2012; Bellemare, 2012; Khan et al., 2019; Maertens et al., 2012; Mishra et al., 2016; Mishra et al., 2018; Ragasa et al., 2018; Rao et al., 2012; Ruml and Qaim, 2019a; Simmons et al., 2005; Tripathi et al., 2005). Possible effects of contracts on agricultural labor use have received much less attention in the empirical literature. This is surprising, because employment is an important issue for sustainable rural development, especially in Africa where rural population growth is still quite large.

The general expectation is that contract farming increases agricultural labor use and employment, because contracting often involves high-value farm commodities that are labor-intensive (Bellemare, 2018; Khan et al., 2019; Narayanan, 2014; Otsuka et al., 2016). This expectation is consistent with a few empirical studies showing that contracting leads to additional labor use in production, harvesting, and post-harvest handling in some situations (Benali et al., 2018; Meemken and Bellemare, 2020; Neven et al., 2009; Rao and Qaim, 2013). However, we argue that these results cannot be generalized, because contracting can also involve the adoption of labor-saving technologies and procedures. Labor-reducing effects through contracts have not been shown previously in a small farm context. Here, we show that they exist using smallholder oil palm production in Ghana as an empirical example.

In particular, using data from a survey of farm households we investigate the effects of two types of contracts – namely marketing and resource-providing contracts – on labor use in oil palm production. While farmers without a contract do some of the post-harvest handling themselves, farmers with a contract sell the oil palm fruit bunches to the buying company immediately after harvest. Some of the contracted farmers also use labor-saving chemical inputs such as herbicides, thus further reducing the labor intensity. We evaluate the effects of contracting on total labor use per unit of land. In addition, we differentiate between household and hired labor, and between male, female, youth, and child labor. Differentiation is useful to better understand possible broader social implications. Endogeneity issues in the evaluation of effects are addressed with a control function approach and through including farmers' willingness-to-pay for certain contract features as an additional explanatory variable in the regressions.

Contract farming in the oil palm sector of Ghana is not a peculiar case. Many smallholders in Africa have traditionally produced palm oil for home consumption and local markets. However, demand for palm oil from domestic and international

markets is growing, so that modern supply chains with new players and smallholder contract schemes are increasingly emerging (Byerlee et al., 2017). Similar trends are also observed in other crops traditionally grown by smallholders. Against this background, better understanding the labor market implications of contract farming is particularly important.

The rest of this chapter is structured as follows. The next section presents further details of trends in Africa's oil palm sector, based on which several concrete research hypotheses are developed. Section 3.3 describes the data collection and the statistical methods used to test the research hypotheses. Section 3.4 presents the empirical results, while section 3.5 concludes.

## 3.2 Background and hypotheses

### 3.2.1 Trends in oil palm production and marketing

Oil palm is native in West Africa and has been grown by smallholders for a long time for home consumption and local markets. Over the last few decades, international demand for palm oil has increased tremendously, but most of this demand was met by production growth in Southeast Asia, not Africa (Byerlee et al., 2017). The situation is now gradually changing. While in Southeast Asia, the expansion of oil palm is increasingly conflicting with environmental objectives, Africa still has more potential for production increases. In West Africa, oil palm has recently become one of the most important cash crops produced, and further growth is expected in the future (Byerlee et al., 2017; Huddleston and Tonts, 2007; Rhebergen et al., 2016). The transformation of oil palm from a local semi-subsistence crop to a major cash crop is associated with a modernization of supply chains and the entry of large processing companies, which secure some of the supply from smallholders through contractual agreements.

Smallholder farmers continue to be the main producers of oil palm in West Africa. In Ghana, smallholder production accounts for 75% of total palm oil supply (Byerlee et al., 2017). Smallholder oil palm production in Ghana also employs over 2 million farm workers (Ministry of Food and Agriculture, 2011). However, the production conditions differ remarkably between traditional supply chains without contracts and modern supply chains with contracts. In traditional supply chains, farmers have no secure sales market. They harvest the fruit bunches and then pick the individual fruits out of the bunches, in order to sell to local customers or home-process to palm oil. Picking, processing, and finding a buyer are time-intensive operations, which are particularly performed by women. As the quantities traded in local markets are small and the fruits are perishable, harvesting typically takes place in a piecemeal fashion.

In contrast, farmers in modern supply chains with a contract have a secure sales market where prices are fixed annually. Contracted farmers harvest the bunches themselves, but instead of picking and processing the fruits, they sell the bunches to the buying companies at the farm gate. The companies have large mills where the fruit bunches are processed. This means that contracted farmers can harvest and sell larger quantities of fruit bunches at once.

In Ghana, two types of contracts exist in the oil palm sector, namely marketing and resource-providing contracts, as shown in Table 3.1. For both types of contracts, the harvest and sales conditions are as described above. However, the contracts differ in terms of the additional assistance provided for production inputs and technologies. While farmers with a marketing contract do not receive production assistance, farmers with a resource-providing contract can obtain chemical inputs, other production tools, and technical support on credit from the contracting company. As a result, farmers with a resource-providing contract often obtain higher yields (Ruml and Qaim, 2019a). On the other hand, they are also more likely to use chemical herbicides for weed control, which reduces labor demand, as the alternative is to control weeds manually. The lower part of Table 3.1 shows production and post-harvest handling steps for the different alternatives with and without contracts, also indicating typical gender responsibilities.

Table 3.1: Production and marketing characteristics in oil palm with and without contract

| | Traditional, without contract | Marketing contract | Resource-providing contract |
|---|---|---|---|
| Buyer | Local customers, small processing mills | Processing company | Processing company |
| Product sold | Oil palm fruits, palm oil | Oil palm bunches | Oil palm bunches |
| Production assistance | None | None | Inputs, technologies, technical support on credit |
| Labor operations | Plot maintenance ♂ | Plot maintenance ♂ | Plot maintenance ♂ |
| | Input application ♂<br>Harvesting (piecemeal) ♀♂<br>Picking of fruits ♀<br>Processing (sometimes) ♀<br>Marketing ♀ | Input application ♂<br>Harvesting (at once) ♀♂ | Input application ♂<br>Harvesting (at once) ♀♂ |

Note: ♂indicates that operation is performed mostly by males. ♀indicates that operation is performed mostly by females.

### 3.2.2 Research hypotheses

Based on the differences between oil palm production and marketing conditions with and without contract, we develop a set of research hypotheses, which will be tested

empirically further bellow. The first hypothesis is:

*Hypothesis 1: Contract farming leads to a reduction in agricultural labor use.*

When total labor input per unit of land is reduced, this can affect either household labor, or hired labor, or both. As picking fruits out of the bunches, processing, and marketing in traditional supply chains without contract are primarily performed by household labor, and these are the main operations falling away in the contract schemes, we further hypothesize:

*Hypothesis 2: Household labor is reduced more than hired labor.*

If household labor in oil palm production is saved, the labor time can be reallocated to other on-farm activities or also to off-farm employment (Davis et al., 2017). We expect a stronger reallocation to off-farm activities, as alternative crops are often less profitable than oil palm. Furthermore, oil palm farmers in Ghana are relatively well educated, meaning that they may have access to more lucrative off-farm economic activities. Hence, we hypothesize:

*Hypothesis 3: The reduction in agricultural labor use leads to a reallocation of household labor to off-farm employment.*

In addition to differentiating between household and hired labor, we are also interested in the gender implications resulting from agricultural labor reduction and reallocation. The contracts in Ghana's oil palm sector do away with on-farm operations that are primarily performed by women (Table 3.1). In addition, especially the resource-providing contracts lead to more agrochemical applications, which is typically a male task in the local context. Hence, we hypothesize:

*Hypothesis 4: Females are more affected than males by the reduction in agricultural labor use.*

If hypothesis 4 is true, it will be interesting to see whether saved household female labor is also reallocated to off-farm employment. If women pursue off-farm economic activities, this is often associated with a gain in female financial autonomy and positive effects for family welfare and nutrition (Amugsi et al., 2016; Maertens and Swinnen, 2012). On the other hand, women often have limited access to off-farm employment due to cultural and educational constraints (Chrisendo et al., 2019). A reduction in female hired labor use through oil palm contracts may also have important social implications, as female agricultural laborers often belong to the most disadvantaged population groups in rural Africa (Fischer and Qaim, 2012; Maertens and Swinnen, 2012; Rao and Qaim, 2013).

Finally, we are interested in effects of contracts on child labor and youth labor in oil palm production. Children and adolescents are typically involved in all on-farm operations up to a certain extent, but especially in fruit picking and processing. Hence, we hypothesize:

*Hypothesis 5: Contract farming leads to a reduction in child and youth labor.*

A reduction in child and youth labor may have positive effects on school attendance and educational attainments.

## 3.3 Materials and methods

### 3.3.1 Farm household survey

This study uses cross-sectional survey data, collected between April and July 2018 in the South of Ghana, where five different processing companies are located that all contract smallholder oil palm farmers (Figure 2.1). Out of the five companies, we selected two that are located in neighboring regions relatively close to each other, namely Benso Oil Palm Plantation (BOPP) owned by Wilmar International Limited in the Western Region and Twifo Oil Palm Plantation (TOPP) owned by Unilever in the Central Region. While Benso has simple marketing contracts with farmers, Twifo uses resource-providing contracts. From both company schemes, contracted oil palm farmers were selected randomly based on complete lists of villages and farmers involved. Comparison farmers were chosen in different locations in the Ashanti Region to reduce non-random selection issues and spillover effects that might bias the impact evaluation. The three neighboring regions included in the survey are shown in Figure 2.1.

All three regions are located in Ghana's green belt, which is classified as suitable for oil palm cultivation (Rhebergen et al., 2016). All three regions are similar in terms of rainfall and climate conditions (Table A.2.1 in Appendix A.2). As contracts are expected to reduce agricultural labor use, farmers in regions with strong economic development and attractive off-farm employment opportunities may be particularly interested in producing oil palm under contract. Hence, comparing farmers in regions with notable differences in economic development could potentially confound the results. To avoid possible bias, we selected the comparison region such that rural unemployment rates and other indicators of economic development are very similar to those in the two contract farming regions (Table A.2.1). Demographic structures in the three regions are also very similar in terms of ethnic and religious composition. Another indicator of similarity is that a new company contract scheme for oil palm was planned in the comparison region, but had not yet started at the time of the survey. When we collected the survey data, oil palm farmers in the comparison region were unaware of the upcoming contract scheme. We learned about the planned contract scheme from the local Ministry of Food and Agriculture (MoFA).

In total, we randomly selected 463 oil palm producing households from 31 villages in the three regions[1]: 193 from the Western Region with a marketing contract, 164 from the Central Region with a resource-providing contract, and 106 from the Ashanti Region without any contract. Personal interviews were carried out with the household heads in the local language, using a structured questionnaire developed for this purpose and programmed in tablet computers[2]. The questionnaire captured information on the household structure, all income sources, the time spent by household members in various economic activities, and other socioeconomic details. Input-output details for oil palm production were captured at the plot level for all plots managed by the sample household. We use complete data for 524 oil palm plots, after excluding those that did not yet bear any fruits. In addition to the household interviews, we also conducted shorter interviews with the chief in each of the villages, capturing information on village-level characteristics[3].

### 3.3.2 Regression models

As discussed, we hypothesize that contract farming reduces agricultural labor use. This hypothesis is tested with a regression model of the following type:

$$Y_{ihj} = \beta_0 + \beta_1 MC_{ihj} + \beta_2 RPC_{ihj} + \beta_3 X_{ihj} + u_{ihj} \tag{3.1}$$

where $Y_{ihj}$ is the agricultural labor use per acre on plot $i$, in household $h$, and village $j$. $MC$ represents the marketing contract and $RPC$ the resource-providing contract; these are dummy variables that take a value of one if the household and plot are part of the respective contract scheme and zero otherwise[4]. Thus, $\beta_1$ measures the effect of the marketing contract and $\beta_2$ the effect of the resource-providing contract. Hypothesis 1, stating that contract farming reduces agricultural labor use, is supported if $\beta_1$ and $\beta_2$ are both negative and statistically significant. We also control for other factors that may influence agricultural labor use, $X_{ihj}$, including plot, household, and village characteristics. $u_{ihj}$ is a random error term that we cluster at the village level.

In order to test hypothesis 2, we estimate disaggregated models using household labor and hired labor as dependent variables. As there are some farmers that do not use both types of labor, the dependent variables in these disaggregated models include zero observations leading to corner solutions. This is accounted for by modeling two decisions for each type of labor as follows:

[1] We only sampled commercial oil palm producers, meaning that households with only a few palms for home consumption purposes and no commercial sales were not considered.

[2] The paper version of the household questionnaire is attached in Appendix B.1.

[3] The paper version of the village questionnaire is attached in Appendix B.2.

[4] $MC$ and $RPC$ are possibly endogenous, which could lead to biased estimates. We discuss endogeneity issues and how we address them further below.

$$D_{ihj} = \alpha_1 MC_{ihj} + \alpha_2 RPC_{ihj} + \alpha_3 X_{ihj} + \mu_{ihj} \qquad \mu_{ihj} \sim N(0,1) \qquad (3.2)$$

$$Q_{ihj} = \gamma_1 MC_{ihj} + \gamma_2 RPC_{ihj} + \gamma_3 X_{ihj} + \epsilon_{ihj} \qquad \epsilon_{ihj} \sim N(0,\sigma^2) \qquad (3.3)$$

where equation (3.2) models the binary decision whether or not to use household (hired) labor on oil palm plot $i$, and equation (3.3) models the decision how much household (hired) labor to use on the plot, conditional on the first decision being positive. Hence, $D_{ihj}$ is a dummy and $Q_{ihj}$ a continuous variable. The other variables are defined as above. Hypothesis 2, stating that household labor is reduced more through contracts than hired labor, is tested by estimating equations (3.2) and (3.3) separately for the use of household and hired labor and then comparing the effects for $MC_{ihj}$ and $RPC_{ihj}$.

Hypothesis 3 states that contract farming leads to a reallocation of household labor from farm to off-farm activities. This is tested with the following equations, which are estimated at the household level:

$$V_{hj} = \pi_1 MC_{hj} + \pi_2 RPC_{hj} + \pi_3 X_{hj} + \tau_{hj} \qquad \tau_{hj} \sim N(0,1) \qquad (3.4)$$

$$W_{hj} = \varphi_1 MC_{hj} + \varphi_2 RPC_{hj} + \varphi_3 X_{hj} + \delta_{hj} \qquad \delta_{hj} \sim N(0,\sigma^2) \qquad (3.5)$$

where $V_{hj}$ is a dummy variable that takes a value of one if at least one member of household $h$ works in off-farm employment, and zero otherwise, whereas $W_{hj}$ is a continuous variable measuring the number of labor days worked in off-farm employment by all household members. Hypothesis 3 is supported if the coefficients $\pi_1$, $\pi_2$ and/or $\varphi_1$, $\varphi_2$ are positive and statistically significant.

Hypothesis 4 states that female labor in oil palm is reduced more than male labor through the contracts, which is tested by running the models in equations (3.2) to (3.5) separately for male and female labor and comparing the coefficients. Finally, hypothesis 5 – concerning the effects of contracts on the use of child and youth labor in oil palm – is tested by re-estimating the models in equations (3.2) and (3.3) with child and youth labor as dependent variables.

We use double hurdle specifications to estimate the models in equations (3.2)-(3.3) and (3.4)-(3.5). The double hurdle specification is suitable to estimate corner solution models with a binary first-stage decision and a continuous variable in the second stage (Burke, 2009; Cragg, 1971; García, 2013). Double hurdle models were used recently in the agricultural economics literature to estimate labor market effects (Benali et al., 2018; Rao and Qaim, 2013). We test the double hurdle specification against the more specific tobit alternative using a likelihood ratio test. The results reject the hypothesis that the tobit is a suitable specification in all cases, meaning that the double hurdle model is preferred (Table A.2.2 in Appendix A.2).

### 3.3.3 Definition of key variables

The dependent variables in the different regression models are total agricultural labor use, as well as labor use by different categeries of laborers, including household and hired labor, male and female labor, and child and youth labor. All these variables are measured in labor days worked per acre of oil palm during the 12 months prior to the survey. Laborers are considered adult if they are 18 years or older. Youth labor includes persons between 15 and 17 years of age, and child labor refers to individuals that are 14 years or younger. Child and youth participation is only counted as labor when the individuals were actively involved in any of the agricultural operations. Activities such as delivering food or water to other laborers or simply accompanying family members without own active involvement is not counted as labor.

The key explanatory variables are the two dummies for particiation in marketing and resource-providing contracts, which were already explained above. In addition, we include a set of control variables. At the plot level, we control for soil quality, irrigation, the number of palms per acre, and the distance from the plot to the closest road that is accessible with a truck. At the household level, we control for the number of adult household members, which is a measure of the availability of household labor, and the total land size. As the current land size can be influenced by contracts, we use land availability in 2008, which is before most of the farmers in the study regions had any oil palm contracts. Total land size includes all plots available to the household for cultivation, regardless of whether or not the plots were actually cultivated in 2008. Furthermore, we control for socioeconomic characteristics of the oil palm farmer (age, sex, education, farming experience). In the household-level models, we control for the characteristics of the household head, which is not necessarily the same person as the oil palm farmer. Finally, we control for distance to the closest market measured in km as a village-level variable; if the village has its own market the distance is set at zero.

### 3.3.4 Dealing with endogeneity

We use the regression models explained above to evaluate the impact of marketing contracts and resource-providing contracts on labor use. However, farmers self-select into contract participation, so that the treatment variables may be endogenous. Farmers with low labor availability (or high opportunity costs of time) may be more likely to participate in contracts that reduce on-farm labor requirements, which could lead to issues of reverse causality. Moreover, there may be unobserved factors that are jointly correlated with contract participation and labor use decisions. Such types of endogeneity could lead to correlation of the contract dummy variables with the error terms and thus bias the estimation results.

Our sampling framework helps to reduce self-selection issues, because farmers with and without contracts were chosen in different regions. While the regions are

similar in terms of agroecological and socioeconomic conditions (Table A.2.1), they differ in the availability of contract schemes, thus providing a quasi-experimental setting. At the time of the survey, farmers in the comparison region did not have access to any of the contract schemes. Similarly, farmers in the two contracting regions only had access to one of the contract types.

In spite of the quasi-experimental setting, some level of endogeneity may still occur. We therefore use a control function (CF) approach with instrumental variables (IVs), which is also known as the two-stage residual inclusion approach (Terza et al., 2008). The control function approach addresses endogeneity, is more flexible than the standard IV model, and can also be used for non-linear models (Wooldridge, 2014). In the first stage, participation in a contract scheme is regressed on the full set of control variables and the instruments. In the second stage, labor use is regressed on contract participation and the control variables, as explained above in equations (3.1) to (3.5), but additionally including residual terms from the first stage as explanatory variables. For the double hurdle models, the residual terms are included in both hurdles.

As we look at two different contract schemes (and the comparison group), we use a multinomial logit for the first stage. This produces two residual terms, one for each contract scheme. We calculate generalized residuals, which are normalized and have a conditional mean at zero (Wooldridge, 2015). If the residual terms are statistically insignificant in the second stage, the null hypothesis that participation in the contract schemes is exogenous cannot be rejected. In that case, the residuals are excluded for the particular model. However, if the residuals are significant, exogeneity has to be rejected and inclusion of the residual terms controls for endogeneity bias.

We use two instruments that are significantly correlated with participation in the two contract schemes but do not influence labor use through other mechanisms. Participation in the marketing contract is instrumented with the share of households in the village producing oil palm commercially ('village share'). Commercial oil palm production means that a household cultivates oil palm and sells at least some of the produce either in local markets or to a company under contract. The rationale for this instrument is that the company will prefer to contract in villages with many commercial oil palm farmers, as this can help to reduce transport and transaction costs. Participation in the resource-providing contract is instrumented with a dummy variable that takes a value of one if the chief of the respective village is a commercial oil palm farmer ('village chief'). The rationale for this instrument is that approval from the village chief is required before the company can contract farmers in a particular village under the resource-providing scheme. The village chief will likely be more obliging when commercially producing oil palm himself/herself.

Table A.2.3 in Appendix A.2 presents the first-stage IV regressions, which confirm that both instruments are significantly correlated with contract participation. At the same time, they are not significantly correlated with any of the outcome variables (Table A.2.4). This is plausible in our quasi-experimental setting. Given that the "treatment" and comparison regions and villages are similar, there is no reason to believe that the village-level share of commercial oil palm farmers or the types of crops grown by the village chief would affect individual labor use through mechanisms other than own contract participation. We conclude that the two instruments are valid. In Table A.2.5, we show results of the exogeneity tests for all models used in this study. Whenever, the exogeneity hypothesis is rejected, the residual terms are included when estimating the treatment effects.

While all criteria for instrument validity are fulfilled, instruments are rarely perfect. Therefore, we use an additional approach to reduce possible issues of endogeneity, namely we include the individual farmer's willingness-to-pay (WTP) for contracts as an additional control variable in those models where exogeneity of contract participation could not be rejected. WTP measures the farmer's subjective preference for producing under contract, which is likely correlated with a number of farmer characteristics, including unobserved ones such as risk aversion, time preferences, and entrepreneurial skills. Hence, controlling for WTP in the models will reduce possible issues caused by unobserved heterogeneity. Using WTP measures to address endogeneity is an approach that was recently used also in other studies evaluating the impacts of contracts and related marketing institutions (Bellemare, 2012; Bellemare and Novak, 2017; Meemken and Qaim, 2018; Verhofstadt and Maertens, 2014).

We derived the farmer's WTP for contracts through a simple experiment that was part of the survey questionnaire. In particular, we offered each farmer a set of hypothetical contract offers requiring varying amounts of initial investments. Respondents were asked: "Would you be willing to enter a contract agreement with a firm that would increase your annual income from oil palm production by setting-up an entire acre of oil palm plantation, but would necessitate an initial investment of Z Ghanaian Cedis (GHS)?" For each respondent, Z started at a low value and, if the answer was 'yes', was increased in follow-up questions[5]. The highest value of Z for which the answer was 'yes' represents the individual WTP, which we include as an additional control variable in our impact regressions.

[5]Question and initial investment amounts are shown in the household questionnaire in Appendix B.1, question 76.

## 3.4 Results

### 3.4.1 Descriptive statistics

Table 3.2 shows descriptive statistics and mean difference tests for all outcome variables used in this study.

Table 3.2: Descriptive statistics of outcome variables

| | Mean | | | Difference | | |
|---|---|---|---|---|---|---|
| | Marketing contract (MC) | Resource-providing contract (RPC) | No contract (NC) | MC-RPC | MC-NC | RPC-NC |
| *Plot-level variables (n=524)* | *(n=222)* | *(n=185)* | *(n=117)* | | | |
| Agricultural labor use (in labor days per acre of oil palm) | 34.78 | 26.86 | 78.06 | *** | *** | *** |
| | (2.16) | (1.87) | (7.24) | | | |
| Household labor (in labor days per acre of oil palm): | 16.06 | 11.03 | 50.91 | ** | *** | *** |
| | (1.60) | (1.16) | (5.17) | | | |
| Male household labor | 9.71 | 7.60 | 27.63 | | *** | *** |
| | (1.13) | (0.88) | (3.19) | | | |
| Female household labor | 6.35 | 3.43 | 23.28 | *** | *** | *** |
| | (0.81) | (0.53) | (2.93) | | | |
| Child labor | 0.23 | 0.11 | 4.08 | | *** | *** |
| | (0.13) | (0.04) | (1.39) | | | |
| Youth labor | 0.50 | 0.29 | 3.28 | | *** | *** |
| | (0.26) | (0.09) | (0.96) | | | |
| Hired labor days (in labor days per acre of oil palm): | 17.36 | 14.97 | 18.65 | | | |
| | (1.73) | (1.82) | (3.68) | | | |
| Male hired labor | 10.67 | 11.43 | 12.16 | | | |
| | (1.14) | (1.22) | (2.41) | | | |
| Female hired labor | 6.69 | 3.54 | 6.49 | ** | | |
| | (0.87) | (1.02) | (1.77) | | | |
| *Household-level variables (n=463)* | *(n=193)* | *(n=164)* | *(n=106)* | | | |
| Days worked in off-farm employment | 151.32 | 125.24 | 117.51 | | | |
| | (12.63) | (13.50) | (15.84) | | | |
| Male days worked in off-farm employment | 69.91 | 62.91 | 67.71 | | | |
| | (9.39) | (10.48) | (11.65) | | | |
| Female days worked in off-farm employment | 81.42 | 62.33 | 49.80 | | ** | |
| | (9.41) | (9.61) | (10.20) | | | |

Note: Mean values are shown with standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

The upper part of Table 3.2 shows labor use at the plot level. As expected, farmers with a contract use significantly less agricultural labor in oil palm production than farmers without a contract. This is true for both types of contracts, but the difference is especially large for the resource-providing contract. Farmers with a marketing contract use less than half, and farmers with a resource-providing contract only use about one-third of the labor that farmers without a contract use per acre

of oil palm. Differences are primarily observed for household labor, including male and female, as well as child and youth labor. For hired labor, differences between plots with and without contracts are not statistically significant.

The lower part of Table 3.2 shows the number of days worked in off-farm employment at the household level. For the total number of days worked in off-farm activities, no significant differences between households with and without contract are observed. However, gender disaggregation reveals that households with a marketing contract have more female off-farm labor days than households without any contract.

The differences in Table 3.2 cannot be interpreted as effects of contracts, as the plots and households also differ in terms of several other characteristics (Table A.2.6 in Appendix A.2). The regression results presented below control for such differences in plot and household characteristics and for possible other confounding factors.

### 3.4.2 Effects of contracts on agricultural labor use

Table 3.3 shows the estimated effects of contract farming on agricultural labor use. Ordinary least squares (OLS) and control function estimates are shown with very similar results, which is to be expected given that the first-stage residuals are not statistically significant in this model. Contract farming reduces agricultural labor use, which holds true for both types of contracts and supports our research hypothesis 1. The marketing contract leads to a reduction of 43 labor days per acre of oil palm, which is equivalent to a 55% decrease when compared to the mean labor use of 78 days on oil palm plots without any contract. The resource-providing contract leads to a reduction of 48 labor days, equivalent to a 62% decrease. We find no statistically significant difference between the effects of both contracts.

Table 3.3: Effects of contracts on agricultural labor use (labor days per acre)

| | (1) | (2) |
|---|---|---|
| | OLS | Control function |
| Marketing contract | -43.36*** | -40.68*** |
| | (7.89) | (8.37) |
| Resource-providing contract | -47.94*** | -43.17*** |
| | (6.17) | (6.30) |
| Control variables included | Yes | Yes |
| Residuals included | No | Yes |
| WTP included | Yes | No |
| Number of observations | 524 | 524 |

Note: Average effects are shown with village cluster-corrected standard errors in parentheses. Full regression results are shown in Table A.2.7 in Appendix A.2. * p<0.1, ** p<0.05, *** p<0.01.

### 3.4.3 Effects of contracts on labor reallocation and employment

Table 3.4 shows the effects of contracts on labor reallocation and employment. These estimates are based on double hurdle models. The results in column (1) suggest that contracts reduce the likelihood of using household labor in oil palm production by 14 and 37 percentage points for marketing and resource-providing contracts, respectively. The results in column (2) further suggest that – for those who use household labor in oil palm production – the number of household labor days per acre is reduced by 16.3 and 23.5 for marketing and resource-providing contracts, respectively. These effects of contracts on household labor use are much stronger than the effects on hired labor use in oil palm production (columns 3 and 4 of Table 3.4). Table 3.5 shows unconditional marginal effects combining the results from both hurdles. It becomes obvious that both types of contracts significantly reduce the use of household labor, but not of hired labor, which supports our research hypothesis 2.

Table 3.4: Effects of contracts on labor reallocation and employment

| | Household labor | | Hired labor days | | Off-farm employment | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Decision | Quantity | Decision | Quantity | Decision | Quantity |
| | 0-1 | Days per acre | 0-1 | Days per acre | 0-1 | Days per household |
| Marketing contract | -0.14** | -16.28*** | -0.18*** | -0.51 | 0.06 | 81.96*** |
| | (0.06) | (5.81) | (0.05) | (5.91) | (0.04) | (22.93) |
| Resource-providing contract | -0.37*** | -23.50*** | 0.00 | 1.25 | -0.01 | 54.12** |
| | (0.05) | (4.90) | (0.05) | (3.29) | (0.04) | (24.55) |
| Control variables included | Yes | Yes | Yes | Yes | Yes | Yes |
| Residuals included | Yes | Yes | Yes | Yes | No | No |
| WTP included | No | No | No | No | Yes | Yes |
| Number of observations | 524 | 381 | 524 | 422 | 463 | 249 |

Note: Marginal effects from double hurdle models are shown with village cluster-corrected standard errors in parentheses. Marginal effects of the second hurdle (quantity) are conditional on the first hurdle being passed. Full results are shown in Table A.2.8 and A.2.9 in Appendix A.2. * p<0.1, ** p<0.05, *** p<0.01.

Table 3.5: Effects of contracts on labor reallocation and employment (unconditional marginal effects)

| | Household labor (days per acre) | Hired labor (days per acre) | Off-farm employment (days per household) |
|---|---|---|---|
| Marketing contract | -16.43*** | -3.77 | 61.10*** |
| | (4.63) | (5.30) | (22.84) |
| Resource-providing contract | -27.15*** | 1.07 | 25.37 |
| | (4.37) | (2.85) | (19.12) |
| Control variables included | Yes | Yes | Yes |
| Number of observations | 524 | 463 | 524 |

Note: Unconditional marginal effects are shown with village cluster-corrected standard errors in parentheses. Full results are shown in Table A.2.10 in Appendix A.2. * p<0.1, ** p<0.05, *** p<0.01.

What do households do with the household labor time saved per acre of oil palm? The results in Table 3.4 suggest that some of the labor saved is reallocated to off-farm economic activities. While contracting has no effect on the likelihood of working off-farm, it significantly increases the number of household labor days in off-farm employment[6]. These results support our research hypothesis 3. Interestingly, however, the effect on off-farm employment is bigger for the marketing contract than for the resource-providing contract, even though the resource-providing contract leads to somewhat larger labor savings per acre of oil palm. This puzzle can be explained by differences in household livelihood strategies. Farmers with a marketing contract use the labor saved primarily to increase their off-farm income. In contrast, households with a resource-providing contract specialize more on commercial farming and expand their total oil palm area, so that the labor saved per acre of land does not necessarily imply an equally large reduction in the total household time spent in agriculture.

### 3.4.4 Gender and age disaggregation for household labor

Table 3.6 presents disaggregated results for male and female household labor and for child and youth labor. These results are also based on double hurdle models. Both types of contracts significantly reduce male and female household labor use per acre of oil palm. The effects of both contracts on male and female labor are similar in magnitude (the differences are not statistically significant). Our research hypothesis 4 stated that female labor is more affected than male labor. This hypothesis is not supported by the empirical results.

The first-hurdle results in columns (5) and (7) of Table 3.6 further suggest that the likelihood of using child and youth labor in oil palm production is reduced by 7 to 13 percentage points through the contracts. The second-hurdle estimates (columns 6 and 8) also have negative signs and are quite large in absolute terms, especially for child labor. However, these second-hurdle estimates are not statistically significant, which is probably due to the small number of households using child and youth labor and the resulting inflation of the standard errors. The unconditional marginal effects (Table A.2.13 in Appendix A.2) show a significant reduction in child labor at least for the resource-providing contract, which supports our research hypothesis 5 at least to some extent. A larger sample might possibly lead to more significant effects.

[6]Note that the effects of contracts on the number of labor days in off-farm employment cannot be compared directly to the effect on the number of days worked in oil palm, because the former is measured per household while the latter is measured per acre of oil palm.

Table 3.6: Effects of contracts on household labor use, by gender and age

| | Male labor | | Female labor | | Child labor | | Youth labor | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | Decision | Quantity | Decision | Quantity | Decision | Quantity | Decision | Quantity |
| | 0-1 | Days per acre | 0-1 | Days per acre | 0-1 | Days per acre | 0-1 | Days per acre |
| Marketing contract | -0.14*** | -12.34*** | -0.13** | -7.51*** | -0.07** | -32.33 | -0.10** | -2.97 |
| | (0.04) | (3.21) | (0.07) | (2.56) | (0.03) | (30.23) | (0.04) | (8.23) |
| Resource-providing | -0.33*** | -13.77*** | -0.43*** | -11.63*** | -0.13*** | -71.05 | -0.10** | -13.21 |
| contract | (0.05) | (3.68) | (0.07) | (2.79) | (0.02) | (95.56) | (0.05) | (29.06) |
| Control variables included | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Residuals included | Yes | No | Yes | Yes | Yes | No | Yes | Yes |
| WTP included | No | Yes | No | No | No | Yes | No | No |
| Number of observations | 524 | 343 | 524 | 270 | 524 | 46 | 524 | 58 |

Note: Marginal effects from double hurdle models are shown with village cluster-corrected standard errors in parentheses. The marginal effects of the second hurdle (quantity) are conditional on the first hurdle being passed. Full results are shown in Tables A.2.11 and A.2.12 in Appendix A.2. Unconditional marginal effects are shown in Table A.2.13. * p<0.1, ** p<0.05, *** p<0.01.

Table 3.7 shows gender-disaggregated effects of the contracts on participation in off-farm employment. For male household members, the likelihood of off-farm employment is not significantly affected, but both contracts increase the number of off-farm labor days of male household members considerably. For female household members, the marketing contract increases the likelihood of off-farm employment by 11 percentage points, even though the effects of both contracts on the number of off-farm labor days of female household members are statistically insignificant. Overall, these results indicate that the reallocation of household labor from farm to off-farm employment is more pronounced for male than female household members. And the reallocation to off-farm employment is stronger for the marketing contract than for the resource-providing contract, which is in line with the aggregated results above.

Table 3.7: Effects of contracts on off-farm employment, by gender

| | Male labor | | Female labor | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | Decision | Quantity | Decision | Quantity |
| | 0-1 | Days per household | 0-1 | Days per household |
| Marketing contract | -0.06 | 104.68*** | 0.11** | -15.52 |
| | (0.05) | (33.89) | (0.05) | (46.01) |
| Resource-providing contract | -0.05 | 82.85** | -0.02 | 69.59 |
| | (0.04) | (37.14) | (0.05) | (57.47) |
| Control variables included | Yes | Yes | Yes | Yes |
| Residuals included | No | No | No | Yes |
| WTP included | Yes | Yes | Yes | No |
| Number of observations | 463 | 151 | 463 | 130 |

Note: Marginal effects from double hurdle models are shown with village cluster-corrected standard errors in parentheses. The marginal effects of the second hurdle (quantity) are conditional on the first hurdle being passed. Full results are shown in Tables A.2.14 and A.2.15 in Appendix A.2. Unconditional marginal effects are show in Table A.2.16. * p<0.1, ** p<0.05, *** p<0.01

### 3.4.5 Gender disaggregation for hired labor

Table 3.8 provides gender-disaggregated results for hired labor. Here, we see notable differences for the two contract types. The marketing contract reduces the likelihood of using hired male labor by 15 percentage points, whereas it has no significant effect on the use of female hired labor. In contrast, the resource-providing contract reduces the likelihood of using female hired labor by 19 percentage points and has no significant effect on male hired labor. The unconditional marginal effects, which are shown in Table A.2.19 in Appendix A.2, suggest that the resource-providing contract reduces hired female labor use by 3.4 days per acre of oil palm. This means that female agricultural laborers may potentially suffer from deteriorating employment opportunities through resource-providing contracts.

Table 3.8: Effects of contracts on hired labor use, by gender

| | Male labor | | Female labor | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | Decision | Quantity | Decision | Quantity |
| | 0-1 | Days per acre | 0-1 | Days per acre |
| Marketing contract | -0.15** | 1.89 | 0.10 | 0.88 |
| | (0.06) | (2.67) | (0.09) | (1.80) |
| Resource-providing contract | 0.08 | -1.33 | -0.19** | -2.37 |
| | (0.05) | (2.09) | (0.09) | (2.81) |
| Control variables included | Yes | Yes | Yes | Yes |
| Residuals included | Yes | No | No | No |
| WTP included | No | Yes | Yes | Yes |
| Number of observations | 524 | 401 | 524 | 214 |

Note: Marginal effects from double hurdle models are shown with village cluster-corrected standard errors in parentheses. The marginal effects of the second hurdle (quantity) are conditional on the first hurdle being passed. Full results are shown in Tables A.2.17 and A.2.18 in Appendix A.2. Unconditional marginal effects are shown in Table A.2.19. * p<0.1, ** p<0.05, *** p<0.01.

## 3.5 Conclusion

While effects of contract farming on labor use and employment were rarely analyzed in previous research, the few studies that exist suggested that contracting increases labor demand for agricultural production, harvesting, and post-harvest handling (Benali et al., 2018; Khan et al., 2019; Narayanan, 2014; Neven et al., 2009; Rao and Qaim, 2013). We have provided new evidence showing that the opposite may also be true. Using survey data from the oil palm sector in Ghana, we have shown that contracts reduce total agricultural labor use per acre. The reduction is mainly observed for household labor. For hired labor, we did not identify significant effects.

Furthermore, we have shown that some of the household labor saved in oil palm production is reallocated to off-farm economic activities. Especially households with a marketing contract increase the number of labor days in off-farm emplyoment considerably. These results are in contrast to Otsuka et al. (2016) and Bellemare (2018), who argued that contract farming reduces off-farm income opportunities for farm households. Clearly, the effects depend on the context. Previous studies mostly looked at contracts for horticultural crops, which are labor-intensive and where the contracts led to additional production and post-harvest operations in order to meet specific quality requirements. This is different for oil palm contracts in Ghana. The contracts in Ghana are not associated with special quality requirements. Instead, labor-intensive post-harvest handling, which is necessary when selling in traditional markets, falls away when selling under contract. The contracting companies pick up the oil palm fruit bunches as harvested without any on-farm processing.

While the concrete results presented here should not be generalized, the finding that contract farming can reduce agricultural labor use under certain conditions certainly holds more broadly. Due to the rising international demand for palm oil, supply chains are being modernized in many African countries. New types of processing technologies and contract schemes are gaining in importance. Similar market trends are also observed for other crops traditionally grown by African smallholders.

In addition to evaluating the effects of contract farming on total labor use, we also disaggregated the analysis by gender and age. Many of the traditional post-harvest operations in oil palm are performed by women, so we had hypothesized that contracts would reduce female labor more than male labor. This hypothesis was not supported by the empirical data. At least for household labor, reductions in male and female labor time were found to be similar in magnitude. Only for hired female labor, we found a decreasing effect through resource-providing contracts. Some gendered substitution of operations in oil palm seems to occur in the sense that a reduction in hired female labor for post-harvest operations is compensated by a slight increase in hired male labor for the application of agrochemicals. Disaggregation by age revealed that contracts significantly reduce the likelihood of using child and youth labor in oil palm.

We argue that more research on the labor market effects of contract farming is needed, as this is an under-researched topic and the effects can differ remarkably depending on the particular context. Creation of decent agricultural and non-agricultural employment is key for sustainable rural development, especially in Africa where rural population growth is still quite substantial.

# Chapter 4

# Heterogeneous effects of marketing contracts and resource-providing contracts on household income


**Abstract**

In the existing literature, the effects of contract farming on household welfare were examined with mixed results. Most studies looked at single contract types. This paper contributes to the literature by comparing two types of contracts – simple marketing contracts and resource-providing contracts – in the Ghanaian oil palm sector. We investigate the effects of both contracts on farm income, as well as spillovers on other household income sources. We use survey data collected with an innovative sampling design and a control function approach to address possible issues of endogeneity. Both contracts lead to large positive effects on total household income in a similar magnitude, yet through quite different mechanisms. Farmers under the marketing contract use the increase in oil palm profits to transition out of agricultural production and into off-farm employment. Farmers under the resource-providing contract have a stronger dependency on income from oil palm, which is considerably more profitable under the contract. The findings underline that contract characteristics matter for the effects and that disaggregated analysis of different income sources is important to understand the underlying mechanisms.



**Keywords:** Contract farming, contract comparison, credit schemes, household income, spillover effects, control function approach, oil palm, Ghana.

**JEL codes:** I31, O12, O13, Q12, Q13


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This chapter is co-authored by Catherine Ragasa (CR) and Matin Qaim (MQ). The contributions of each author are as follows: AR developed the research idea, collected, analyzed, and interpreted the data. CR assisted in the analysis of the data and the interpretation of the results. AR wrote the paper. CR and MQ commented at all stages of the research and contributed to writing and revising the paper. All authors read and approved the final manuscript.

## 4.1 Introduction

The participation of smallholder farmers in modern supply chains is considered a crucial contributor to rural economic development and poverty reduction. However, smallholder market access is usually limited due to inefficiencies in input and output markets, and farm production is associated with high levels of risk. Market failures and risk lead to an under-investment in inputs, technologies, and higher-value crops (Barrett et al., 2012; Bellemare and Bloem, 2018). Contract farming has emerged as an institutional response to market failures, with the potential to reduce risk, increase smallholder investments in inputs and technologies, and thus contribute to higher productivity and income (Eaton and Shepherd, 2001; Otsuka et al., 2016; Ton et al., 2018).

The existing literature examined effects of contract farming on revenues and profits of the contracted crops (Bolwig et al., 2009; Girma and Gardebroek, 2015; Hernández et al., 2007; Jones and Gibbon, 2011; Kalamkar, 2012; Kanburi Bidzakin et al., 2019; Kumar et al., 2019; Leung et al., 2008; Mishra et al., 2018; Tripathi et al., 2005; Väth and Kirk, 2014), on agricultural income (Champika and Abeywickrama, 2014; Escobal and Cavero, 2012; Islam et al., 2019), and on total household income (Andersson et al., 2015; Bellemare, 2012; Cahyadi and Waibel, 2013; Maertens and Swinnen, 2009; Maertens and Velde, 2017; Mwambi et al., 2016; Rao and Qaim, 2011; Saigenji and Zeller, 2009; Wang et al., 2014a; Warning and Key, 2002). The results are mixed (for a more comprehensive overview see Bellemare and Bloem, 2018; Otsuka et al., 2016; and Ton et al., 2018). The empirical evidence is commonly derived from an assessment of the effects of one specific contract type. This approach neglects that different types of contracts may also have different effects. A substantial difference exists between simple marketing contracts that only offer a secure output market, and resource-providing contracts that additionally provide inputs and other technical services through interlinked credit schemes (Bijman, 2008). While some studies investigate the differences in effects across crops (Khan et al., 2019; Kumar and Kumar, 2008; Miyata et al., 2009; Narayanan, 2014; Simmons et al., 2005) and contracting companies (Nagaraj et al., 2008; Ragasa et al., 2018), only little evidence exists on the heterogeneity of effects across contract types. Currently three studies exist that investigate the effects of different contract types on rice in Benin (Arouna et al., 2019), horticulture production in Kenya (Ashraf et al., 2009), and patty seed in Nepal (Mishra et al., 2016). All stated studies find only minor differences between the contracts, potentially due to the relatively low investments required in the production of the respective crops. To the best of our knowledge, there is no evidence on the effects of marketing contracts and resource-providing contracts in a high-value crop sector with relatively high initial investment requirements. Such a sector is potentially more suited to investigate these differences. Oil palm is one example of a capital-intensive crop that has re-

cently gained in importance among smallholders in different parts of the world. In general, small-scale farmers often face financial constraints for the establishment and maintenance of oil palm plantations. These constraints can potentially be overcome with a suitable contract design. It thus has to be tested whether a simple marketing contract can enable farmers to make the required investments, or whether a resource-providing contract is better suited to overcome the capital constraints.

We perform a cross-contract comparison in the Ghanaian oil palm sector, which is dominated by small-scale producers. In particular, we provide empirical evidence on the effects of marketing contracts and resource-providing contracts on income from a high-value crop that requires relatively high initial investments. Moreover, we expand the analysis by investigating spillover effects of both contracts on the household's other income sources. Bellemare (2018) provides first evidence of spillover effects of contract farming on other income sources in Madagascar. He finds that the increase in income from the contracted crops comes with high opportunity costs. Households turn away from nonfarm activities, due to higher labor inputs in the production of the contracted crop. Little is known about these effects beyond the results of his study.

We contribute to the existing literature in two ways: (1) by estimating the effects of marketing contracts and resource-providing contracts on income in a high-value crop sector, and (2) by investigating the spillover effects of both contracts on the household's other income sources. Investigating these effects will contribute towards a better understanding of suitable contract designs, which can lead to higher incomes for smallholder farmers.

We perform this analysis with cross-sectional data on farmers with marketing contracts, resource-providing contracts, and no contracts. Previous findings indicate differential effects of both contracts on the adoption of agrochemical inputs, specialization, production expansion, productivity (Ruml and Qaim, 2019a), and agricultural labor use (Ruml and Qaim, 2019b). The results here indicate different effects on farm income and other income sources.

We use an innovative sampling design and a control function approach to address possible issues of unobserved heterogeneity across oil palm producers. For the control function approach we use two village-level instruments related to the behavior of the village leader and other farmers in the same village. We analyze the effects of both types of contracts on oil palm profits, profits from other cash crops and livestock, income from off-farm wage employment and self-employment, and total household income.

To confirm the robustness of the results we re-estimate the models including (1) a willingness-to-pay and a risk preference measure to control for remaining unobserved heterogeneity across groups, and (2) inverse probability of treatment weights. Our results are robust to all model specifications and estimation tech-

niques. We find that both contracts lead to a similar effect on total household income, but through different pathways. Farmers under the marketing contract reduce their agricultural production and generate more income off-farm. Farmers under the resource-providing contract increase their dependency on the more profitable oil palm production, which drives the increase in total household income.

The chapter is structured as follows: Section 4.2 describes the set-up of the study and both contract farming schemes, including a review of previous findings on their effects. Section 4.3 describes materials and methods used in the analysis. Section 4.4 presents and discusses the empirical results; and section 4.5 concludes.

## 4.2 Background: Oil palm contract farming in Ghana

### 4.2.1 The Ghanaian oil palm sector

In Ghana, oil palm is a traditional crop that was – until recently – mainly produced for home consumption. However, with the rising national and international demand for vegetable oils, Ghana has increased its oil palm production to commercial scale (Byerlee et al., 2017). Several large national and international processing companies are now located in the south of the country, to process oil palm fruit bunches into palm oil. These companies typically have large own plantations (nucleus estates) and additionally procure supply from farmers through contractual agreements (Huddleston and Tonts, 2007; Ministry of Food and Agriculture, 2011). The farmers are mostly small-scale producers (1-39 acres), who persist to dominate the Ghanaian oil palm sector and produce 75% of the total supply (Byerlee et al., 2017).

Despite its economic importance and the large areas dedicated to the cultivation of oil palm, Ghana remains a net importer of palm oil, with local consumption exceeding production. While agroecological factors are favorable for oil palm production (Rhebergen et al., 2016), institutional factors pose challenges for small-scale producers. In the past, smallholders lacked a sufficiently large and reliable market outlet to incentivize increased production (Ministry of Food and Agriculture, 2011). Hence, the new marketing channels established by the contracting companies, which regularly purchase oil palm fruit bunches in large quantities and at stable prices, improve the situation and could contribute to gradually increasing supply. Under the marketing contracts, product sales are arranged in advance through contractual agreements, which substantially reduce the market risk for farmers.

Farmers often also lack access to the capital required for the establishment of an oil palm plantation and for the required production inputs (Ministry of Food and Agriculture, 2011). Plantation establishment is costly, and larger revenues start to flow only after 4 years or more (Baumann, 2000; Byerlee et al., 2017). Hence, farmers require access to longer-term credits. Under resource-providing contracts, the

contracting companies supply farmers with credits for the establishment and maintenance of the plantation. These credits are paid back by the farmer through a share of the harvest that is supplied to the company without payment (or reduced payment). In addition to providing farmers with a secure sales market, these contracts directly address smallholder credit constraints. In the following, we introduce two contract farming schemes in the oil palm sector in Ghana: one marketing contract scheme and one resource-providing contract scheme.

### 4.2.2 The marketing contract scheme

The marketing contract in our study region is a verbal agreement between the processing company and the farmer, specifying an annual fixed price and regular pick-ups of the harvested oil palm fruit bunches. The processing company is the Benso Oil Palm Plantation (BOPP), a subsidiary of Wilmar International Limited. The company cultivates a 4700 hectare nucleus estate and procures oil palm from contracted smallholders through middlemen that pick up the harvest at the farm gate. Farmers are paid for the harvest a few weeks after pick-up. Quality standards are very low and basically not existing. Farmers did not report about any rejections from the company. Only in peak seasons, it sometimes takes the company somewhat longer to pick up and weigh the harvest. During the waiting period, the fruit bunches lose water and hence weight, which reduces farmers' revenues.

Beyond these sales to the company at a fixed annual price, the marketing contract specifies no conditions and the farmers do not receive assistance. However, the company renovated the roads connecting the processing plant and some of the contracted villages to reduce transportation costs. This infrastructure development is potentially an additional benefit for all farmers in the villages, regardless of whether or not they are contracted themselves. Considering that the marketing contract does not include any credits, entering the scheme is relatively easy for farmers. A few farmers in the study region joined the marketing contract scheme in the 1980s, the early years of the scheme. Most other farmers joined in the 1990s and early-2000s.

We find that the marketing contract leads to a reduction in the number of cash crops produced by the households, but not to the adoption of agrochemical inputs or to higher yields (Ruml and Qaim, 2019a). The company regularly collects the oil palm bunches, which means that the household does not have to pick the oil palm fruits out of the bunches, manually process the oil palm into palm oil, or market the produce, all of which is necessary when supplying traditional local markets. We find that the marketing contract leads to a significant reduction of agricultural labor use per acre, of over 50% on average. Households react to the lower labor requirement by reallocating household labor towards off-farm wage and self-employment (Ruml and Qaim, 2019b). Based on these previous findings we expect that the marketing

contract reduces the income derived from cash crops other than oil palm (negative spillover), but increases the income from off-farm wage and self-employment (positive spillover).

### 4.2.3 The resource-providing contract scheme

The resource-providing contract in the study region is a written agreement between the processing company and the farmer, specifying an annual fixed price, regular pick-ups of the harvested oil palm, and in-kind credit provisions. The processing company is the Twifo Oil Palm Plantation (TOPP) which includes a 4300 hectare nucleus estate and is owned by Unilever. The in-kind credits include the required inputs for the establishment and the maintenance of the plantation. The credit is not a lump sum, but depends on the services the farmer requires, e.g. the amount of labor and the machinery that the company provides. The credit is paid back by the farmer through 25% of each harvest, with interest rates. The farmer has full decision autonomy on the inputs he/she applies and the amount of credit, meaning that the production intensities are not pre-determined by the company. Output quality standards are low, but weight losses due to waiting times can occur in the peak seasons in the same way as discussed above for the marketing contract. The establishment of most plantations contracted under the resource-providing scheme was between 2008 and 2010. Similar to the marketing scheme, the company renovated the roads connecting the processing plant and some of the contracted villages to reduce transportation costs.

We find that the resource-providing contract leads to a specialization on oil palm through the expansion of the area under cultivation. Under the resource-providing contract, farmers sometimes acquire additional land to increase the production of oil palm. They also adopt chemical fertilizer and have a substantially higher productivity (Ruml and Qaim, 2019a). As the marketing contract, the resource-providing contract leads to a strong decrease in the agricultural labor use per acre. However, the reallocation of household labor towards off-farm employment is smaller, as farmers expand the area under (oil palm) cultivation, which leads to lower labor savings at the farm level. On average, we find an annual increase of 83 additional labor days worked in off-farm employment by male household members (Ruml and Qaim, 2019b). Whether the higher productivity and the increased production scale create revenues that are large enough to offset the additional costs and credit repayment rates will be tested in the following analysis.

## 4.3 Material and method

### 4.3.1 Data and sampling design

We collected cross-sectional data between April and July 2018. Out of five large processing companies in the region, we selected two based on their contract types and the geographical proximity to each other (Figure 2.1). For comparison, we selected a region that is currently outside of the companies' catchment areas. A contract farming scheme is currently developed and scheduled for implementation in this comparison region, yet the farmers in that region were unaware of the upcoming scheme at the time of the survey. The Ministry of Food and Agriculture (MoFA) provided us with the list of villages selected for the new scheme. In these villages, the contracting company will offer contracts in the near future.

We decided to sample farmers from a comparison region rather than non-contracted farmers in the contract regions themselves, in order to reduce issues of selection bias and possible spillover effects of the contract schemes to non-contracted households. Spillovers may occur because also non-contracted farmers in the contract villages can sell their produce to the contracting company in times of supply shortages, or through the account of a contracted neighbor. Especially for the marketing contract, both cases were regularly reported in focus group discussions that we had organized. The independent producers in the contract villages are few in numbers and they declined the contract offer, which was also available to them. This raises concerns of selection bias from the farmer side. Surrounding villages without contracted farmers were not chosen by the contracting companies, so that sampling control farmers in these surrounding villages might have been associated with selection bias from the company side. This is why we decided to select a different comparison region, which is similar in terms of many relevant variables only that no contract scheme existed at the time of the survey.

The three selected regions (one for each contract type and one comparison region) are bordering each other, as illustrated in Figure 2.1. The farmers under the marketing contract are located in the Western Region, the farmers under the resource-providing contract in the Central Region, and the comparison farmers in the Ashanti Region. All three regions are very similar in terms of their agroecological conditions and their suitability for oil palm cultivation (Rhebergen et al., 2016). Regional borders are informal and the population is alike in terms of its ethnic and religious composition.

The villages within the three regions were selected based on the lists provided by the contracting companies, and the MoFA. We randomly sampled 9 villages under the marketing contract, 13 villages under the resource-providing contract, and 9 comparison villages registered for the upcoming contract farming scheme. Within the sampled villages, a local interviewer team compiled lists with all households

eligible for this study. This includes the contracted households in the contracted villages, and commercial oil palm farming households in the comparison villages. All households listed produce oil palm on their own lands or under private land arrangements (e.g. sharecropping). Based on these lists we randomly sampled and interviewed 75% of the households in each village, using a structured questionnaire programmed into tablet computers[1]. In total, this added up to 463 households, of which 193 produce under the marketing contract, 164 under the resource-providing contract, and 106 without any contract.

### 4.3.2 Estimation strategy

The objective of this paper is to estimate the effects of the marketing contract and the resource-providing contract on household income in total, and by income source. We model the estimation in equation (4.1), where $Y_{hj}$ denotes the respective per capita income of household $h$ in village $j$, for the last 12 months prior to the survey. $MC_{hj}$ and $RPC_{hj}$ denote two treatment dummies that equal one if the household is contracted under the marketing contract (MC) and the resource-providing contract (RPC), respectively.

$$lnY_{hj} = \beta_0 + \beta_1 MC_{hj} + \beta_2 RPC_{hj} + \beta_3 X_{hj} + u_{hj} \tag{4.1}$$

To derive relative changes, $lnY_{hj}$ denotes the inverse hyperbolic sine transformation of $Y_{hj}$. This transformation is more suited to account for zeros and negative values among the observations, as suggested by (Bellemare and Wichman, 2019). After estimation, we calculate semi-elasticities, such that $\beta_1$ and $\beta_2$ present the marginal effects of the respective contract scheme on the household's per capita income in percentage terms.

The income categories under investigation include the household's oil palm profits, other cash crop profits, livestock income, income from off-farm wage and self-employment, and total household income. Oil palm profits are calculated as the total revenues made from oil palm minus all input and transportation costs. Household labor was not valued for this calculation, so that the profit can be interpreted as the return to household labor. For farmers under the resource-providing contract, the credit repayment rates were deducted as variable costs. Other cash crop profits and livestock income were calculated in the same way. Livestock is a minor income source in the study setting, yet we include it for completeness. The income from off-farm wage and self-employment is the sum of all annual salaries/wages and profits from non-farm enterprises. Lastly, total household income is the sum of all the different income sources. To account for differences in household structures, per capita incomes were derived using the Oxford Equivalent Scale.

[1]The paper version of the household questionnaire is attached in Appendix B.1.

Collecting credible data on household income requires an elaborate set of questions and the ability of farmers to recall the required information. For the profits from oil palm and other cash crops we split the questions into plots and types of crop; we asked each sale and input expenditure for each crop on each plot separately. For the hired labor expenditure for oil palm we continued this separation and additionally split the questions into production steps and the type of labor hired (male and female adult, child and youth), to get accurate wages and working hours. Income from off-farm wage and self-employment was easier to collect, as households typically have very few off-farm income sources (if any) and with relatively little variation over the year. For the profits of self-employment, the interviewer team assisted the household in calculating monthly profits and adding them up to annual values.

### 4.3.3 Identification strategy

Estimating the effects of contract farming with cross-sectional data raises concerns of endogeneity (unobserved heterogeneity and reverse causality). Cross-sectional data limit the ability to observe changes in the outcome variables for the same unit of observation over time; and modelling the variation across different units risks capturing the unobserved heterogeneity across these units and not the effect of the treatment. In equation (4.1), this implies a possible correlation between the contract participation variables and the error term, which violates the assumptions of the OLS model and leads to inconsistent and biased results. Endogeneity is also likely since income level can affect contract participation. The two dummy variables measuring the participation in the marketing contract and the resource-providing contract may be endogenous to the income model. There is also the potential issue of non-random self-selection of farmers into the respective contract farming scheme (Bellemare, 2012). We use a set of strategies to reduce such issues of endogeneity. First, the set-up of the study and the sampling strategy were chosen such that they reduce the risk of selection bias. As described above, we only considered villages that are eligible for contracting from the company perspective and included comparison farmers that have not yet made the participation decision.

Second, we use propensity score matching to ensure the comparability of the farmers with and without contracts. We calculate propensity scores based on a multinomial logit model (for the two contract options and the control), and restrict the analysis to the households with common support. In total, three households with marketing contracts are excluded from further analysis. The three households have no common support, under both the nearest neighbor matching (NNM) and the kernel matching (KM).

Third, we address endogeneity by using instruments that explain contract participation but do not directly influence income beyond the effect through contract participation. The instrument for the marketing contract is the share of oil palm producing households in the village. Due to the high transportation and transaction costs of the processing companies, a village is more likely to be involved in the contract scheme if a large share of farmers produce oil palm. The marketing scheme does not provide financial assistance to the farmers and the company is dependent on farmers with established oil palm plantations. Thus, we expect that a higher share of commercial oil palm farmers in a village will increase the chance of a farmer being targeted by the contract scheme. The share of commercial oil palm farming households in the village does not directly influence the household's total income, or any of the income sources.

The instrument for the resource-providing contract is a dummy variable that equals one if the village chief is a commercial oil palm farmer. In this set-up, the village chief acts as an intermediary between the contracting company and the farmers within the village. We argue that the village chief is more likely to cooperate with the company if being a commercial oil palm farmer himself/herself. Again, the instrument has no direct influence on the household's incomes, considering that we only measure whether the village chief produces oil palm and not how he/she produces it.

Using these instruments, we employ a control function (CF) approach, which is efficient also when the first-stage equation is nonlinear, as in our case (Terza et al., 2008; Wooldridge, 2014). In our CF model, contract participation is estimated in a first step, based on which the residuals for each treatment are calculated (Terza et al., 2008; Wooldridge, 2014). Equations (4.2) and (4.3) describe this procedure.

$$C_{hj} = \alpha_0 + \alpha_1 X_{hj} + \alpha_2 Z_j + v_{hj} \tag{4.2}$$

$$\hat{v}_{hj} = C_{hj} - \hat{C}_{hj} \tag{4.3}$$

where $C_{hj}$ is a binary variable that equals one if the household is under contract and zero otherwise, $X_{hj}$ captures the exogenous household and village level controls, and $Z_j$ is the vector of instruments described above. Since we have two different contract farming schemes, the underlying model in equation (4.2) is a multinomial logit model.

We include the two described instruments that are exogenous to the household's per capita incomes and sufficiently explain the participation in the respective contract farming scheme in the multinomial logit model. Both instruments pass the exclusion restriction, as illustrated in Table A.3.1 in Appendix A.3. Both instruments have no correlation with any of the outcome variables in the control group. This indicates that they have no direct effect on the outcome variables, other than through contract participation. Furthermore, they sufficiently explain participation

in the respective contract farming scheme, as illustrated in Table A.3.2 in Appendix A.3. Both instruments are statistically significant at the one percent level in the reduced form of the marketing contract. Further, the results of the Anderson and Cragg-Donald tests suggest that the instruments are not under-identified and not weak.

After estimation, we derive the residuals $\hat{v}_{hj}$ through the difference between actual participation $C_{hj}$ and estimated participation $\hat{C}_{hj}$ in the respective contract scheme, as described in equation (4.3). Based on these residuals, we calculate generalized residuals, which are normalized and have a conditional mean at zero (Gourieroux et al., 1987; Wooldridge, 2015). These generalized residuals are included in the regressions in a second step. If they are statistically significant, exogeneity has to be rejected and the residuals are included to control for endogeneity. If the residuals are statistically insignificant, exogeneity cannot be rejected, and OLS without further inclusion of the residuals can be applied.

In our case, we find no statistical significance of the residual terms and hence cannot reject exogeneity for all model specifications, as illustrated in Table A.3.3 in Appendix A.3. Thus, OLS estimations are consistent and will be employed.

We further perform two robustness checks to verify the results. First, we include a willingness-to-pay and a risk preference measure in all model specifications. The self-selection of farmers into contract farming is based on unobservable characteristics, such as their entrepreneurial ability, or their risk and time preferences. A systematic difference in these unobservables between contracted and non-contracted farmers would lead to a correlation with the error term and bias in the OLS results (Angrist and Pischke, 2008), as described above. The household's willingness-to-pay for contracting and risk preferences are likely correlated with entrepreneurial ability and other relevant unobserved factors, so that including these indicators can test for possible bias due to unobserved heterogeneity. A similar approach was applied in Bellemare and Novak (2017), Meemken and Qaim (2018), and Verhofstadt and Maertens (2014) to test and control for unobserved heterogeneity. In our study, the willingness-to-pay measure was derived through a set of hypothetical contract offers with required initial investments. The variable captures the highest initial investment the farmer was willing to make, to participate in a contract[2]. The risk preferences were measured through a set of choices, in which the farmer decided between a lower risk and a higher risk crop. Our risk variable represents these choices in categorical form, ranging from 0 (risk averse) to 5 (risk friendly)[3]. We include both measures as a robustness check, to test whether the OLS results are robust to this modification.

As a second robustness check, we perform an inverse probability of treatment

[2]The variable is based on question 76 in the household questionnaire in Appendix B.1.
[3]The variable is based on question 75 in the household questionnaire in Appendix B.1.

weighting (IPTW) to control for pre-treatment imbalances (McCaffrey et al., 2013). In a first step, we estimate the probability of a household being under the marketing contract or the resource-providing contract, based on a multinomial logit model. In a second step, we use the inverse probabilities as weights in the OLS regression. Thus, each household in the sample is assigned a weight that expresses the likelihood that the household would be under contract. This way, a non-contracted household with a high probability to be under contract contributes more to this analysis compared to a household with a low probability. For the contracted farmers, the weights have the opposite effect. This approach further increases the comparability of the three groups.

It should be stressed that impact evaluation with cross-section observational data remains a challenge, where possibly not all issues of endogeneity can be solved. Another limitation that should be mentioned is that the marketing contract and the resource-providing contract are offered by two different companies. Hence, we are not able to separate the contract effects from company characteristics or other company services (such as infrastructure improvements) that may also play a role. Results should therefore be interpreted as the total package of contracts, services, and infrastructural support to the contract regions/villages. Despite these limitations, the results across the estimation and identification techniques are consistent, which provides confidence on the validity of the findings.

## 4.4 Results

### 4.4.1 Descriptive results

Table 4.1 compares oil palm profits and related variables across contract and comparison groups. Mean differences between the three groups are tested for statistical significance. Mean revenues and profits are higher for farmers under the marketing contract than for non-contract farmers, whereas production costs are lower. However, these differences are not statistically significant, due to large data variability, especially in the group of non-contract farmers. Farmers under the resource-providing contract cultivate a larger area of land with oil palm and have substantially higher yields, revenues, and profits than the other two groups, and these differences are statistically significant.

Farmers in both contract groups receive significantly lower output prices than non-contract farmers. Apparently, the security provided by the contracts and the ability to sell larger quantities comes with a lower average price per ton of fruit bunches. Yet, the variability of the output prices is also substantially lower in both contract schemes. Independent producers have a variety of market outlets, including small processors and local consumers, who purchase either small quantities of

oil palm fruits or manually processed palm oil. Hence, spot market prices depend on fluctuating demand and can vary substantially. Although independent producers receive a higher mean price per ton, they can usually not sell in larger quantities.

Table 4.1: Descriptive results – oil palm profitability

| | Mean | | | Difference | | |
|---|---|---|---|---|---|---|
| | Marketing contract (MC) | Resource-providing contract (RPC) | No contract (NC) | MC-RPC | MC-NC | RPC-NC |
| Total area under oil palm (in acres) | 4.59 | 8.02 | 5.05 | *** | | *** |
| | (0.28) | (0.62) | (0.53) | | | |
| Total yields (in tons) | 13.90 | 43.08 | 13.08 | *** | | *** |
| | (1.19) | (5.32) | (1.96) | | | |
| Revenues (in GHS) | 4604.69 | 10017.24 | 4267.88 | *** | | *** |
| | (398.41) | (1236.50) | (931.31) | | | |
| Production costs acre (in GHS) | 2548.50 | 3931.67 | 3650.16 | ** | | |
| | (224.32) | (559.84) | (1032.82) | | | |
| Price per ton of oil palm (in GHS) | 337.28 | 310.06 | 422.02 | *** | *** | *** |
| | (3.46) | (0.03) | (38.13) | | | |
| Average profits per acre (in GHS) | 399.55 | 738.88 | 205.56 | *** | | *** |
| | (60.00) | (65.10) | (138.05) | | | |
| Total profits (in GHS) | 2056.20 | 6085.67 | 617.73 | *** | | *** |
| | (343.97) | (902.79) | (1179.12) | | | |

Note: GHS refers to Ghanaian Cedis. Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 4.2 compares mean per capita incomes across the three groups. Compared to non-contract farmers, farmers under the marketing contract have higher oil palm profits, lower profits from other cash crops, lower income from livestock and off-farm employment, and lower total household incomes. However, these differences are not statistically significant. The results in the lower part of Table 4.2 further indicate that farmers under the marketing contract derive a lower share of their income from oil palm and a higher share from other cash crops and off-farm wage and self-employment.

Farmers under the resource-providing contract have much higher oil palm profits than the other two groups and these differences are statistically significant (Table 4.2). This difference in oil palm profits seems to over-compensate lower incomes from other sources, resulting in higher total household incomes per capita among farmers with a resource-providing contract. These simple comparisons should not be over-interpreted, but they suggest that the contracts may not only influence the income magnitude, but may also lead to shifts in the role of different income sources. Descriptive statistics for the variables that are used as controls in the regression models are shown in Table A.3.5 in Appendix A.3.

Table 4.2: Descriptive results – per capita income, by income source

| | Mean | | | Difference | | |
|---|---|---|---|---|---|---|
| | Marketing contract (MC) | Resource-providing contract (RPC) | No contract (NC) | MC-RPC | MC-NC | RPC-NC |
| Oil palm profits (in GHS) | 812.26 | 2196.28 | 299.38 | *** | | *** |
| | (146.43) | (440.56) | (339.69) | | | |
| Profits from other cash crops (in GHS) | 1565.20 | 1540.87 | 2138.76 | | | |
| | (215.77) | (212.87) | (903.45) | | | |
| Livestock income (in GHS) | 29.39 | 44.79 | 43.38 | | | |
| | (12.21) | (16.32) | (14.24) | | | |
| Income from off-farm wage and self-employment (in GHS) | 623.08 | 638.75 | 1019.39 | | | |
| | (83.56) | (169.28) | (350.98) | | | |
| Total household income (in GHS) | 3029.93 | 4657.72 | 3500.91 | ** | | |
| | (313.39) | (649.43) | (923.29) | | | |
| *Income shares* | | | | | | |
| Oil palm profits (in GHS) | 0.38 | 0.72 | 0.43 | | | |
| | (0.06) | (0.18) | (0.13) | | | |
| Profits from other cash crops (in GHS) | 0.33 | 0.14 | 0.29 | | | |
| | (0.05) | (0.18) | (0.08) | | | |
| Livestock income (in GHS) | 0.01 | 0.01 | 0.02 | | | |
| | (0.00) | (0.00) | (0.01) | | | |
| Income from off-farm wage and self-employment (in GHS) | 0.20 | 0.13 | 0.14 | * | | |
| | (0.03) | (0.03) | (0.07) | | | |
| Share of households with positive oil palm profits | 0.77 | 0.84 | 0.60 | | *** | *** |
| | (0.03) | (0.03) | (0.05) | | | |
| Share with positive profits for other cash crops | 0.78 | 0.82 | 0.81 | | | |
| | (0.03) | (0.03) | (0.04) | | | |
| Share of household with livestock income | 0.13 | 0.16 | 0.21 | | | |
| | (0.02) | (0.03) | (0.04) | | | |
| Share of households with off-farm wage and self-employment | 0.49 | 0.46 | 0.48 | | | |
| | (0.04) | (0.04) | (0.05) | | | |

Note: Additional descriptive statistics are presented in Table A.3.4 in Appendix A.3. Descriptive statistics of the control variables are presented in Table A.3.5 in Appendix A.3. Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

### 4.4.2 Econometric results

Table 4.3 presents the OLS results of the effects of contract participation on per capita income after controlling for confounding factors. We focus on the semi-elasticities shown in the lower part of Table 4.3 for easy interpretation. According to these estimates, the marketing contract leads to a 95% increase in per capita oil palm income. Further, we identify spillover effects of the marketing contract on other income sources: we find a 9% reduction in profits from other cash crops, an 18% reduction in livestock income, and an 11% increase in income off-farm wage and self-employment. The net effect of the marketing contract on total per capita household income is a 67% increase. Overall, these results suggest that the oil palm marketing contract leads to very sizeable income gains and also contributes to a cer-

tain transition of farm households towards off-farm economic activities. A stronger emphasis on off-farm activities is possible because of the significant labor savings associated with the contract (Ruml and Qaim, 2019b), as discussed above.

Table 4.3: OLS results – per capita income, by income source

| | Oil palm profits | Profits other cash crops | Livestock income | Income off-farm wage and self-employment | Total household income |
|---|---|---|---|---|---|
| Marketing contract | 2.29*** | -0.22* | -0.43** | 0.27** | 1.63*** |
| | (0.22) | (0.06) | (0.07) | (0.06) | (0.05) |
| Resource-providing contract | 3.90*** | 0.23 | -0.42** | 0.16 | 1.96** |
| | (0.07) | (0.14) | (0.06) | (0.11) | (0.25) |
| Other controls included | Yes | Yes | Yes | Yes | Yes |
| *Semi elasticities* | | | | | |
| Marketing contract | 0.95*** | -0.09*** | -0.18*** | 0.11*** | 0.67*** |
| | (0.09) | (0.02) | (0.03) | (0.02) | (0.02) |
| Resource-providing contract | 1.39*** | 0.08* | -0.15*** | 0.06 | 0.70*** |
| | (0.03) | (0.05) | (0.02) | (0.04) | (0.09) |
| Number of observations | 460 | 460 | 460 | 460 | 460 |

Note: Full regression results are presented in Table A.3.6 in Appendix A.3. Treatment clustered standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The results for the resource-providing contract show a 139% increase in oil palm profits (Table 4.3), which is substantially larger than the effect of the marketing contract. Furthermore, we find a positive spillover effect of the resource-providing contract for oil palm on profits from other cash crops in a magnitude of 8%. The positive profit effect for other cash crops points at productivity gains across the different crops produced; at least it cannot be the result of larger areas grown with other cash crops, because farmers under the resource-providing contract actually specialize more on oil palm and grow smaller areas with other cash crops than non-contracted farmers (Ruml and Qaim, 2019a). Livestock income is reduced by 15% through the resource-providing contract, whereas income from off-farm wage and self-employment is not affected significantly. The net effect of the resource-providing contract on total per capita household income is a 70% increase.

The control function estimates are shown in Table 4.4. These are very similar to the OLS estimates just discussed, which underlines the robustness of the findings. The only major difference is that with the control function approach we do not find statistically significant effects of both contracts on profits from other cash crops.

Table 4.4: Control function results – per capita income, by income source

| | Oil palm profits | Profits other cash crops | Livestock income | Income off-farm wage and self-employment | Total household income |
|---|---|---|---|---|---|
| Marketing contract | 2.35** | -0.17 | -0.39** | 0.38 | 2.37** |
| | (0.27) | (0.16) | (0.08) | (0.15) | (0.40) |
| Resource-providing contract | 4.08** | -0.01 | -0.57** | 0.56 | 1.94** |
| | (0.67) | (0.32) | (0.09) | (0.25) | (0.21) |
| Other controls included | Yes | Yes | Yes | Yes | Yes |
| *Semi elasticities* | | | | | |
| Marketing contract | 0.97*** | -0.07 | -0.16*** | 0.13* | 0.98*** |
| | (0.11) | (0.06) | (0.03) | (0.07) | (0.17) |
| Resource-providing contract | 1.45*** | -0.01 | -0.20*** | 0.06 | 0.70*** |
| | (0.24) | (0.11) | (0.03) | (0.04) | (0.07) |
| Number of observations | 460 | 460 | 460 | 460 | 460 |

Note: Full regression results are presented in Table A.3.7 in Appendix A.3. Treatment clustered standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01.

### 4.4.3 Robustness checks

We now present the results of the two robustness checks that were described above in connection with the identification strategy. Table 4.5 presents the results of models that include the farmers' willingness-to-pay for contracting and risk preferences as additional explanatory variables to control for unobserved heterogeneity. The estimates are very similar to the OLS results above in terms of both their magnitude and statistical significance. Only the effect of the resource-providing contract on profits from other cash crops is not statistically significant.

Table 4.5: OLS results – per capita income, by income source (including willingness-to-pay and risk preferences)

| | Oil palm profits | Profits other cash crops | Livestock income | Income off-farm wage and self-employment | Total household income |
|---|---|---|---|---|---|
| Marketing contract | 2.31** | -0.27** | -0.43** | 0.33** | 1.64*** |
| | (0.24) | (0.06) | (0.07) | (0.03) | (0.03) |
| Resource-providing contract | 3.95*** | 0.20 | -0.40** | 0.20 | 1.98** |
| | (0.10) | (0.14) | (0.05) | (0.16) | (0.24) |
| Other controls included | Yes | Yes | Yes | Yes | Yes |
| *Semi elasticities* | | | | | |
| Marketing contract | 0.96*** | -0.11*** | -0.18*** | 0.14*** | 0.68*** |
| | (0.10) | (0.03) | (0.03) | (0.01) | (0.01) |
| Resource-providing contract | 1.40*** | 0.07 | -0.14*** | 0.07 | 0.71*** |
| | (0.03) | (0.05) | (0.02) | (0.06) | (0.08) |
| Number of observations | 460 | 460 | 460 | 460 | 460 |

Note: Full regression results are presented in Table A.3.8 in Appendix A.3. Treatment clustered standard errors in parentheses.* p < 0.1, ** p < 0.05, *** p < 0.01.

Table 4.6 presents the results of the models with inverse probability weighting. Again, the effects are similar to the OLS results. In fact, using the inverse probability weights increases the magnitude of some of the coefficients. Overall, we conclude that the main findings are quite robust to changes in the estimation strategy.

Table 4.6: OLS results – per capita income, by income source (inverse probability of treatment weighting)

| | Oil palm profits | Profits other cash crops | Livestock income | Income off-farm wage and self-employment | Total household income |
|---|---|---|---|---|---|
| Marketing contract | 2.07*** | -0.45** | -0.37*** | 0.65* | 1.31*** |
| | (0.04) | (0.05) | (0.01) | (0.15) | (0.06) |
| Resource-providing contract | 3.99*** | 0.08* | -0.45*** | 0.32 | 1.97*** |
| | (0.17) | (0.03) | (0.02) | (0.22) | (0.15) |
| Other controls included | Yes | Yes | Yes | Yes | Yes |
| *Semi elasticities* | | | | | |
| Marketing contract | 0.86*** | -0.18*** | -0.15*** | 0.27*** | 0.54*** |
| | (0.02) | (0.02) | (0.00) | (0.06) | (0.02) |
| Resource-providing contract | 1.65*** | 0.03*** | -0.19*** | 0.13 | 0.81*** |
| | (0.07) | (0.01) | (0.01) | (0.09) | (0.06) |
| Number of observations | 460 | 460 | 460 | 460 | 460 |

Note: Full regression results are presented in Table A.3.9 in Appendix A.3. Treatment clustered standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

## 4.5 Discussion and policy implications

### 4.5.1 Discussion of results

The results show that both the marketing contract and the resource-providing contract lead to significant increases in oil palm profits and total household incomes. The effect on oil palm profits is larger for the resource-providing contract, while the effect on total household income is similar for both contracts. The effects were found to be robust to a variety of model specifications and estimation techniques.

The findings suggest that while marketing contracts and resource-providing contracts lead to similar effects on total household income, the impact mechanisms of both contracts are quite different. We find that farmers under the marketing contract use the gain in oil palm profits and the saved labor time to transition out of agricultural production. While oil palm remains an important income source for these farmers, the production of other cash crops and livestock decreases and the income from off-farm wage and self-employment increases. These results are quite different from those of Bellemare (2018), who finds that contracted smallholders turn away from nonfarm activities due to higher labor use for the contracted crop.

Obviously, the effects depend on the type of crop and how the labor requirements change through contracting. For oil palm in Ghana, production under contract leads to a substantial reduction in agricultural labor use (Ruml and Qaim, 2019b).

Households producing under the resource-providing contract react quite differently. The provision of in-kind credits entails a large expansion of their oil palm plantations and a significant increase in productivity and profits. For households with a resource-providing contract, oil palm is by far the most important source of income and we find no indication of a significant transition towards off-farm economic activities.

### 4.5.2 Policy implications

Our findings suggest that the effects of contract farming strongly depend on the type of contract. This has important policy implications, depending on what the concrete policy objective is. If the main policy objective is to help farmers overcome their constraints in accessing credit, inputs, and technologies, and thus increase their farm incomes, resource-providing contracts are better suited than marketing contracts. Previous research suggests that marketing contracts alone may not be sufficient to increase smallholders' input and technology constraints (Ruml and Qaim, 2019a). However, if the main policy objective is to improve the wellbeing of smallholders – not necessarily only through farm income gains but through total household income gains, including from off-farm activities – marketing contracts may also serve the purpose, as our results from Ghana suggest.

Of course, the concrete results from the oil palm sector in Ghana cannot be generalized, as the outcomes depend on the type of crop, the type of market failures, and the agricultural and non-agricultural opportunities in a particular context. But the general finding that contract design matters substantially for the impact and the underlying impact mechanisms is certainly valid beyond the case of oil palm in Ghana.

### 4.5.3 Study limitations

Our study has two limitations. First, the potential issue of endogeneity that we addressed with a control function approach. The instruments used are at the village level and do not capture individual unobserved heterogeneity. Therefore, in a robustness check we tried to control for some of the possibly remaining unobserved heterogeneity through willingness-to-pay and risk preference measures. Furthermore, we increased comparability of farmers in the different contracts and the comparison group through inverse probability of treatment weighting. Our results are robust to these alternative specifications. Nevertheless, we may not have fully

addressed all unobserved heterogeneity at the household level. Hence, some caution in the causal interpretation is warranted. Second, we included two companies and contracts in our sample to estimate the effects of each type of contract. With this sampling strategy we are not able to separate the contract effects from potential effects of company characteristics. Separating these effects would require an alternative sampling strategy, which might be an interesting direction for future research.

## 4.6 Concluding remarks

In this paper, we have examined the effects of marketing contracts and resource-providing contracts in the Ghanaian oil palm sector. We have estimated the effects of both contracts on total household income and on different income sources. We have contributed to the existing literature in two ways: First, by performing a cross-contract comparison, which is useful to better understand the role of contract characteristics. To the best of our knowledge, this is the first study that compares effects of different types of contracts for a high-value crop in a developing country. Second, by analyzing the effects of both contracts on all farm and non-farm income sources, which is useful to identify spillovers and indirect effects that are not obvious when only focusing on profits from the contracted crop alone.

We have used a comprehensive identification strategy to reduce issues of endogeneity and also carried out various robustness checks. The results suggest that marketing contracts and resource-providing contracts both lead to large increases in total household income, yet through different mechanisms. Farmers under the marketing contract use the increase in oil palm profits to transition out of agricultural production. While oil palm remains an important income source for them, the income from other cash crops and livestock decreases and the income from off-farm wage and self-employment increases. Households producing under the resource-providing contract react in a different way. The provision of in-kind credits leads to a significant increase in oil palm profits and a stronger dependency on income from oil palm. For households under the resource-providing contract, income from other sources is largely unchanged, so that the large increase in household income is mainly attributable to gains in oil palm profits. Both contracts substantially reduce the variability of production costs and all income sources.

Overall, our findings underline that contract characteristics matter and should not be ignored when designing contract farming policies and when estimating resulting effects. In this setting, both types of contracts have similar effects on total household income but quite different effects on various income components, which further underlines that disaggregated analysis of different income sources is impor-

tant to understand the underlying mechanisms. Follow-up research on the effects of different types of contracts will be useful to provide the knowledge required for the development of suitable contract designs.

# Chapter 5

# Smallholder farmers' dissatisfaction with contract schemes in spite of economic benefits: Issues of mistrust and lack of transparency


**Abstract**

Contract farming is typically seen as a useful mechanism to help smallholders. However, despite economic benefits, high dropout rates from contract schemes are commonplace. We use data from Ghana to show that smallholders benefit from a resource-providing contract in terms of higher yields and profits, but most of them still regret their decision to participate and would prefer to exit if they could. The main problem is insufficient information from the company. Farmers do not understand all contract details, which leads to mistrust. We argue that lack of transparency may explain high dropout rates in Ghana and other situations too.



**Keywords:** Contract farming, continuity, attrition, information, transparency.

**JEL codes:** L29; L49; O12; O13; Q13


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This chapter is co-authored by Matin Qaim (MQ). The contributions of each author are as follows: AR and MQ developed the research idea. AR collected, analyzed, and interpreted the data. AR wrote the paper. MQ commented at all stages of the research and contributed to writing and revising the paper. All authors read and approved the final manuscript.

## 5.1 Introduction

Contract farming describes an arrangement between a buying company and a selling farmer in which the terms of the sale are specified in advance (Grosh, 1994). It is an institutional response to the high risks and uncertainties in spot markets, which are often characterized by significant market failures. Contract farming can reduce these risks and uncertainties, and thus incentivize increased smallholder investments, leading to higher productivity and income (Bellemare and Lim, 2018; Eaton and Shepherd, 2001; Key and Runsten, 1999; Simmons et al., 2005). Therefore, contract farming is often seen as a useful tool for poverty alleviation and rural development (Otsuka et al., 2016; Wang et al., 2014b). It is also seen as an efficient mechanism to link smallholder farmers to high-value supply chains (Nguyen et al., 2015).

The question whether contract farming is really beneficial for smallholder farmers has long been a subject of debate. One strand of literature raises concerns that contract farming leads to the exploitation of unpaid family labor and land (Clapp, 1994; Little and Watts, 1994), and to the overexploitation of the farmers' natural resources (Bijman, 2008). It is argued that contracts create unequal power relations, due to the monopsonistic nature of the company (Clapp, 1994; Little and Watts, 1994; Morrison et al., 2006; Oya, 2012). It is also argued that contracts lead to a loss of farmers' autonomy, unequal gender relations (Bijman, 2008), and changes in social behavior (Adams et al., 2019).

A second, mostly empirical strand of literature provides evidence on positive effects of contract farming on production and household welfare. From an economics perspective, farmers with a contract typically benefit through higher yields (Brambilla and Porto, 2011; Champika and Abeywickrama, 2014; Hernández et al., 2007), revenues (Bolwig et al., 2009; Cai et al., 2008; Jones and Gibbon, 2011; Kalamkar, 2012; Tripathi et al., 2005; Wainaina et al., 2012), profits (Islam et al., 2019; Kumar and Kumar, 2008; Kumar et al., 2019; Mishra et al., 2018; Narayanan, 2014), and incomes (Andersson et al., 2015; Ashraf et al., 2009; Bellemare, 2012; Cahyadi and Waibel, 2016; Ito et al., 2012; Khan et al., 2019; Maertens and Swinnen, 2009; Maertens and Velde, 2017; Miyata et al., 2009; Rao and Qaim, 2011). A recent analysis of the existing empirical results showed that positive productivity effects were found in 92%, and positive income effects in 75% of the cases (Wang et al., 2014b)[1].

However, in spite of positive income effects of contract farming in many situations, high smallholder dropout rates from contract schemes are often observed

[1]However, there may be a certain publication bias in the literature on contract farming, with positive results having a higher likelihood of being published than negative results (Ton et al., 2018). A recent study with representative data from six developing countries showed that contract farming had significantly positive income effects in only three of the six countries (Meemken and Bellemare, 2020).

(Andersson et al., 2015; Euler et al., 2016; Gatto et al., 2017; Minot and Ngigi, 2004; Minot and Sawyer, 2016; Narayanan, 2013; Narayanan, 2014; Ton et al., 2018). One reason for dropouts is that smallholders violate the contract conditions or are unable to consistently meet the quality requirements. However, there are also cases where farmers simply seem to be dissatisfied (Andersson et al., 2015; Gatto et al., 2017; Ochieng et al., 2017). Thus, the debate around the development potential of contract farming is ongoing and requires additional research on potentials and constraints beyond narrowly defined economic indicators. In particular, farmers' satisfaction with contract farming is not yet sufficiently understood, but is important to reduce dropouts and facilitate lasting partnerships between smallholder farmers and agribusiness companies.

The objectives of this paper are to analyze concerns about farmers' satisfaction with contract farming and to illustrate that economic benefits are insufficient to explain farmers' perceptions and dropout behavior. We use an interesting empirical example to underline the importance of social aspects related to trust and transparency for the longer-term success of contract schemes. The example is a resource-providing contract between a large processing company and smallholder oil palm producers in Ghana. The contract scheme can be considered a success from an economics perspective. Previous work showed that oil palm farmers with a contract benefit substantially in terms of higher production investments, crop yields (Ruml and Qaim, 2019a), and household incomes (Ruml et al., 2020). Despite these economic gains, we show here that most farmers regret their decision to participate in the contract scheme and would like to exit the scheme as soon as legally possible. In other words, clear economic improvements notwithstanding, farmers are deeply dissatisfied with the contract.

This example provides an interesting opportunity to investigate problems with contract farming that have not yet received sufficient attention in the literature. Based on insights derived from focus group discussions with farmers and a structured survey, we examine the relationship between the contracting company and the farmers in order to highlight the importance of information, contract understanding, and transparency. We find that these aspects are crucial for farmers' satisfaction and might explain their dropout behavior.

In particular, we provide statistics on the self-reported information farmers had about the contracts when signing it and their level of contract understanding. The results challenge the common assumption that farmers rationally self-select into contract schemes and are enabled to make informed decisions about their production investments through proper information provided by the company. We also analyze problems that arise if farmers – due to limited contract understanding – perceive the company's actions as opportunistic. While the specific results relate to the case of the oil palm contract in Ghana, comparison with other examples from the litera-

ture suggests that similar problems of mistrust and lack of transparency also occur in many other contract schemes in various developing countries. Our results may encourage follow-up research to investigate the benefits and challenges of contracted smallholders beyond narrowly defined economic indicators.

## 5.2 Case study

### 5.2.1 The Ghanaian oil palm sector

Oil palm is native in Ghana and palm oil is a crucial part of the local diet. Traditionally, farmers manually process the harvested fruit bunches into palm oil, to consume it or to sell it to other households on the local market (Byerlee et al., 2017). In recent decades, oil palm has gained in importance for the food and cosmetics industry, and the local demand substantially increased (Huddleston and Tonts, 2007). As a response, the Ghanaian government incentivized a diversion away from citrus fruits and cocoa towards oil palm, which is by now one of the most important cash crops produced in the country (Rhebergen et al., 2016). Several national and international companies have established large processing mills with own plantations and contractual agreements with smallholders to meet the high demand and to run at full processing capacity.

### 5.2.2 The contract farming scheme

One of the contract farming schemes in the Ghanaian oil palm sector is the Twifo Oil Palm Plantation (TOPP), owned by Unilever. In addition to the 10,000 acres of company plantation land, Unilever sources oil palm from approximately 1000 oil palm farming households through contractual agreements. The contracts are offered in selected villages, with the village chief as intermediary between the farmers and the company. Unilever states that they accept all farmers that have land available for cultivation and are willing to accept the contract terms. The company is the only large buyer of oil palm fruit bunches in this region. Although farmers are able to sell small quantities on the local market, they are unable to sell larger quantities outside of the company contracts. Thus, side-selling is a rare phenomenon and Unilever enjoys a monopsonistic position.

The contracting unit is the individual oil palm plot. The company sources all output produced on the contracted plots at an annually fixed price without any quality restrictions. They pick up the harvested oil palm fruit bunches at the farm gate with trucks in intervals of 2-3 weeks. The contracted oil palm plots are established by Unilever on credit. The company assists farmers with the planting materials, other inputs, machineries, and labor during the planting phases. The

size of the credit depends on the inputs and services used. The credits plus an annual interest rate of 11.5% are paid back by farmers through the output supply: 25% of each harvest is taken by the company without payment. The credits are typically repaid over a period of 20-25 years. Throughout this period, farmers can additionally demand inputs, such as agrochemicals, tools, machinery, and labor, also on credit. These extra credits are not included in the initial agreement and are additionally deducted from the harvest. After the plot is established, farmers make their own decisions regarding input use and intensities. The company only supplies those inputs on credit that the farmer demands.

### 5.2.3 Sample and previous findings

We randomly sampled 13 villages from a complete list of contract villages provided by Unilever. Within these 13 villages, the local interviewer team compiled full lists of all contracted households with at least one plot registered with Unilever. From these lists we randomly sampled and interviewed 75% of the households in each village. Overall, our sample includes 164 households, with 169 independent oil palm farmers that answered the questions discussed here (in a few households more than one farmer had a contract)[2].

Table 5.1 presents farm, farmer, and household characteristics of the households in our sample. The average farm size is around 20 acres, even though 30% of the households actually have less than 10 acres of land. The average area under contract is 8 acres. Most contracted farmers are male. On average, farmers are 56 years old, have 7 years of formal education, and 16 years of experience in oil palm cultivation. Most households have been under contract for 8-10 years. Prior to the contracts, only 45% of the households cultivated oil palm commercially (beyond just small quantities for home consumption). However, nowadays 21% also cultivate oil palm on independent plots, beyond the contracted ones. In addition to oil palm, households grow other cash crops such as cocoa and rubber and food crops such as cassava and maize.

[2]In previous studies about the economic impacts of the contract scheme we additionally sampled 193 households producing oil palm under simple marketing contracts (without credit and input provision) and 106 oil palm producers without any contract. However, these additional households were sampled in different regions. For details on sampling and identification strategy, please see (Ruml and Qaim, 2019a; Ruml and Qaim, 2019b; Ruml et al., 2020).

Table 5.1: Farm, farmer, and household characteristics

| | Mean | Std. Dev. |
|---|---|---|
| *Farmer(n = 169) and household (n=164) characteristics* | | |
| Gender (female = 1) | 0.31 | (0.46) |
| Age (in years) | 55.94 | (12.18) |
| Education (in years) | 6.80 | (4.66) |
| Experience (in years) | 15.63 | (9.54) |
| Number of household members | 5.20 | (2.60) |
| Number of adult household members (above 18) | 2.85 | (1.30) |
| Number of youth household members (>14 and <18) | 0.49 | (0.71) |
| Number of child household members (<14) | 1.86 | (1.72) |
| Commercial oil palm production prior to contract farming (yes = 1) | 0.45 | (0.50) |
| Independent oil palm production (yes = 1) | 0.21 | (0.41) |
| Years under contract | 9.34 | (1.02) |
| | | |
| *Farm characteristics (n= 164)* | | |
| Total land availability (in acres) | 19.94 | (18.70) |
| Small-scale farmers (<10 acres) | 0.30 | (0.46) |
| Medium-scale farmers (10 – 19 acres) | 0.37 | (0.48) |
| Large-scale farmers (>20 acres) | 0.33 | (0.47) |
| Land purchase since contract participation (in acres) | 4.34 | (7.40) |
| Absolut area under oil palm cultivation (in acres) | 9.36 | (9.83) |
| Relative area under oil palm cultivation | 0.51 | (0.24) |
| Area under contract (in acres) | 7.67 | (6.93) |
| Number of other cash crops produced | 2.40 | (0.81) |

Previous analyses of the data found that the Unilever contract increases the adoption of chemical fertilizers and herbicides and leads to a doubling of oil palm yields. Contracted households expanded their commercial production and became more specialized on oil palm (Ruml and Qaim, 2019a). Results also show that the contract significantly reduces agricultural labor use per acre of oil palm, due to the adoption of labor-saving technologies and because post-harvest handling and processing of the fruit bunches no longer take place at the individual farm. These labor savings also lead to a reallocation of household labor to off-farm economic activities (Ruml and Qaim, 2019b). Finally, the data show that the contract leads to a strong increase in oil palm profits (140%) and total household incomes (70%) (Ruml et al., 2020).

### 5.2.4 Farmer satisfaction

The resource-providing contract in Ghana's oil palm sector leads to sizeable economic benefits for farmers, which is consistent with most studies on the effects of contract farming in developing countries. Thus, from an economics perspective, this contract can be considered a success. However, building on information collected through focus group discussions, we expanded the survey questionnaire to also capture data beyond purely economic outcome measures. In particular, we asked all farmers in the sample two questions related to their satisfaction. First, we asked whether they would sign the contract again, if they had the chance to go back in

time. The purpose of this question was to see whether farmers regret signing the contract in the first place. If this question was answered with no (they would not sign the contract again), we asked them for specific reasons. Second, we asked the farmers if they would sign the contract again in the future, after the current contract expires, if the contract remained unchanged.

Mean values of the farmers' answers to these questions are shown in Table 5.2. Only 43% of the farmers do not regret signing the contract and would sign it again in the same situation. Hence, more than half would not sign the contract again and state several reasons. The most often mentioned reason relates to unfair contract terms, which indicates that farmers were unaware of the true contract features prior to signing the contract. In particular, many farmers consider the output prices too low, and the interest rates and input prices too high. These answers indicate that farmers did not make informed and rational choices when they signed the contract.

Moreover, many farmers criticize the lack of transparency and honesty of the company. Throughout the interviewed villages, farmers often reported that the company enters the farmland without informing the farmer. The output and input prices and related calculations and deductions are perceived as not transparent. In some cases it was reported that the company harvested a plot without prior knowledge of the farmer. Moreover, some farmers feel deceived because the initial information they received from the company was incomplete and the initial promises made were not met. On the other hand, the farmers do not necessarily see the benefits that they get from the contracts. While they know that they are generally better off today than 10 years ago, they do not know how their situation would have developed had they not signed the contract.

Table 5.2: Contract satisfaction

| | Yes | No | Share (std. dev.) |
|---|---|---|---|
| *n = 169* | | | |
| If you had the chance to go back in time, would you sign the contract again? | 73 | 96 | 0.43 |
| | | | (0.50) |
| Why would you not sign the contract again? | | | |
| Unfair contract terms | | 90 | |
| Too low output prices | | 51 | |
| Interest rates are too high | | 28 | |
| Too high input prices | | 18 | |
| Lack of transparency and honesty | | 11 | |
| Initial set-up is too expensive | | 2 | |
| After this contract ends, would you sign up for another one, assuming the contract terms are unchanged? | 65 | 104 | 0.38 |
| | | (0.49) | |

Considering the widespread criticism, it is not surprising that only 38% of the farmers plan to sign an additional round of the same contract in the future (Table 5.2). Whether farmers will really not sign in the future and drop out of the scheme cannot be observed at this point. The scheme is in its first round of contracting, and the current contracts will still continue for another 10-15 years. A simple "no" response to the second question could also indicate that farmers would not require the contractual support any longer. This was reported, for instance, in connection with contract schemes in Thailand, India, and Indonesia (Euler et al., 2016; Narayanan, 2013). In those cases, farmers became wealthier through many years of contract farming and could afterwards expand their plantations also without additional support. In some cases, they also started investing into other businesses outside of agriculture (Narayanan, 2013).

These examples from other countries suggest that not signing a contract again is not necessarily an indicator of dissatisfaction. However, in our case the level of dissatisfaction is quite obvious through the combination of answers to the two questions we asked. Our data show that only a very small fraction of those who stated that they would not sign a new contract do not regret signing the current contract. Furthermore, Table 5.3 shows that neither regretting to have signed the contract nor not being willing to sign a new contract is significantly correlated with household income. Hence, we conclude that the dissatisfaction is not primarily driven by objectively measurable economic indicators.

Table 5.3: Pearson's correlations between contract satisfaction and household income

| | Per capita household income (in GHS) |
|---|---|
| If you had the chance to go back in time, would you sign the contract again? | 0.0794 |
| After this contract ends, would you sign up for another one, if the contract terms remained unchanged? | 0.0686 |

Note: None of the correlation coefficients are statistically significant.

## 5.3 Incomplete information and contract understanding

It is widely assumed that participation of farmers in contract farming schemes is the result of an expected cost-benefit analysis that considers both production and transaction costs for the independent production, as well as the production under contract (Simmons et al., 2005). Thus, farmers self-select into contract farming if their expected utility is higher under contract (Barrett et al., 2012; Bellemare, 2012). In order for this decision to be rational, it needs to be based on information

of input and output prices to determine production costs, as well as on contract conditions to determine transaction costs. Farmers also require cost and price information to make optimal decisions on production investments. If farmers lack this information, they potentially over-utilize or under-utilize production inputs. In the existing literature, farmers were sometimes found to lack this information under contract farming. They are often unaware of input prices, contract conditions, the exact company they signed the contract with (Simmons et al., 2005), or the company's policies (Porter and Phillips-Howard, 1997). Particularly written contracts can be problematic, as they lack transparency when phrased in a language that is inaccessible to farmers (Cahyadi and Waibel, 2016).

Based on the concrete complaints raised by our sample farmers in Ghana we investigate the information and understanding that they had about the contract at the time of the survey and prior to signing the contract (Table 5.4). The contracts the farmers signed were written in English, included several lengthy clauses, and a cost and repayment schedule. The results show that only 28% of the farmers in the sample speak and read English, meaning that 72% of the farmers were unable to even read the contract before they signed it. The problem of insufficient or inaccessible information is also supported by the fact that only 32% of the farmers reported that they actually understood the contract prior to signing it.

We further asked two test questions to check the farmers' knowledge about distinct contract characteristics. First, the contract specifies that after a certain delay in output supply (more than 6 weeks) the company has the right to take over the oil palm plot. The take-over means that the company decides on all input applications and provides all the labor required to cultivate the plot. The farmer loses decision-making power, is not allowed to work on the plot anymore, and receives no payment until the debt is repaid in full. Eighty-six percent of the farmers were aware of these consequences at the time of the survey (Table 5.4). However, further discussions with the farmers suggest that this was not widely understood before signing the contract. Instead, farmers learned this through experience. Several actually faced such "expropriation", and this information spread widely also among surrounding households and villages. Second, the contract specifies that if the farmer deceases during the time of the contract duration, the contract would either be continued by the heir, or the plot would be taken over by the company until the debt is repaid in full. Except for one farmer, all farmers in the sample were aware of this contract condition. Yet, further discussions with the farmers revealed that many are unaware that the family of the deceased has to provide a death certificate, which is untypical and difficult to get in the local setting. We learned about one case where the death of the farmer was not confirmed through a certificate and the company consequently took over production on the plot, denying the widow access to the plot and payments from the harvest.

Table 5.4: Information and contract understanding

| | Yes | No | Share (std. dev.) |
|---|---|---|---|
| *n = 168* | | | |
| Self-reported understanding of English | 48 | 121 | 0.28 (0.45) |
| Self-reported understanding of contract | 54 | 115 | 0.32 (0.47) |
| Test question understanding of contract breech (take-over of plot by company in case of delayed output supply) | 146 | 23 | 0.86 (0.34) |
| Test question understanding of contract duration (responsibility of heir in case of farmer death) | 168 | 1 | 0.99 (0.08) |
| Knowledge of the initial credit size | 37 | 132 | 0.22 (0.41) |

The last row in Table 5.4 shows that only 22% of the contracted farmers are aware of the amount of the initial credit they are currently paying off. As described, the company provides assistance in the form of labor, planting material, agrochemical inputs, and machinery to establish the oil palm plantation on the contracted plot. The resulting credit is then paid back over 20-25 years following the plantation establishment through 25% of each harvest. This credit is not a fixed amount that is equal across all contracted farmers, as it depends on the types of assistance and inputs required by an individual farmer. Seventy-eight percent of the farmers in our sample were unaware of the amount of these charges and thus could not make a rational and informed decision on how much and what type of assistance and inputs to use. Further, they could not weigh the value of the assistance and inputs received on credit against the actual value of the later repayment in terms of oil palm fruit bunches. For the 22% of the farmers who reported their initial amount of credit, we cannot check whether the amount was estimated correctly, as Unilever did not provide information to cross-check.

This combination of easy access to credit and lack of information and transparency has also been reported elsewhere and increases the risk of indebtedness for farmers (Bijman, 2008). Farmers do not know how much they owe, and how long it will take them to pay back this debt. As a response to this lack of transparency, several farmers reported that they had applied for a credit at a formal bank, in order to pay back Unilever at once and then exit the contract. However, Unilever did not allow such one-time repayment, so that many farmers feel locked into the contract scheme with too limited information on actual contract conditions. This happens when contracts seem attractive in the beginning and farmers sign long-term agreements involving large debts without having full information (Glover, 1987). Such situations increase the risk of default with the consequence that farmers may have

to sacrifice the autonomy over their land and also lose the opportunity to sell any output to the company (Key and Runsten, 1999). This is particularly problematic if farmers are highly specialized on the contracted crop and the firm has a monopsony in the region, as in our case.

## 5.4 Transparency

One concern raised in the existing literature on contract farming is the potential monopsony power of the contracting company. This monopsony power makes farmers more dependent and vulnerable to the contractor (Cai et al., 2008; Eaton and Shepherd, 2001) and as such, it generates an asymmetric power relation between the two parties (Adams et al., 2019; Key and Runsten, 1999; Morrison et al., 2006). If the farmers can only sell to this particular company, the company can execute power by stopping or rationing the procurements, for instance in times of supply abundance (Glover, 1987; Huacuja, 2006) or low market prices (Bijman, 2008).

Monopsony power is particularly problematic if farmers perceive the actions of the company as opportunistic, because the farmer is powerless towards this behavior. Evidence in the existing literature includes reports about the manipulation of quality standards and reductions in the price received or the quantity weighed (Eaton and Shepherd, 2001; Glover, 1987; Huacuja, 2006; Ochieng et al., 2017; Singh, 2002). Frequently reported examples of the perceived execution of the company's monopsony power are reported weighing losses as a result of long waiting hours at either the farm or the company gate. Farmers often have to wait until the harvest is picked up or received by the company, leading to weight losses due to water evaporation. This way, the farmer is paid for less than what was actually delivered, in addition to potential spoilage during waiting times (Glover, 1987).

Table 5.5: Descriptive statistics of perceived weighing losses

| | Number of farmers | Share | Std. Dev. |
|---|---|---|---|
| Experienced at least one weighing loss | 59 | 0.37 | (0.48) |
| Ability to estimate this loss | 30 | 0.49 | (0.50) |
| Average estimated loss (in tons) | 30 | 4.87 | (5.57) |

For our case of oil palm farmers in Ghana, we find that 37% of the farmers in the sample (59 farmers) experienced such weight and weighing losses (Table 5.5). Out of the 59 farmers, 30 were able to estimate the quantity of the loss in tons. The average stated loss within the 12 months prior to the survey is approximately 5 tons, which is equivalent to 77% of the average annual yield per acre (Ruml and Qaim, 2019a). Some farmers further claimed that the quantities the company paid

for were less than what they had actually delivered, which has also been reported elsewhere (Huacuja, 2006; Ochieng et al., 2017).

These actions are not necessarily opportunistic, because differences in farmers' estimates and actual weights can always occur, but distrust and lack of transparency can easily lead to perceived unfairness, which is then hard to prove or disprove (Glover, 1987; Rist et al., 2010). Some contract schemes do not allow the farmers to be present at the time of the weighing or grading (Huacuja, 2006), which further decreases transparency and raises the farmers' suspicion and mistrust (Eaton and Shepherd, 2001; Saenger et al., 2014; Schipmann and Qaim, 2011). In the sweet potato supply chain in the Philippines, the price setting of contractors is largely intransparent and farmers perceived it as unfair. Yet, examinations of the price margins revealed that the companies are actually not acting opportunistically (Batt and Cadilhon, 2007). Similarly, the weighing losses can be a result of imperfect harvest logistics, which cause dissatisfaction among farmers (Isager et al., 2018).

Table 5.6 shows for our sample of oil palm farmers in Ghana that the experience of at least one perceived weighing loss during the last 12 months is negatively correlated with the stated willingness to sign a new contract in the future. Hence, lack of information and transparency, distrust, and dissatisfaction seem to be associated and possibly mutually reinforcing.

Table 5.6: Pearson's correlation between contract satisfaction and weighing losses

| | Experience of at least one weighing loss |
|---|---|
| If you had the chance to go back in time, would you sign the contract again? | -0.0265 |
| After this contract ends, would you sign up for another one if the contract terms remained unchanged? | -0.1616* |

Notes: *marks the significance on a 5% level.

Perceived opportunism due to lack of transparency can also increase the farmer's perceived risk, if he/she feels vulnerable and unprotected towards the company's contract breech (Dedehouanou et al., 2013; Glover, 1987). Further, the experience of weighing losses can lead to lower expectations of revenues. Rational farmers will take this into account when making decisions about their production investments, and potentially lower their input use (Saenger et al., 2014). Thus, contract farming can introduce additional risks to the farmer, rather than solving the market risks and uncertainties.

The importance of transparency in contract farming was also illustrated by Saenger et al. (2014). The authors introduced an independent quality control through a randomized controlled trial (RCT) for contracted dairy producers in Vietnam. They found no opportunistic behavior of the company regarding the reported

quality of the milk. Nevertheless, the option of independent milk test result verification led to a significant increase in the farmers' production investments and productivity. Hence, the perceived opportunistic behavior of the contracting company introduces an additional risk that can influence the farmers' production decisions and lower the potential benefits of the contracts.

## 5.5 Discussion

The existing literature on contract farming in developing countries largely focusses on the question whether contracting is economically beneficial for smallholders. Empirical studies confirm that smallholders mostly benefit through higher yields and incomes. Nevertheless, high dropout rates from contract schemes are observed, reasons of which have not been analyzed sufficiently. In this paper, we argue that looking at narrowly defined economic indicators may be insufficient to understand farmers' views and perceptions about the contracts they have signed. The analysis of contracting in the small farm sector should be extended to more explicitly investigate farmers' satisfaction with their contract experience.

The empirical case from the oil palm sector in Ghana presented here underlines the importance of investigation beyond purely economic indicators. We found that the economic benefits that the resource-providing contract clearly brings about are fairly unrelated to the farmers' level of satisfaction, their wish to exit, and their regret to have signed the contract in the first place. The farmers' dissatisfaction seems to be much more related to the lack of information provided by the company and the limited understanding of several of the contract details.

Our data revealed that farmers were not sufficiently informed about the contracts they signed and are mostly unaware of the amount of debt they have with the company. Under the contract, farm inputs and services are easy to obtain for farmers. However, without fully understanding the debt implications this easy access raises the risk of farmers' indebtedness and default. Lack of knowledge about the level of debt and about the contractually agreed prices and repayment schedules leads to a feeling of unfair treatment among farmers, whenever the average price paid by the company is below the spot-market price or when payment is made for quantities that are smaller than what was actually supplied. Lack of transparency increases farmers' uncertainty and causes mistrust. Many farmers believe that the company behaves opportunistically, and this feeling is correlated with the farmers' wish to exit the scheme. However, in this long-term scheme, farmers cannot exit the contract during a 20-25 year period. Farmers' inability to exit also means that the company does not have an immediate incentive to improve the communication and increase the level of transparency. On the other hand, if the company wants

to expand its business and contract new farmers, satisfaction among the already contracted farmers could help, because positive and negative perceptions can spread rapidly through farmer-to-farmer exchange.

We should stress that we have no indication of true opportunistic behavior by the company. Moreover, it is important to highlight again that the farmers have actually benefited substantially from the contract in terms of higher incomes. These gains are not always so obvious for farmers. Most of them are much better off today than they were several years ago before the contract scheme had started, but farmers certainly cannot know how their situation would have developed had they not signed the contract. In this case, farmers' satisfaction with the contracts seems to be influenced more by perceptions than by actual benefits. In other words, farmers' perceptions matter and need to be accounted for by the contracting company when the wish is to develop mutually beneficial and lasting business relationships.

A review of the existing literature on contract farming provides signals that situations of limited contract transparency and mistrust are actually quite commonplace, even though issues of farmers' dissatisfaction with contracts and the underlying reasons have rarely been analyzed. Future research and policymaking should consider issues of contract transparency, farmers' satisfaction, and reasons for dropouts more explicitly, as mistrust is never a good basis for successful partnerships and for the development of smallholder-inclusive agricultural supply chains more generally.

# Chapter 6

# General conclusion

## 6.1 Main findings and policy recommendations

Agri-food systems in developing countries are undergoing a rapid transformation, characterized by modernizing supply chains and a rising importance of higher-value products. Participation of smallholders in these modern and high-value supply chains is considered a crucial contributor for rural development and poverty alleviation. However, smallholders face several constraints that limit their participation, and productivities and incomes remain low. Contract farming has the potential to overcome some of these constraints simultaneously and lead to higher smallholder productivities and incomes. Since contract types can vary substantially, different types of constraints are addressed by each contract. It has yet to be tested which type of contract is most suited and for which situation. We analyze and compare the effects of marketing contracts and resource-providing contracts for oil palm producers in Ghana. To the best of our knowledge, this thesis presents the first comprehensive analysis investigating the effects of marketing contracts and resource-providing contracts in a capital-intensive high-value crop sector.

Several general conclusions can be drawn from this dissertation:

Our findings illustrate that contracts can reduce risks and market failures and thus contribute to agricultural growth in the small farm sector. However, the actual results strongly depend on the type of contract. We have found sizeable differences in the effects between marketing contracts and resource-providing contracts, which illustrates that not all contracts are useful in every situation. We do not find any evidence that the marketing contract, which addresses market risk and uncertainty, leads to higher production investments or yields. However, the additional provision of in-kind credits under the resource-providing contract does lead to the expected results. Thus, marketing contracts seem to be insufficient to increase farm investments and productivity in a setting with severe credit and input market failures. This is especially true for capital-intensive high-value crops, such as oil palm and other plantation crops.

Even though our results illustrate that the marketing contract analyzed in this thesis is insufficient to increase smallholders' production investments and productivities, we find that it leads to a higher profitability of oil palm. This can be attributed to the stable prices and the ability to sell in large quantities. This substantially reduces the variability of oil palm profits for farmers under the marketing contract, as well as for farmers under the resource-providing contract. Although the increase in oil palm profitability under the resource-providing contract is substantially larger, our results provide evidence that contracts can lead to higher profits, even if they do not lead to an increase in production investments and productivity. Thus, we show that increased productivities are not the only pathway through which contract farming can lead to higher household welfare.

Moreover, the findings reveal that contract farming does not necessarily lead to an increase in agricultural labor demand and an employment creation. In fact, the opposite can also be true. We find that both investigated contracts lead to a strong reduction in agricultural labor use, due to the use of labor-saving procedures and technologies. These results certainly depend on the specific context, but are plausibly valid for settings other than the one analyzed in this thesis. Due to the rising international demand for palm oil, supply chains are being modernized, and new types of processing technologies and contract schemes are gaining in importance. Similar market trends are also observed for other crops traditionally grown by African smallholders, such as cassava, rice, and maize for which new processing facilities and contract schemes are being developed, particularly in West Africa. However, more research is needed as effects can differ remarkably depending on the particular context.

While both contracts lead to a similar reduction in agricultural labor use, the reallocation of household labor differs between both types of contracts. The marketing contract leads to a strong reallocation of household labor towards off-farm employment, and a transition out of agricultural production. This reallocation towards off-farm employment is smaller for households under the resource-providing contract; these households substantially expand their land under oil palm cultivation. Thus, each type of contract leads to a different reaction to the reduced labor requirements, which strongly influences the pathways through which each type of contract leads to an increase in household income. This increase can only be partly attributed to the higher profitability of oil palm per unit of land. Other parts of the increase in household income are due to increased income from off-farm employment for the households under the marketing contract, and to a larger scale of oil palm production for households under the resource-providing contract. These findings underline that disaggregated analyses are needed to understand the effect mechanisms.

Overall, these results contribute to a better understanding of the type of contracts that can be useful for smallholder farmers and agricultural development, con-

ditional on the specific setting. Previous studies had evaluated the effects of contracts in different environments, but very few studies had compared the effects of different contract types in a comparable setting, as we have done here. Our findings are consistent with previous research suggesting that marketing contracts alone may not suffice to increase smallholders' production investments and productivities. However, if the main policy objective is to improve the wellbeing of smallholders, marketing contracts can be effective tools. If the main policy objective is to help farmers overcome constraints regarding credit access, inputs, and technologies, and thus increase their farm incomes, resource-providing contracts are better suited than marketing contracts. Of course, these results cannot be generalized to all kinds of food production and market environments in developing countries, since the outcomes depend on the type of crop, the type of market failures, and the agricultural and non-agricultural employment opportunities in a particular context. That said, the general finding that contract design matters substantially for the impact and the underlying impact mechanisms is certainly valid beyond the case of oil palm in Ghana. Hence, the contract characteristics, such as the provision of in-kind credits, matter and should not be ignored when designing contract farming policies and when estimating resulting effects. Follow-up research on the effects of different types of contracts will be useful to provide the knowledge required for the development of suitable contract designs.

Beyond the differential effects of both types of contracts on farm production and household welfare, we find that the type of contract has broader social and distributional implications. Resource-providing contracts are particularly beneficial for small- and medium-scale farmers, who suffer most under market risk and factor market failures. Hence, if small- and medium-scale farmers have access to contracts that help overcome market risk and financial constraints, they may benefit more than large-scale farmers. Both types of contracts affect the use of youth and child labor in the agricultural production, and can have differential effects on male and female labor participation. These implications should not be ignored when analyzing the effects of contract farming, and when designing contract farming policies.

In general, future research should expand the analysis of the effects of contract farming beyond economic measures, such as productivities and incomes, which might not be in direct relation with farmer satisfaction. This is illustrated in the fourth paper of this analysis, in which we illustrate that farmers under the resource-providing contract are dissatisfied with the contract, despite having economic benefits. The identified lack of contract understanding, trust, and transparency poses a problem to the development potential of contract farming, and should be addressed by future research and policy makers. One possible direction could be the development and strengthening of farmer groups and associations, to increase the farmers' bargaining power and actively involve them in contract negotiations.

## 6.2 Limitations and directions for future research

This dissertation has several general limitations that should be mentioned:

First, the use of cross-sectional data for impact evaluations raises concerns about endogeneity (unobserved heterogeneity and reverse causality). With cross-sectional data, changes in the outcome variables cannot be observed over time for the same household. Estimating the effects of contract farming on the outcome variables across different households comes with the risk of capturing unobserved heterogeneity across households and not the effect of contract farming. This risk is elevated through the non-random self-selection of farmers into the particular contract schemes. Some of the investigated outcome variables might also affect this participation decision. Households with e.g. lower labor availability, or higher household incomes might be more or less likely to select themselves into contract farming. Studies using panel data are better suited to control for this unobserved heterogeneity; randomized experiments have further advantages to investigate causal effects, as they can address all sources of endogeneity.

Throughout this dissertation, we used different approaches to reduce issues of endogeneity. The study set-up and sampling strategy were designed to minimize possible issues associated with non-random self-selection into the marketing or resource-providing contracts. Moreover, instruments were used to model the participation decision and to reduce the risk of unobserved heterogeneity and reverse causality. However, the instruments used throughout the analyses are at the village level and might not fully capture unobserved heterogeneity at the household level. Thus, a willingness-to-pay and risk preference measure was introduced to directly control and test for such unobserved heterogeneity. Overall, the presented results are robust to the different identification strategies employed, yet some caution in the causal interpretation is warranted.

Second, we included two companies and contracts in our sample to estimate the effects of each type of contract. With this sampling strategy we are not able to separate the effects of both types of contracts from potential effects of company characteristics. Organizational structure, trustworthiness, and reputation of the contracting companies are some of several company characteristics that could influence the effects of each type of contract in this study. Separating these effects would require an alternative sampling strategy that includes more companies and contracts, and captures information at the company level. Such an alternative sampling strategy would also increase the external validity of the findings. While the effects identified in this thesis are not necessary unique to the particular context, they cannot be widely generalized. In general, follow-up research should consider broadening the sampling strategy. Studies investigating several contract farming schemes, several types of contracts, for several crops, and in a broader range of settings have higher external validity (Meemken and Bellemare, 2020). Hence, future

research should move away from case and context specific impact assessments, attempting to derive more general findings. Both, using panel or experimental data, and a broader study set-up require larger research budgets but are certainly interesting directions for future research. In spite of the mentioned limitations, the findings presented in this thesis are relevant, and the general finding that contract characteristics matter also holds in other situations.

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# Appendix A

# Appendix dissertation chapters

## A.1 Dissertation chapter 2

Table A.1.1: Correlations between instruments and plot-level outcome variables

| | Chemical fertilizer | Herbicides | Yields per acre |
|---|---|---|---|
| Village share | 0.0405 | 0.1011 | -0.0697 |
| Village chief | 0.1075 | -0.0329 | -0.1161 |

Note: The correlation analysis only includes observations from the comparison group of farmers without any contract. None of the correlation coefficients is statistically significant at the 5% level.

Table A.1.2: Correlations between instruments and household-level outcome variables

| | Scale of Production | Specialization | Cash crop diversity |
|---|---|---|---|
| Village share | -0.0611 | 0.0721 | -0.0131 |
| Village chief | -0.0684 | 0.1829 | -0.0886 |

Note: The correlation analysis only includes observations from the comparison group of farmers without any contract. None of the correlation coefficients is statistically significant at the 5% level.

Table A.1.3: First-stage IV regressions of plot-level models (input use)

| | Marketing contract | | Resource-providing contract | |
|---|---|---|---|---|
| Gender of the farmer (dummy) | 0.0880** | (0.04) | -0.0669 | (0.05) |
| Education of the farmer (in years) | 0.0044 | (0.01) | -0.0001 | (0.00) |
| Experience of the farmer (in years) | 0.0088** | (0.00) | -0.0075** | (0.00) |
| Cocoa cultivation (dummy) | -0.0477 | (0.06) | 0.0358 | (0.05) |
| Decision spraying (dummy) | -0.0862 | (0.06) | 0.1081 | (0.09) |
| Good soil (dummy) | -0.0500 | (0.05) | 0.0318 | (0.04) |
| Distance inputs (in km) | -0.0118* | (0.01) | 0.0092 | (0.01) |
| Village share (IV MC) | 0.7757* | (0.46) | 0.0467 | (0.39) |
| Village chief (IV RPC) | -0.4261** | (0.20) | 0.5306*** | (0.18) |
| Constant | 0.3341** | (0.23) | 0.0416 | (0.17) |
| Number of observations | 551 | | 551 | |

Note: Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.1.4: First-stage IV regressions of plot-level models (oil palm yield per acre)

| | Marketing contract | | Resource-providing contract | |
|---|---|---|---|---|
| Gender of the farmer (dummy) | 0.1016** | (0.05) | -0.0772 | (0.05) |
| Education of the farmer (in years) | 0.0045 | (0.01) | 0.0005 | (0.01) |
| Experience of the farmer (in years) | 0.0038* | (0.00) | -0.0017 | (0.00) |
| Number of palms per acre | 0.0007** | (0.00) | -0.0007* | (0.00) |
| Age of palms (in years) | 0.0285*** | (0.01) | -0.0314*** | (0.01) |
| Irrigation (dummy) | -0.0194 | (0.05) | 0.0635 | (0.05) |
| Good soil (dummy) | -0.0229 | (0.049 | 0.0097 | (0.03) |
| Market access (in km) | 0.0209 | (0.03) | -0.0091 | (0.04) |
| Village share (IV MC) | 0.6687* | (0.39) | 0.1125 | (0.28) |
| Village chief (IV RPC) | -0.4274** | (0.18) | 0.5159*** | (0.13) |
| Constant | -0.0760 | (0.24) | 0.4808*** | (0.18) |
| Number of observations | 551 | | 551 | |

Note: Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.1.5: First-stage IV regressions of household-level models (scale of production, specialization, cash crop diversity)

| | Marketing contract | | Resource-providing contract | |
|---|---|---|---|---|
| Gender of the household head (dummy) | 0.0559* | (0.03) | -0.0203 | (0.03) |
| Education of the household head (in years) | 0.0070* | (0.00) | -0.0031 | (0.00) |
| Experience of the household head (in years) | 0.0075*** | (0.00) | -0.0074*** | (0.00) |
| Land availability household (in acres) | -0.0010 | (0.00) | 0.0054* | (0.00) |
| Land availability household (square term) | 0.0000 | (0.00) | -0.0000* | (0.00) |
| Market access (in km) | 0.0532 | (0.05) | -0.0227 | (0.059 |
| Average land charges village (in GHS per acre) | 0.0020*** | (0.00) | -0.0013* | (0.00) |
| Shocks | -0.1488*** | (0.04) | 0.0679 | (0.04) |
| Village share (IV MC) | 0.8380*** | (0.30) | -0.0280 | (0.30) |
| Village chief (IV RPC) | -0.4470*** | (0.14) | 0.5287*** | (0.13) |
| Constant | 0.0685 | (0.15) | 0.2579 | (0.16) |
| Number of observations | 463 | | 463 | |

Note: Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.1.6: Test for exogeneity of contract variables in plot-level models

| | Chemical fertilizer | Herbicides | Yield |
|---|---|---|---|
| *p-values* | 0.3982 | 0.2162 | 0.2935 |

Note: For the input-use models with binary outcome variables, A Wald test was used. For the yield model with a continuous outcome variable, a Wu-Hausman test was used.

Table A.1.7: Wu-Hausman test for exogeneity of contract variables in household-level models

| | Scale of production | Specialization | Cash crop diversity |
|---|---|---|---|
| *p-values* | 0.4397 | 0.1034 | 0.8096 |

Table A.1.8: Effects of contracts on chemical fertilizer and herbicide use (total sample)

| | Chemical fertilizer | | Herbicides | |
|---|---|---|---|---|
| | Probit | IV probit | Probit | IV probit |
| Marketing contract (dummy) | 0.0508 | 0.0202 | -0.0117 | -0.1323 |
| | (0.06) | (0.11) | (0.11) | (0.28) |
| Resource-providing contract (dummy) | 0.1797*** | 0.1462 | 0.1211 | 0.0952 |
| | (0.05) | (0.12) | (0.09) | (0.27) |
| Female farmer (dummy) | 0.0567 | 0.0426 | -0.0681 | -0.0792 |
| | (0.04) | (0.04) | (0.05) | (0.06) |
| Education of farmer (years) | 0.0074** | 0.0069*** | 0.0071 | 0.0084 |
| | (0.00) | (0.00) | (0.00) | (0.01) |
| Experience of farmer (years) | 0.0010 | 0.0006 | -0.0101*** | -0.0112*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Willingness to pay (500 GHS) | 0.0111 | | 0.0097 | |
| | (0.01) | | (0.01) | |
| Cocoa cultivation (dummy) | 0.0155 | 0.0187 | 0.0745 | 0.0673 |
| | (0.06) | (0.06) | (0.07) | (0.07) |
| Decision spraying (dummy) | 0.0102 | 0.0158 | -0.0434 | -0.0746 |
| | (0.03) | (0.03) | (0.06) | (0.07) |
| Good soil (dummy) | -0.0521** | 0.0406 | 0.0093 | 0.0115 |
| | (0.03) | (0.03) | (0.04) | (0.05) |
| Distance to input provider (km) | -0.0046 | -0.0057 | 0.0033 | 0.0020 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Number of observations | 551 | 551 | 551 | 551 |
| Wald $chi^2$ | 54.98 | 25.02 | 37.90 | 27.31 |
| *p-value* (joint significance) | 0.0000 | 0.0029 | 0.0000 | 0.0012 |
| Pseudo $R^2$ | 0.1174 | | 0.0575 | |

Note: Average marginal effects are shown with cluster-corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.1.9: Effects of contracts on oil palm yield in t/acre (total sample)

| | OLS | IV |
|---|---|---|
| Marketing contract (dummy) | -0.7664 | 0.0677 |
| | (0.84) | (1.62) |
| Resource-providing contract (dummy) | 2.9182*** | 2.4741 |
| | (0.87) | (1.80) |
| Female farmer (dummy) | 0.0984 | 0.0852 |
| | (0.46) | (0.46) |
| Education of farmer (years) | 0.0342 | 0.0280 |
| | (0.04) | (0.04) |
| Experience of farmer (years) | -0.0971*** | -0.1015*** |
| | (0.02) | (0.02) |
| Willingness to pay (500 GHS) | -0.0371 | |
| | (0.10) | |
| Number of palms per acre | 0.0274*** | 0.0263*** |
| | (0.01) | (0.01) |
| Age of palms (years) | 0.0910** | 0.0465 |
| | (0.04) | (0.04) |
| Irrigation (dummy) | -0.5267 | -0.5312 |
| | (0.44) | (0.44) |
| Good soil (dummy) | 0.2739 | 0.2681 |
| | (0.34) | (0.35) |
| Market access (km) | 0.0254 | 0.0168 |
| | (0.09) | (0.13) |
| Constant | 2.3451** | 2.8536* |
| | (1.09) | (1.56) |
| Number of observations | 551 | 551 |
| F-statistic/Wald $chi^2$ | 17.01 | 86.85 |
| *p-value* (joint significance) | 0.0000 | 0.0000 |
| $R^2$ | 0.1431 | 0.1341 |

Note: Average marginal effects are shown with cluster-corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.1.10: Effects of contracts on household-level outcome variables (total sample)

| | Scale of production (0-1) | | Specialization (0-1) | | Cash crop diversity (number) | |
|---|---|---|---|---|---|---|
| | OLS | IV | OLS | IV | OLS | IV |
| Marketing contract | -0.0196 | -0.0354 | -0.0123 | -0.0260 | -0.5093*** | -0.6662** |
| | (0.02) | (0.05) | (0.03) | (0.10) | (0.12) | (0.26) |
| Resource-providing contract | 0.0417** | -0.0057 | 0.0961*** | 0.1575** | -0.5229*** | -0.7189** |
| | (0.02) | (0.05) | (0.02) | (0.08) | (0.13) | (0.30) |
| Female household head (dummy) | -0.0398** | -0.0397** | 0.0688* | 0.0686** | -0.0385 | -0.0265 |
| | (0.02) | (0.02) | (0.03) | (0.03) | (0.12) | (0.10) |
| Education of household head (years) | 0.0015 | 0.0014 | -0.0031 | -0.0026 | 0.0178 | 0.0178 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.01) | (0.01) |
| Experience of household head (years) | -0.0024** | -0.0027*** | 0.0052*** | 0.0060*** | -0.0007 | -0.0011 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.01) | (0.00) |
| Willingness to pay (500 GHS) | 0.0025 | | -0.0017 | | 0.0001 | |
| | (0.00) | | (0.01) | | (0.03) | |
| Land availability household (acres) | -0.0051*** | -0.0048*** | -0.0092*** | -0.0095*** | 0.0200*** | 0.0209*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.01) | (0.01) |
| Land availability (squared) | 0.0000** | 0.0000** | 0.0001*** | 0.0001*** | -0.0002*** | -0.0002*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Market access (km) | -0.0037 | -0.0026 | -0.0020 | -0.0016 | 0.0632*** | 0.0744*** |
| | (0.00) | (0.00) | (0.01) | (0.01) | (0.02) | (0.02) |
| Average land rent (GHS/acre) | -0.0002** | -0.0002*** | 0.0002 | 0.0003 | -0.0005 | -0.0005 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Shocks | 0.0132*** | 0.0122* | -0.0352*** | -0.0385** | 0.0870** | 0.0689 |
| | (0.00) | (0.01) | (0.01) | (0.02) | (0.04) | (0.06) |
| Constant | 0.9234*** | 0.9605*** | 0.5377*** | 0.4955*** | 1.3791*** | 1.5092*** |
| | (0.02) | (0.04) | (0.04) | (0.06) | (0.26) | (0.28) |
| Number of observations | 463 | 463 | 463 | 463 | 463 | 463 |
| F-statistic/Wald $chi^2$ | 8.51 | 145.69 | 35.61 | 108.59 | 12.94 | 71.74 |
| *p-value* (joint significance) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| $R^2$ | 0.1299 | 0.1210 | 0.1661 | 0.1525 | 0.1150 | 0.1097 |

Note: Marginal effects are shown with cluster-corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.1.11: Effects of contracts on input use by farm size category (subsample analyses)

| | Chemical fertilizer use (dummy) | | | Herbicide use (dummy) | | |
|---|---|---|---|---|---|---|
| | Small-scale | Medium-scale | Large-scale | Small-scale | Medium-scale | Large-scale |
| Marketing contract | 0.0677 | 0.0485 | 0.0337 | 0.0716 | -0.1448 | 0.0975 |
| | (0.08) | (0.09) | (0.12) | (0.10) | (0.14) | (0.12) |
| Resource-providing contract | 0.1909*** | 0.1813** | 0.1712* | 0.3231*** | -0.0454 | 0.1403 |
| | (0.06) | (0.08) | (0.01) | (0.12) | (0.13) | (0.11) |
| Female farmer (dummy) | 0.0731 | 0.0000 | 0.1039* | 0.0530 | -0.0897 | -0.0826 |
| | (0.05) | (0.04) | (0.06) | (0.07) | (0.10) | (0.13) |
| Education of farmer (years) | 0.0124*** | 0.0131** | 0.0002 | 0.0283*** | 0.0063 | -0.0188* |
| | (0.00) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| Experience of farmer (years) | 0.0016 | -0.0006 | 0.0017 | -0.0092** | -0.0124*** | -0.0098** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Willingness to pay (500 GHS) | 0.0095 | -0.0035 | 0.0299* | 0.0817*** | 0.0191 | -0.0249 |
| | (0.01) | (0.01) | (0.02) | (0.01) | (0.02) | (0.02) |
| Cocoa cultivation (dummy) | 0.0683 | 0.0343 | 0.0215 | 0.2509* | 0.1019 | 0.0235 |
| | (0.09) | (0.05) | (0.09) | (0.13) | (0.06) | (0.15) |
| Decision spraying (dummy) | 0.0076 | -0.0525 | 0.0707 | -0.1836* | 0.0819 | -0.0074 |
| | (0.06) | (0.05) | (0.10) | (0.10) | (0.11) | (0.16) |
| Good soil (dummy) | -0.0374 | -0.0320 | -0.1220 | -0.0314 | 0.0253 | -0.0152 |
| | (0.03) | (0.04) | (0.08) | (0.06) | (0.07) | (0.09) |
| Distance to input provider (km) | 0.0018 | -0.0149** | -0.0137* | -0.0071 | 0.0128 | 0.0009 |
| | (0.00) | (0.01) | (0.01) | (0.01) | (0.01) | (0.00) |
| Number of observations | 191 | 211 | 149 | 191 | 211 | 149 |
| Wad $chi^2$ | 51.58 | 45.96 | 72.43 | 251.61 | 66.57 | 17.61 |
| *p-value* (joint significance) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0619 |
| Pseudo $R^2$ | 0.1517 | 0.2000 | 0.1416 | 0.1704 | 0.0968 | 0.0722 |

Note: Average marginal effects from probit models are shown with cluster-corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.1.12: Effects of contracts on oil palm yield (t/acre) by farm size category (subsample analyses)

| | Small-scale | Medium-scale | Large-scale |
|---|---|---|---|
| Marketing contract | -0.2379 | 0.1732 | -2.0271 |
| | (0.69) | (0.50) | (1.72) |
| Resource-providing contract | 4.0295*** | 4.3482*** | 0.6007 |
| | (0.91) | (0.53) | (2.18) |
| Female farmer (dummy) | 0.6034 | 0.3702 | -0.3727 |
| | (0.86) | (1.00) | (1.18) |
| Education of farmer (years) | 0.1126 | 0.0034 | -0.0601 |
| | (0.07) | (0.05) | (0.08) |
| Experience of farmer (years) | -0.0815* | -0.0913*** | -0.1186*** |
| | (0.04) | (0.02) | (0.04) |
| Willingness to pay (55 GHS) | 0.0479 | 0.2158*** | -0.2593 |
| | (0.24) | (0.07) | (0.17) |
| Number of palms per acre | 0.0152*** | 0.0503* | 0.0290*** |
| | (0.00) | (0.03) | (0.01) |
| Age of palms (years) | 0.1306* | 0.0585* | 0.0709 |
| | (0.07) | (0.03) | (0.06) |
| Irrigation (dummy) | -0.5090 | -0.7795 | -0.6718 |
| | (0.72) | (0.53) | (0.89) |
| Good soil (dummy) | 0.0636 | 0.6428 | 0.5616 |
| | (0.78) | (0.46) | (0.76) |
| Market access (km) | 0.0100 | 0.1733** | -0.2520 |
| | (0.11) | (0.08) | (0.24) |
| Constant | 0.9473 | -0.3091 | 6.0200** |
| | (1.67) | (1.23) | (2.46) |
| Number of observations | 191 | 211 | 149 |
| F-statistic | 41.33 | 13.01 | 5.85 |
| *p-value* (joint significance) | 0.0000 | 0.0000 | 0.0000 |
| $R^2$ | 0.1722 | 0.2730 | 0.1065 |

Note: Marginal effects from OLS models are shown with cluster-corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.1.13: Effects of contracts on household-level outcomes by farm size category (subsample analyses)

| | Scale of production (0-1) | | | Specialization (0-1) | | | Cash crop diversity (number) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Small-scale | Medium-scale | Large-scale | Small-scale | Medium-scale | Large-scale | Small-scale | Medium-scale | Large-scale |
| Marketing contract (dummy) | -0.0497** | -0.0033 | 0.0563 | 0.0601 | -0.0113 | -0.0846 | -0.4599* | -0.7148*** | -0.0242 |
| | (0.02) | (0.03) | (0.07) | (0.05) | (0.04) | (0.07) | (0.25) | (0.18) | (0.24) |
| Resource-providing contract (dummy) | 0.0156 | 0.0426* | 0.0730 | 0.1284** | 0.0887* | 0.0310 | -0.4754** | -0.8036*** | -0.1705 |
| | (0.02) | (0.02) | (0.06) | (0.05) | (0.04) | (0.07) | (0.22) | (0.18) | (0.24) |
| Female household head (dummy) | -0.0580* | -0.0064 | -0.0221 | 0.0719 | 0.0150 | 0.0953* | 0.0503 | -0.0709 | 0.0059 |
| | (0.03) | (0.03) | (0.06) | (0.06) | (0.05) | (0.05) | (0.19) | (0.29) | (0.16) |
| Education of household head (years) | 0.0005 | 0.0022 | -0.0001 | -0.0033 | -0.0033 | 0.0010 | 0.0201 | 0.0015 | 0.0222 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.01) | (0.02) | (0.02) |
| Experience of household head (years) | -0.0040** | -0.0006 | -0.0029 | 0.0045** | 0.0034 | 0.0072** | -0.0091 | 0.0065 | -0.0018 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.01) | (0.01) | (0.01) |
| Willingness to pay (500 GHS) | -0.0032 | 0.0038 | 0.0032 | 0.0023 | -0.0100 | 0.0075 | -0.0297 | 0.0035 | -0.0039 |
| | (0.00) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.03) | (0.06) | (0.04) |
| Land availability (acres) | -0.0059 | -0.0093** | -0.0043 | -0.0289 | -0.0454*** | -0.0059* | -0.0819 | -0.0036 | 0.0074 |
| | (0.01) | (0.00) | (0.00) | (0.02) | (0.01) | (0.00) | (0.06) | (0.08) | (0.01) |
| Land availability (squared) | -0.0000 | 0.0001 | 0.0000 | 0.0009 | 0.0017*** | 0.0000* | 0.0092* | 0.0003 | -0.0001 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Market access (km) | -0.0010 | -0.0074 | -0.0012 | -0.0033 | -0.0004 | 0.0002 | 0.0630 | 0.0303 | 0.0982*** |
| | (0.00) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.04) | (0.04) | (0.03) |
| Average land rent (GHS per acre) | -0.0001 | -0.0002*** | -0.0004 | 0.0003** | -0.0000 | 0.0001 | -0.0008 | -0.0004 | 0.0000 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Shocks | 0.0036 | 0.0194** | 0.0251* | -0.0256* | -0.0292** | -0.0383* | 0.0757 | 0.0463 | 0.1604** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.02) | (0.08) | (0.03) | (0.07) |
| Constant | 0.9882*** | 0.9248*** | 0.9022*** | 0.5633*** | 0.7382*** | 0.4578*** | 1.6180*** | 1.9384*** | 1.2112*** |
| | (0.04) | (0.04) | (0.08) | (0.10) | (0.08) | (0.11) | (0.34) | (0.57) | (0.42) |
| Number of observations | 182 | 177 | 104 | 182 | 177 | 104 | 182 | 177 | 104 |
| F-statistic | 9.24 | 10.94 | 2.91 | 11.49 | 22.39 | 4.62 | 4.53 | 21.55 | 6.29 |
| *p-value* (joint significance) | 0.0000 | 0.0000 | 0.0111 | 0.0000 | 0.0000 | 0.0005 | 0.0010 | 0.0000 | 0.0000 |
| $R^2$ | 0.1170 | 0.1379 | 0.1547 | 0.1587 | 0.2173 | 0.1404 | 0.1424 | 0.1090 | 0.1175 |

Note: Marginal effects from OLS models are shown with cluster-corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

## A.2 Dissertation chapter 3

Table A.2.1: Regional characteristics

| | Western Region (Marketing contract) | Central Region (Resource-providing contract) | Ashanti Region (Comparison) |
|---|---|---|---|
| Area classification | Tropical savanna climate | Tropical savanna climate | Tropical savanna climate |
| Highest temperature (monthly average) | 28.86˚C | 28.66˚C | 28.63˚C |
| Lowest temperature (monthly average) | 25.09˚C | 25.30˚C | 25.22˚C |
| Mean temperature | 27.16˚C | 27.19˚C | 26.97˚C |
| Average annual rainfall | 1268.03mm | 1248.53mm | 1245.79mm |
| Gross income per capita (GNI) | 3782 GHS | 3634 GHS | 3598 GHS |
| Human development index (HDI) | 0.609 | 0.541 | 0.603 |
| Employment to population ratio | 66.3 | 66.1 | 64.8 |
| Rural unemployment rates | 3.8% | 4.1% | 4.6% |

Note: Temperature and rainfall data are derived from the World Bank Climate Change Knowledge Portal and refer to monthly averages between 1991 and 2015. Mean temperature and average annual rainfall are calculated based on monthly averages. GNI and HDI are derived from the Global Data Lab 2017. Employment rates are derived from the Ghana Statistical Service, 2013.

Table A.2.2: Likelihood-ratio tests to test the tobit model against the more general double hurdle specification

| | Prob $>chi^2$ |
|---|---|
| Household labor days, per acre | 0.0000 |
| Male household labor days, per acre | 0.0000 |
| Female household labor days, per acre | 0.0000 |
| Child labor days, per acre | 0.0000 |
| Youth labor days, per acre | 0.0000 |
| Hired labor days, per acre | 0.0000 |
| Male hired labor days, per acre | 0.0000 |
| Female hired labor days, per acre | 0.0000 |
| Household days in off-farm employment | 0.0000 |
| Male days in off-farm employment | 0.0000 |
| Female days in off-farm employment | 0.0000 |

Table A.2.3: First-stage regressions

| | For labor use models | | For off-farm employment models | |
|---|---|---|---|---|
| | Marketing contract | Resource-providing contract | Marketing contract | Resource-providing contract |
| Adult household members | -0.00 | 0.52*** | -0.01 | 0.15 |
| | (0.12) | (0.16) | (0.12) | (0.13) |
| Education (in years) | 0.05 | 0.03 | 0.04 | 0.02 |
| | (0.04) | (0.04) | (0.04) | (0.04) |
| Experience (in years) | 0.03 | -0.02 | 0.04** | -0.03 |
| | (0.02) | (0.02) | (0.02) | (0.02) |
| Female (dummy) | 1.00*** | 0.22 | 0.10 | -0.02 |
| | (0.37) | (0.41) | (0.47) | (0.48) |
| Age (in years) | -0.01 | 0.07*** | 0.01 | 0.05*** |
| | (0.01) | (0.02) | (0.01) | (0.01) |
| Land availability (in acres, in 2008) | -0.02* | -0.01 | | |
| | (0.01) | (0.01) | | |
| Good soil (dummy) | -0.18 | 0.03 | | |
| | (0.32) | (0.41) | | |
| Irrigation (dummy) | 0.10 | 0.54 | | |
| | (0.34) | (0.42) | | |
| Number of palms | 0.01 | 0.00 | | |
| | (0.01) | (0.01) | | |
| Age of palms (in years) | 0.14*** | -0.35*** | | |
| | (0.03) | (0.07) | | |
| Distance to road (walking minutes) | 0.01 | -0.01 | | |
| | (0.01) | (0.01) | | |
| Market access (km) | 1.08*** | 0.94*** | 0.82*** | 0.85*** |
| | (0.31) | (0.31) | (0.29) | (0.29) |
| Village chief (IV) | -1.22*** | 3.73*** | -0.82** | 3.04*** |
| | (0.33) | (0.56) | (0.32) | (0.46) |
| Village share (IV) | 10.83*** | 9.35*** | 11.41*** | 9.74*** |
| | (1.47) | (1.61) | (1.47) | (1.52) |
| Constant | -4.51*** | -6.45*** | -3.35*** | -7.03*** |
| | (1.10) | (1.49) | (0.84) | (1.04) |
| Number of observations | 524 | 463 | | |
| Prob>$chi^2$ | 0.0000 | 0.0000 | | |
| Pseudo $R^2$ | 0.4968 | | | |

Notes: Coefficient estimates from multinomial logit models are shown with standard errors in parentheses. The socioeconomic characteristics refer to the farmer for the plot-level analyses, and to the household head for the household-level analyses. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A.2.4: Correlations between instruments and outcome variables

| | Village share | Village chief |
|---|---|---|
| *n=119* | | |
| Labor intensity, in days per acre | -0.0139 | 0.1235 |
| | (0.7303) | (0.1807) |
| Household labor days, per acre | -0.0179 | -0.0188 |
| | (0.4198) | (0.1693) |
| Male household labor days, per acre | -0.1013 | -0.0808 |
| | (0.6110) | (0.2909) |
| Female household labor days, per acre | 0.1009 | 0.0720 |
| | (0.3842) | (0.2027) |
| Youth labor days, per acre | -0.1155 | 0.0182 |
| | (0.3114) | (0.5981) |
| Child labor days, per acre | -0.0355 | 0.0354 |
| | (0.6277) | (0.0889) |
| Hired labor days, per acre | 0.1045 | -0.0724 |
| | (0.7993) | (0.8549) |
| Male hired labor days, per acre | 0.1148 | -0.0463 |
| | (0.9369) | (0.8782) |
| Female hired labor days, per acre | 0.0729 | -0.1109 |
| | (0.5234) | (0.5548) |
| *n=106* | | |
| Household days for off-farm employment | -0.0768 | -0.1251 |
| | (0.4337) | (0.2021) |
| Male days for off-farm employment | -0.1174 | -0.1430 |
| | (0.2306) | (0.1435) |
| Female days for off-farm employment | 0.0148 | -0.0309 |
| | (0.8805) | (0.7531) |

Note: Correlation coefficients are shown with *p-values* in parentheses. Only comparison group farmers without contracts are included, as we want to test whether the instruments are correlated with the outcome variables through mechanisms other than contract participation.

Table A.2.5: Test results for exogeneity of contract participation

| | First hurdle | Second hurdle |
|---|---|---|
| Labor intensity, in days per acre | Exogeneity not rejected | |
| Household labor days, per acre | Exogeneity rejected | Exogeneity rejected |
| Male household labor days, per acre | Exogeneity rejected | Exogeneity not rejected |
| Female household labor days, per acre | Exogeneity rejected | Exogeneity rejected |
| Child labor days, per acre | Exogeneity rejected | Exogeneity not rejected |
| Youth labor days, per acre | Exogeneity rejected | Exogeneity rejected |
| Hired labor days, per acre | Exogeneity rejected | Exogeneity rejected |
| Male hired labor days, per acre | Exogeneity rejected | Exogeneity not rejected |
| Female hired labor days, per acre | Exogeneity not rejected | Exogeneity not rejected |
| Household days for off-farm employment | Exogeneity not rejected | Exogeneity not rejected |
| Male days for off-farm employment | Exogeneity notrejected | Exogeneity not rejected |
| Female days for off-farm employment | Exogeneity not rejected | Exogeneity rejected |

Note: The null hypothesis that contract participation is exogenous was tested based on the statistical significance of the residual terms in the second-stage regressions of the control function approach.

Table A.2.6: Descriptive statistics of control variables

| | Mean | | | Difference | | |
|---|---|---|---|---|---|---|
| | Marketing contract (MC) | Resource-providing contract (RPC) | No contract (NC) | MC-RPC | MC-NC | RPC -NC |
| Number of adult household members | 2.72 (0.09) | 2.91 (0.09) | 2.70 (0.12) | | | |
| Education of the farmer (in years) | 7.91 (0.30) | 7.42 (0.34) | 7.28 (0.36) | | | |
| Experience of the farmer (in years) | 20.12 (0.58) | 15.70 (0.71) | 17.38 (8.14) | *** | *** | |
| Female farmer (dummy) | 0.26 (0.03) | 0.26 (0.03) | 0.22 (0.04) | | | |
| Willingness-to-pay (in 500 GHS) | 2.08 (0.13) | 2.05 (0.15) | 2.72 (0.19) | | *** | *** |
| Age of the farmer (in years) | 52.18 (0.76) | 55.78 (0.88) | 49.43 (1.01) | *** | ** | *** |
| Total land availability 2008 (in acres) | 13.27 (0.93) | 15.20 (1.30) | 12.88 (1.47) | | | |
| Good soil (dummy) | 0.67 (0.03) | 0.72 (0.03) | 0.73 (0.04) | | | |
| Irrigation (dummy) | 0.32 (0.03) | 0.30 (0.03) | 0.27 (0.04) | | | |
| Number of palms | 68.84 (3.02) | 63.73 (2.39) | 63.05 (1.24) | | | |
| Age of the palms (in years) | 14.96 (0.43) | 9.30 (0.06) | 12.94 (0.45) | *** | *** | *** |
| Distance to road (walking minutes) | 13.03 (1.20) | 7.97 (0.98) | 14.36 (1.46) | *** | | *** |
| Market access (km) | 0.90 (0.14) | 1.10 (0.13) | 0.09 (0.04) | | *** | *** |

Note: Mean values are shown with standard errors in parentheses. Good soil is a dummy variable that equals one for the most suited soils for oil palm cultivation. The suitability of the soil types was ranked with the MoFA, and an answer set of 5 types of soil was available for the farmer to choose from. Irrigation is a dummy variable that equals one if the plot is irrigated. GHS = Ghanaian Cedis. Distance to the next road is measured from the plot location to the next road that is accessible by car/truck. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2.7: Effects of contracts on agricultural labor use (full results)

| | OLS | Control function |
|---|---|---|
| Marketing contract | -43.36*** | -40.68*** |
| | (7.89) | (8.37) |
| Resource-providing contract | -47.94*** | -43.17*** |
| | (6.17) | (6.30) |
| Adult household members | 3.63 | 3.60 |
| | (2.16) | (2.12) |
| Education (in years) | -0.21 | -0.24 |
| | (0.77) | (0.78) |
| Experience (in years) | -0.12 | -0.09 |
| | (0.20) | (0.20) |
| Age (in years) | -0.45** | -0.48** |
| | (0.21) | (0.22) |
| Female (dummy) | 8.43 | 8.62 |
| | (7.72) | (7.78) |
| Willingness-to-pay (in 500 GHS) | 0.50 | |
| | (1.08) | |
| Land availability (in acres, in 2008) | 0.11 | 0.09 |
| | (0.27) | (0.27) |
| Good soil (dummy) | -2.42 | -2.34 |
| | (5.70) | (5.50) |
| Irrigation (dummy) | -2.18 | -2.07 |
| | (2.34) | (2.41) |
| Number of palms | 0.16*** | 0.17*** |
| | (0.03) | (0.03) |
| Age of palms (in years) | 0.51 | 0.64 |
| | (0.39) | (0.48) |
| Distance to a road (walking minutes) | -0.08 | -0.08 |
| | (0.13) | (0.13) |
| Market access (in km) | -0.22 | 1.06 |
| | (0.45) | (1.57) |
| Constant | 75.48*** | 73.45*** |
| | (14.92) | (15.55) |
| Residuals included | No | Yes |
| Number of observations | 524 | 524 |
| F Statistic | 21.91 | 7.79 |
| Prob>F | 0.0000 | 0.0000 |
| $R^2$ | 0.2046 | 0.2065 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2.8: Double hurdle results – household labor reallocation and hired labor use

| | Household labor days per acre of oil palm | | Hired labor days per acre of oil palm | | Household labor days in off-farm employment | |
|---|---|---|---|---|---|---|
| | Decision | Quantity | Decision | Quantity | Decision | Quantity |
| Marketing contract | -0.68** | -0.56*** | -0.75*** | -0.02 | 0.17 | 0.31*** |
| | (0.30) | (0.19) | (0.21) | (0.28) | (0.12) | (0.08) |
| Resource-providing contract | -1.77*** | -0.81*** | 0.01 | 0.06 | -0.04 | 0.21** |
| | (0.26) | (0.14) | (0.20) | (0.15) | (0.12) | (0.09) |
| Adult household members | 0.20*** | 0.15*** | -0.15** | -0.03 | 0.16*** | 0.08** |
| | (0.05) | (0.05) | (0.07) | (0.05) | (0.05) | (0.03) |
| Education (in years) | -0.04** | -0.02 | 0.06*** | 0.00 | 0.02* | 0.01 |
| | (0.02) | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) |
| Experience (in years) | 0.01* | 0.02* | -0.03*** | 0.01 | -0.01 | -0.00 |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| Female (dummy) | -0.51*** | -0.08 | 0.61*** | 0.38*** | 0.25 | 0.11 |
| | (0.17) | (0.13) | (0.12) | (0.15) | (0.18) | (0.14) |
| Willingness-to-pay (in 500 GHS) | | | | | -0.01 | -0.03 |
| | | | | | (0.03) | (0.02) |
| Age (in years) | -0.06*** | -0.01*** | 0.02*** | 0.00 | -0.02*** | -0.00 |
| | (0.01) | (0.01) | (0.00) | (0.01) | (0.01) | (0.01) |
| Land availability (in acres, in 2008) | -0.03*** | -0.02** | 0.03*** | 0.01*** | -0.00 | 0.00 |
| | (0.01) | (0.01) | (0.01) | (0.00) | (0.00) | (0.00) |
| Good soil (dummy) | -0.09 | -0.24 | -0.04 | 0.01 | | |
| | (0.15) | (0.19) | (0.17) | (0.10) | | |
| Irrigation (dummy) | -0.44*** | -0.04 | 0.01 | 0.12 | | |
| | (0.12) | (0.13) | (0.17) | (0.10) | | |
| Number of palms | -0.00 | 0.01** | -0.00** | 0.00*** | | |
| | (0.00) | (0.00) | (0.00) | (0.00) | | |
| Age of palms (in years) | 0.02 | 0.00 | -0.01 | -0.00 | | |
| | (0.02) | (0.01) | (0.01) | (0.02) | | |
| Distance to road (walking minutes) | -0.01 | -0.00 | 0.00 | -0.00 | | |
| | (0.01) | (0.00) | (0.00) | (0.00) | | |
| Market access (km) | 0.18*** | 0.12* | -0.11** | -0.06 | 0.03 | -0.06* |
| | (0.06) | -0.01*** | (0.05) | (0.06) | (0.02) | (0.03) |
| Constant | 4.93*** | 3.37*** | 0.21 | 1.69*** | 0.67* | 4.89*** |
| | (0.48) | (0.48) | (0.44) | (0.52) | (0.39) | (0.31) |
| Residuals included | Yes | Yes | Yes | Yes | No | Yes |
| Number of observations | 524 | 381 | 524 | 422 | 463 | 249 |
| Prob>$chi^2$ | 0.0000 | | 0.0000 | | 0.0000 | |
| Pseudo $R^2$ | 0.0947 | | 0.0455 | | 0.0170 | |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2.9: Marginal effects – household labor reallocation and hired labor use

| | Household labor days per acre of oil palm | | Hired labor days per acre of oil palm | | Household labor days in off-farm employment | |
|---|---|---|---|---|---|---|
| | Decision | Quantity | Decision | Quantity | Decision | Quantity |
| Marketing contract | -0.14** | -16.28*** | -0.18*** | -0.51 | 0.06 | 81.96*** |
| | (0.06) | (5.81) | (0.05) | (5.91) | (0.04) | (22.93) |
| Resource-providing contract | -0.37*** | -23.50*** | 0.00 | 1.25 | -0.01 | 54.12** |
| | (0.05) | (4.90) | (0.05) | (3.29) | (0.04) | (24.55) |
| Adult household members | 0.04*** | 4.38*** | -0.04** | -0.67 | 0.06*** | 20.79** |
| | (0.01) | (1.57) | (0.02) | (1.12) | (0.02) | (8.43) |
| Education (in years) | -0.01** | -0.60 | 0.01*** | 0.10 | 0.01* | 1.60 |
| | (0.00) | (0.39) | (0.00) | (0.36) | (0.01) | (3.13) |
| Experience (in years) | 0.00 | 0.44* | -0.01*** | 0.21 | -0.00 | -0.18 |
| | (0.00) | (0.23) | (0.00) | (0.14) | (0.00) | (1.65) |
| Female (dummy) | -0.11*** | -2.35 | 0.14*** | 8.04** | 0.10 | 29.80 |
| | (0.04) | (3.90) | (0.03) | (3.32) | (0.07) | (37.10) |
| Willingness-to-pay (in 500 GHS) | | | | | -0.01 | -8.60 |
| | | | | | (0.01) | (6.24) |
| Age (in years) | -0.01*** | -0.39*** | 0.01*** | 0.07 | -0.01*** | -0.09 |
| | (0.00) | (0.15) | (0.00) | (0.12) | (0.00) | (1.39) |
| Land availability (in acres, in 2008) | -0.01*** | -0.53** | 0.01*** | 0.16*** | -0.00 | 1.21 |
| | (0.00) | (0.22) | (0.00) | (0.06) | (0.00) | (0.80) |
| Good soil (dummy) | -0.02 | -6.96 | -0.01 | 0.23 | | |
| | (0.03) | (5.49) | (0.04) | (2.10) | | |
| Irrigation (dummy) | -0.09*** | -1.26 | 0.00 | 2.48 | | |
| | (0.02) | (3.83) | (0.04) | (1.95) | | |
| Number of palms | -0.00 | 0.20** | -0.00** | 0.07** | | |
| | (0.00) | (0.10) | (0.00) | (0.03) | | |
| Age of palms (in years) | 0.01 | 0.02 | -0.00 | -0.03 | | |
| | (0.00) | (0.28) | (0.00) | (0.35) | | |
| Distance to road (walking minutes) | -0.00 | -0.07 | 0.00 | -0.07 | | |
| | (0.00) | (0.14) | (0.00) | (0.08) | | |
| Market access (km) | 0.04*** | 3.37* | -0.02* | -1.19 | 0.01 | -14.49* |
| | (0.01) | (2.01) | (0.01) | (1.34) | (0.01) | (8.55) |
| Residuals included | Yes | No | Yes | Yes | No | Yes |
| Number of observations | 524 | 381 | 524 | 422 | 463 | 249 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2.10: Unconditional marginal effects – household labor reallocation and hired labor use

| | Household labor days per acre of oil palm | Hired labor days per acre of oil palm | Household labor days in off-farm employment |
|---|---|---|---|
| Marketing contract | -16.43*** | -3.77 | 61.10*** |
| | (4.63) | (5.30) | (22.84) |
| Resource-providing contract | -27.15*** | 1.07 | 25.37 |
| | (4.37) | (2.85) | (19.12) |
| Adult household members | 4.50*** | -1.22 | 26.89*** |
| | (1.26) | (1.01) | (7.19) |
| Education (in years) | -0.66* | 0.33 | 3.22 |
| | (0.34) | (0.31) | (2.60) |
| Experience (in years) | 0.42** | 0.05 | -0.98 |
| | (0.20) | (0.14) | (1.27) |
| Female (dummy) | -4.20 | 9.37*** | 41.06 |
| | (3.24) | (3.15) | (25.68) |
| Willingness-to-pay (in 500 GHS) | | | -6.00 |
| | | | (4.90) |
| Age (in years) | -0.57*** | 0.17* | -2.00** |
| | (0.13) | (0.10) | (0.96) |
| Land availability (in acres, in 2008) | -0.55*** | 0.25*** | 0.32 |
| | (0.20) | (0.06) | (0.44) |
| Good soil (dummy) | -6.15 | 0.03 | |
| | (4.70) | (1.67) | |
| Irrigation (dummy) | -3.00 | 2.10 | |
| | (3.05) | (1.98) | |
| Number of palms | 0.16** | 0.05* | |
| | (0.08) | (0.03) | |
| Age of palms (in years) | 0.12 | -0.07 | |
| | (0.24) | (0.32) | |
| Distance to road (walking minutes) | -0.09 | -0.03 | |
| | (0.11) | (0.07) | |
| Market access (in km) | 3.57** | -1.46 | -5.27 |
| | (1.57) | (1.14) | (5.06) |
| Number of observations | 524 | 524 | 524 |

Note: Cluster corrected standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.2.11: Double hurdle results – household labor use, by gender and age

| | Male household labor | | Female household labor | | Child household labor | | Youth household labor | |
|---|---|---|---|---|---|---|---|---|
| | Decision | Quantity | Decision | Quantity | Decision | Quantity | Decision | Quantity |
| Marketing contract | -0.62*** | -0.68*** | -0.43** | -0.49*** | -0.52** | -0.72 | -0.65** | -1.65*** |
| | (0.19) | (0.16) | (0.21) | (0.16) | (0.25) | (0.87) | (0.26) | (0.44) |
| Resource-providing contract | -1.48*** | -0.76*** | -1.40*** | -0.76*** | -1.04*** | -1.57*** | -0.63** | 0.80 |
| | (0.23) | (0.19) | (0.23) | (0.18) | (0.15) | (0.42) | (0.31) | (0.54) |
| Adult household members | 0.25*** | 0.10** | 0.29*** | 0.04 | 0.01 | 0.08 | 0.04 | 0.08 |
| | (0.06) | (0.05) | (0.06) | (0.07) | (0.07) | (0.19) | (0.03) | (0.15) |
| Education (in years) | -0.01 | -0.03* | -0.03* | -0.00 | -0.05* | 0.00 | -0.05** | 0.01 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.03) | (0.04) | (0.03) | (0.04) |
| Experience (in years) | 0.01 | 0.01 | -0.01 | 0.03*** | -0.00 | -0.00 | -0.01 | 0.03* |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.02) | (0.01) | (0.02) |
| Gender (dummy) | -1.42*** | -0.28 | 0.38** | 0.36** | -0.34 | 0.07 | -0.42 | 0.43 |
| | (0.13) | (0.22) | (0.18) | (0.15) | (0.27) | (0.70) | (0.28) | (0.33) |
| Willingness-to-pay (in 500 GHS) | | -0.03 | | | | -0.14 | | |
| | | (0.04) | | | | (0.15) | | |
| Age (in years) | -0.05*** | -0.01*** | -0.02*** | -0.01** | -0.00 | -0.06** | 0.01 | 0.02 |
| | (0.01) | (0.00) | (0.01) | (0.01) | (0.01) | (0.02) | (0.01) | (0.02) |
| Land availability (in acres, in 2008) | -0.02*** | -0.02 | -0.01*** | -0.02** | -0.01 | -0.03*** | -0.01 | -0.02** |
| | (0.00) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| Good soil (dummy) | -0.08 | -0.19 | 0.06 | -0.20 | 0.43** | 0.30 | 0.26 | 0.25 |
| | (0.15) | (0.20) | (0.10) | (0.17) | (0.18) | (0.54) | (0.17) | (0.37) |
| Irrigation (dummy) | -0.42*** | -0.06 | -0.14 | 0.07 | 0.49*** | -0.29 | 0.23 | -0.34 |
| | (0.11) | (0.11) | (0.18) | (0.17) | (0.19) | (0.41) | (0.19) | (0.38) |
| Number of palms | -0.00 | 0.00 | 0.00 | 0.00 | 0.00*** | 0.00 | 0.00 | 0.01 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.01) | (0.00) | (0.01) |
| Age of palms (in years) | 0.03** | -0.01 | 0.02 | 0.00 | 0.00 | 0.11*** | 0.03** | 0.13*** |
| | (0.01) | (0.01) | (0.02) | (0.01) | (0.02) | (0.03) | (0.01) | (0.04) |
| Distance to road (walking min.) | -0.01** | -0.00 | -0.01*** | 0.01 | -0.00 | -0.02 | -0.01 | -0.00 |
| | (0.00) | (0.00) | (0.00) | (0.01) | (0.01) | (0.01) | (0.01) | (0.00) |
| Market access (km) | 0.19*** | 0.00 | 0.16** | 0.13** | -0.08 | 0.50*** | -0.17 | 1.11*** |
| | (0.05) | (0.03) | (0.06) | (0.06) | (0.06) | (0.12) | (0.11) | (0.29) |
| Constant | 3.96*** | 3.61*** | 1.45*** | 2.61*** | -0.76 | 3.95*** | -0.98* | -2.49 |
| | (0.61) | (0.54) | (0.45) | (0.45) | (0.58) | (1.12) | (0.55) | (1.84) |
| Residuals included | Yes | No | Yes | Yes | Yes | No | Yes | Yes |
| Number of observations | 524 | 343 | 524 | 270 | 524 | 46 | 524 | 58 |
| Prob>$chi^2$ | 0.0000 | | 0.0000 | | 0.0000 | | 0.0014 | |
| Pseudo $R^2$ | 0.1112 | | 0.1040 | | 0.1803 | | 0.1411 | |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2.12: Marginal effects – household labor use, by gender and age

| | Male household labor | | Female household labor | | Child household labor | | Youth household labor | |
|---|---|---|---|---|---|---|---|---|
| | Decision | Quantity | Decision | Quantity | Decision | Quantity | Decision | Quantity |
| Marketing contract | -0.14*** | -12.34*** | -0.13** | -7.51*** | -0.07** | -32.33 | -0.10** | -2.97 |
| | (0.04) | (3.21) | (0.07) | (2.56) | (0.03) | (30.23) | (0.04) | (8.23) |
| Resource-providing contract | -0.33*** | -13.77*** | -0.43*** | -11.63*** | -0.13*** | -71.05 | -0.10** | -13.21 |
| | (0.05) | (3.68) | (0.07) | (2.79) | (0.02) | (95.56) | (0.05) | (29.06) |
| Adult household members | 0.06*** | 1.83** | 0.09*** | 0.67 | 0.00 | 3.42 | 0.01 | 1.33 |
| | (0.01) | (0.91) | (0.02) | (1.10) | (0.01) | (12.50) | (0.01) | (3.37) |
| Education (in years) | -0.00 | -0.56* | -0.01** | -0.07 | -0.01* | 0.22 | -0.01** | -0.25 |
| | (0.01) | (0.30) | (0.00) | (0.28) | (0.00) | (1.84) | (0.00) | (0.58) |
| Experience (in years) | 0.00 | 0.18 | -0.00 | 0.40*** | -0.00 | -0.14 | -0.00 | 0.28 |
| | (0.00) | (0.15) | (0.00) | (0.14) | (0.00) | (0.71) | (0.00) | (0.63) |
| Gender (dummy) | -0.32*** | -5.12 | 0.12** | 5.57** | -0.04 | 3.24 | -0.07 | 4.81 |
| | (0.02) | (4.04) | (0.05) | (2.26) | (0.04) | (30.17) | (0.04) | (11.28) |
| Willingness-to-pay (in 500 GHS) | | -0.58 | | | | -6.37 | | -0.04 |
| | | (0.78) | | | | (13.61) | | (1.17) |
| Age (in years) | -0.01*** | -0.22*** | -0.01*** | -0.22** | -0.00 | -2.52 | 0.00 | 0.31 |
| | (0.00) | (0.08) | (0.00) | (0.10) | (0.00) | (4.45) | (0.00) | (0.85) |
| Land availability (in acres, in 2008) | -0.01*** | -0.28 | -0.00*** | -0.25** | -0.00 | -1.33 | -0.00 | -0.38 |
| | (0.00) | (0.18) | (0.00) | (0.11) | (0.00) | (1.93) | (0.00) | (0.67) |
| Good soil (dummy) | -0.02 | -3.39 | 0.02 | -3.08 | 0.06** | 13.72 | 0.04 | 7.13 |
| | (0.03) | (3.56) | (0.03) | (2.65) | (0.02) | (32.73) | (0.03) | (15.17) |
| Irrigation (dummy) | -0.09*** | -1.08 | -0.04 | 1.02 | 0.06*** | -12.90 | 0.04 | -4.27 |
| | (0.02) | (2.05) | (0.05) | (2.59) | (0.02) | (25.51) | (0.03) | (11.07) |
| Number of palms | -0.00 | 0.07 | 0.00 | 0.07 | 0.00*** | 0.06 | 0.00 | 0.21 |
| | (0.00) | (0.06) | (0.00) | (0.05) | (0.00) | (0.48) | (0.00) | (0.51) |
| Age of palms (in years) | 0.01** | -0.16 | 0.01 | 0.01 | 0.00 | 4.91 | 0.01** | 1.97 |
| | (0.00) | (0.24) | (0.01) | (0.14) | (0.00) | (7.43) | (0.00) | (3.24) |
| Distance to road (walking min.) | -0.00* | -0.00 | -0.00*** | 0.09 | -0.00 | -0.74 | -0.00 | -0.16 |
| | (0.00) | (0.08) | (0.00) | (0.09) | (0.00) | (1.30) | (0.00) | (0.35) |
| Market access (km) | 0.04*** | 0.04 | 0.05** | 1.93** | -0.01 | 22.72 | -0.03 | 5.07 |
| | (0.01) | (0.50) | (0.02) | (0.91) | (0.01) | (37.17) | (0.02) | (9.65) |
| Residuals included | Yes | No | Yes | Yes | Yes | No | Yes | Yes |
| Number of observations | 524 | 343 | 524 | 270 | 524 | 46 | 524 | 58 |

Note: Cluster corrected standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A.2.13: Unconditional marginal effects – household labor use, by gender and age

| | Male household labor | Female household labor | Child household labor | Youth household labor |
|---|---|---|---|---|
| Marketing contract | -11.34*** | -6.52*** | -1.83 | -76.93 |
| | (2.46) | (1.82) | (1.21) | (360.96) |
| Resource-providing contract | -15.40*** | -13.31*** | -3.84*** | -27.60 |
| | (2.74) | (2.03) | (1.15) | (147.52) |
| Adult household members | 2.23*** | 1.69** | 0.11 | 4.18 |
| | (0.67) | (0.68) | (0.31) | (20.47) |
| Education (in years) | -0.46** | -0.17 | -0.08 | -3.34 |
| | (0.21) | (0.21) | (0.06) | (16.73) |
| Experience (in years) | 0.17 | 0.21** | -0.01 | -0.34 |
| | (0.11) | (0.11) | (0.04) | (2.19) |
| Gender (dummy) | -8.76*** | 5.13*** | -0.50 | -20.56 |
| | (3.11) | (1.59) | (0.84) | (106.78) |
| Willingness-to-pay (in 500 GHS) | -0.43 | | -0.18 | |
| | (0.58) | | (0.21) | |
| Age (in years) | -0.34*** | -0.23*** | -0.08** | 0.74 |
| | (0.08) | (0.08) | (0.04) | (3.49) |
| Land availability (in acres, in 2008) | -0.29** | -0.22*** | -0.05** | -1.08 |
| | (0.14) | (0.08) | (0.02) | (5.08) |
| Good soil (dummy) | -2.82 | -1.64 | 1.15* | 22.45 |
| | (2.85) | (1.84) | (0.64) | (106.58) |
| Irrigation (dummy) | -2.27 | 0.05 | 0.49 | 9.06 |
| | (1.54) | (1.90) | (0.43) | (53.24) |
| Number of palms | 0.05 | 0.05 | 0.01 | 0.26 |
| | (0.04) | (0.03) | (0.01) | (1.12) |
| Age of palms (in years) | -0.01 | 0.10 | 0.14* | 4.79 |
| | (0.17) | (0.07) | (0.08) | (21.57) |
| Distance to road (walking min.) | -0.03 | 0.01 | -0.03 | -0.42 |
| | (0.06) | (0.06) | (0.02) | (2.07) |
| Market access (km) | 0.70* | 1.87*** | 0.50** | 10.03 |
| | (0.39) | (0.58) | (0.25) | (38.77) |
| Number of observations | 524 | 524 | 524 | 524 |

Note: Cluster corrected standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A.2.14: Double hurdle results – off-farm employment

| | Male off-farm employment | | Female off-farm employment | |
|---|---|---|---|---|
| | Decision | Quantity | Decision | Quantity |
| Marketing contract | -0.18 | 0.45*** | 0.35** | -0.06 |
| | (0.16) | (0.13) | (0.16) | (0.18) |
| Resource-providing contract | -0.15 | 0.36** | -0.06 | 0.27 |
| | (0.13) | (0.15) | (0.17) | (0.22) |
| Adult household members | 0.07 | 0.05 | 0.20*** | -0.00 |
| | (0.05) | (0.05) | (0.04) | (0.04) |
| Education (in years) | 0.03* | 0.00 | 0.00 | 0.01 |
| | (0.02) | (0.02) | (0.02) | (0.01) |
| Experience (in years) | -0.00 | 0.00 | -0.02*** | 0.01 |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| Gender (dummy) | -0.81*** | 0.02 | 0.84*** | -0.06 |
| | (0.16) | (0.28) | (0.17) | (0.13) |
| Willingness-to-pay (in 500 GHS) | 0.02 | -0.06* | -0.03 | |
| | (0.04) | (0.03) | (0.04) | |
| Age (in years) | -0.03*** | 0.00 | -0.00 | -0.01 |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| Land availability (in acres, in 2008) | -0.00 | 0.00 | 0.00 | -0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Market access (in km) | -0.01 | -0.09** | 0.04 | -0.12** |
| | (0.03) | (0.04) | (0.04) | (0.05) |
| Constant | 0.71* | 4.56*** | -0.88** | 5.58*** |
| | (0.37) | (0.31) | (0.41) | (0.37) |
| Residuals included | No | No | No | Yes |
| Number of observations | 463 | 151 | 463 | 130 |
| Prob>$chi^2$ | 0.0005 | | 0.0000 | |
| Pseudo $R^2$ | 0.0351 | | 0.0315 | |

Note: Cluster corrected standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A.2.15: Marginal effects – off-farm employment

| | Male off-farm employment | | Female off-farm employment | |
|---|---|---|---|---|
| | Decision | Quantity | Decision | Quantity |
| Marketing contract | -0.06 | 104.68*** | 0.11** | -15.52 |
| | (0.05) | (33.89) | (0.05) | (46.01) |
| Resource-providing contract | -0.05 | 82.85** | -0.02 | 69.59 |
| | (0.04) | (37.14) | (0.05) | (57.47) |
| Adult household members | 0.02 | 12.69 | 0.06*** | -0.83 |
| | (0.02) | (11.32) | (0.01) | (10.83) |
| Education (in years) | 0.01* | 0.73 | 0.00 | 2.25 |
| | (0.01) | (4.12) | (0.01) | (3.35) |
| Experience (in years) | -0.00 | 0.63 | -0.01*** | 2.29 |
| | (0.00) | (2.55) | (0.00) | (2.04) |
| Gender (dummy) | -0.26*** | 5.12 | 0.26*** | -14.61 |
| | (0.05) | (64.40) | (0.05) | (34.82) |
| Willingness-to-pay (in 500 GHS) | 0.01 | -14.52* | -0.01 | |
| | (0.01) | (8.21) | (0.01) | |
| Age (in years) | -0.01*** | 0.66 | -0.00 | -2.34 |
| | (0.00) | (1.67) | (0.00) | (1.60) |
| Land availability (in acres, in 2008) | -0.00 | 0.58 | 0.00 | -0.05 |
| | (0.00) | (0.77) | (0.00) | (0.61) |
| Market access (km) | -0.00 | -20.45** | 0.01 | -31.15** |
| | (0.01) | (10.13) | (0.01) | (14.33) |
| Residuals included | No | No | No | Yes |
| Number of observations | 463 | 151 | 463 | 130 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2.16: Unconditional marginal effects – off-farm employment

| | Male off-farm employment | Female off-farm employment |
|---|---|---|
| Marketing contract | 19.34 | 23.14 |
| | (18.77) | (16.64) |
| Resource-providing contract | 14.56 | 14.52 |
| | (16.10) | (17.97) |
| Adult household members | 9.36** | 15.84*** |
| | (4.55) | (3.61) |
| Education (in years) | 2.52 | 0.99 |
| | (2.04) | (2.25) |
| Experience (in years) | 0.04 | -1.12 |
| | (1.32) | (0.92) |
| Gender (dummy) | -58.80*** | 62.33*** |
| | (21.94) | (15.80) |
| Willingness-to-pay (in 500 GHS) | -3.26 | -2.34 |
| | (3.93) | (2.92) |
| Age (in years) | -1.69** | -1.00 |
| | (0.76) | (0.61) |
| Land availability (in acres, in 2008) | 0.11 | 0.34 |
| | (0.27) | (0.41) |
| Market access (km) | -6.80 | -5.62* |
| | (4.94) | (2.98) |
| Number of observations | 463 | 463 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2.17: Double hurdle results – hired labor use, by gender

| | Male hired labor | | Female hired labor | |
|---|---|---|---|---|
| | Decision | Quantity | Decision | Quantity |
| Marketing contract | -0.57** | 0.13 | 0.29 | 0.07 |
| | (0.22) | (0.18) | (0.28) | (0.14) |
| Resource-providing contract | 0.31 | -0.09 | -0.56** | -0.19 |
| | (0.20) | (0.14) | (0.28) | (0.23) |
| Adult household members | -0.12** | -0.03 | -0.12** | 0.10 |
| | (0.05) | (0.06) | (0.05) | (0.06) |
| Education (in years) | 0.06*** | 0.01 | 0.03** | -0.01 |
| | (0.01) | (0.02) | (0.02) | (0.02) |
| Experience (in years) | -0.02* | 0.00 | -0.01 | 0.01 |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| Gender (dummy) | 0.84*** | 0.43*** | -0.08 | 0.27* |
| | (0.13) | (0.10) | (0.17) | (0.15) |
| Willingness-to-pay (in 500 GHS) | | -0.02 | -0.03 | -0.01 |
| | | (0.04) | (0.04) | (0.04) |
| Age (in years) | 0.02*** | 0.01 | 0.02*** | -0.01 |
| | (0.01) | (0.00) | (0.01) | (0.01) |
| Land availability (in acres, in 2008) | 0.02* | 0.01** | 0.02*** | 0.00 |
| | (0.01) | (0.00) | (0.01) | (0.00) |
| Good soil (dummy) | -0.06 | -0.00 | 0.19 | -0.07 |
| | (0.16) | (0.09) | (0.17) | (0.19) |
| Irrigation (dummy) | 0.13 | 0.14 | 0.10 | 0.09 |
| | (0.13) | (0.09) | (0.17) | (0.10) |
| Number of palms | -0.00 | 0.00*** | -0.00 | 0.00*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Age of palms (in years) | -0.00 | -0.01 | -0.01 | 0.00 |
| | (0.01) | (0.01) | (0.02) | (0.02) |
| Distance to road (walking min.) | 0.00 | -0.00 | 0.00 | 0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Market access (km) | -0.09 | -0.06** | -0.00 | 0.01 |
| | (0.06) | (0.03) | (0.04) | (0.03) |
| Constant | -0.34 | 1.48*** | -1.35** | 1.73*** |
| | (0.47) | (0.34) | (0.54) | (0.47) |
| | | | 0.29 | 0.07 |
| Residuals included | Yes | No | No | No |
| Number of observations | 524 | 401 | 524 | 214 |
| Prob>$chi^2$ | 0.0000 | | 0.0000 | |
| Pseudo $R^2$ | 0.0495 | | 0.0581 | |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2.18: Marginal effects – hired labor use, by gender

| | Male hired labor | | Female hired labor | |
|---|---|---|---|---|
| | Decision | Quantity | Decision | Quantity |
| Marketing contract | -0.15** | 1.89 | 0.10 | 0.88 |
| | (0.06) | (2.67) | (0.09) | (1.80) |
| Resource-providing contract | 0.08 | -1.33 | -0.19** | -2.37 |
| | (0.05) | (2.09) | (0.09) | (2.81) |
| Adult household members | -0.03** | -0.44 | -0.04** | 1.21 |
| | (0.01) | (0.82) | (0.02) | (0.78) |
| Education (in years) | 0.02*** | 0.12 | 0.01** | -0.08 |
| | (0.00) | (0.28) | (0.01) | (0.22) |
| Experience (in years) | -0.00* | 0.04 | -0.00 | 0.10 |
| | (0.00) | (0.11) | (0.00) | (0.12) |
| Gender (dummy) | 0.22*** | 6.26*** | -0.03 | 3.45* |
| | (0.03) | (1.80) | (0.06) | (2.07) |
| Willingness-to-pay (in 500 GHS) | | -0.36 | -0.01 | -0.08 |
| | | (0.58) | (0.01) | (0.52) |
| Age (in years) | 0.01*** | 0.09 | 0.01*** | -0.10 |
| | (0.00) | (0.07) | (0.00) | (0.08) |
| Land availability (in acres, in 2008) | 0.00* | 0.09** | 0.01*** | 0.02 |
| | (0.00) | (0.04) | (0.00) | (0.05) |
| Good soil (dummy) | -0.02 | -0.04 | 0.06 | -0.85 |
| | (0.04) | (1.30) | (0.06) | (2.41) |
| Irrigation (dummy) | 0.03 | 2.09 | 0.03 | 1.20 |
| | (0.03) | (1.30) | (0.06) | (1.19) |
| Number of palms | -0.00 | 0.06** | -0.00 | 0.05*** |
| | (0.00) | (0.02) | (0.00) | (0.01) |
| Age of palms (in years) | -0.00 | -0.13 | -0.00 | 0.04 |
| | (0.00) | (0.19) | (0.01) | (0.25) |
| Distance to road (walking min.) | 0.00 | -0.03 | 0.00 | 0.01 |
| | (0.00) | (0.06) | (0.00) | (0.03) |
| Market access (in km) | -0.02 | -0.94** | -0.00 | 0.13 |
| | (0.02) | (0.45) | (0.01) | (0.43) |
| Residuals included | Yes | No | No | No |
| Number of observations | 524 | 401 | 524 | 214 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.2.19: Unconditional marginal effects – hired labor use, by gender

| | Male hired labor | Female hired labor |
|---|---|---|
| Marketing contract | -0.49 | 1.59 |
| | (2.40) | (0.97) |
| Resource-providing contract | 0.05 | -3.37** |
| | (1.62) | (1.45) |
| Adult household members | -0.76 | -0.00 |
| | (0.72) | (0.32) |
| Education (in years) | 0.32 | 0.10 |
| | (0.22) | (0.10) |
| Experience (in years) | -0.03 | 0.01 |
| | (0.10) | (0.07) |
| Gender (dummy) | 7.93*** | 1.09 |
| | (1.77) | (1.03) |
| Willingness-to-pay (in 500 GHS) | -0.28 | -0.15 |
| | (0.46) | (0.21) |
| Age (in years) | 0.15** | 0.05 |
| | (0.06) | (0.04) |
| Land availability (in acres, in 2008) | 0.13** | 0.11*** |
| | (0.05) | (0.02) |
| Good soil (dummy) | -0.25 | 0.46 |
| | (0.92) | (1.22) |
| Irrigation (dummy) | 2.13* | 0.94 |
| | (1.23) | (0.84) |
| Number of palms | 0.04** | 0.02*** |
| | (0.02) | (0.01) |
| Age of palms (in years) | -0.11 | -0.02 |
| | (0.18) | (0.14) |
| Distance to road (walking min.) | -0.02 | 0.02 |
| | (0.05) | (0.02) |
| Market access (km) | -1.05** | 0.05 |
| | (0.44) | (0.22) |
| Number of observations | 524 | 524 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

## A.3 Dissertation chapter 4

Table A.3.1: Exclusion restriction correlation test

| | IV: Share of households producing oil palm commercially | IV: Village chief is a commercial oil palm farmer |
|---|---|---|
| Oil palm profits | -0.0759 | -0.0482 |
| Profits other cash crops | -0.0087 | -0.0234 |
| Livestock profits | -0.0029 | 0.0178 |
| Income off-farm wage and self-employment | -0.1488 | -0.1478 |
| Total household income | -0.0930 | -0.0965 |

Note: The correlations are for the control group only.

Table A.3.2: First-stage IV regressions (reduced form)

| | Marketing Contract | Resource-providing Contract |
|---|---|---|
| Age of the household head (in years) | -0.02* | 0.06*** |
| | (0.01) | (0.01) |
| Experience of the household head (in years) | 0.06*** | -0.07*** |
| | (0.01) | (0.02) |
| Gender of the household head (dummy) | -0.10 | 0.09 |
| | (0.33) | (0.34) |
| Number of adult household members | -0.05 | 0.11 |
| | (0.10) | (0.11) |
| Number of children | -0.14* | 0.20** |
| | (0.08) | (0.09) |
| Official position (dummy) | -0.23 | 0.15 |
| | (0.28) | (0.29) |
| Land availability 2008 (in acres) | -0.02 | 0.03 |
| | (0.02) | (0.02) |
| Land availability2 2008 | 0.00 | -0.00 |
| | (0.00) | (0.00) |
| Market access (in km) | -0.00 | 0.05 |
| | (0.06) | (0.08) |
| IV: Share of households producing oil palm commercially | 4.13*** | 0.52 |
| | (0.63) | (0.69) |
| IV: Village chief is a commercial oil palm farmer | -2.10*** | 3.60*** |
| | (0.26) | (0.43) |
| Constant | 0.07 | -6.41*** |
| | (0.64) | (0.93) |
| Number of observations | 460 | 460 |
| F-Statistic | 67.36 | 83.38 |
| Prob>F | 0.0000 | 0.0000 |
| Adj. $R^2$ | 0.2756 | 0.3704 |
| *p-value* Anderson test | 0.0000 | |
| Cragg-Donald F-statistic | 45.80 | |

Note: Gender is a dummy variable that equals one if the household head is female. Official position is a dummy variable that equals one if any household member holds an official position in the village. Test statistics derived through the ivregress command.

Table A.3.3: Statistical significance of the generalized residual terms (p-values)

| | Marketing contract | Resource-providing contract |
|---|---|---|
| Oil palm profits | 0.934 | 0.813 |
| Profits other cash crops | 0.608 | 0.287 |
| Livestock profits | 0.666 | 0.261 |
| Income off-farm wage and self-employment | 0.688 | 0.318 |
| Total household income | 0.213 | 0.884 |

Table A.3.4: Additional descriptive statistics

| | | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Oil palm profits (in GHS) | NC | 106 | 299.37 | 3497.34 | -14637.84 | 19921.33 |
| | MC | 190 | 812.26 | 2018.42 | -2871.00 | 18620.00 |
| | RPC | 164 | 2196.28 | 5641.92 | -7048.68 | 44782.06 |
| Other cash crop profits | NC | 106 | 2138.76 | 9301.55 | -283.85 | 90955.13 |
| | MC | 190 | 1565.20 | 2974.23 | -388.70 | 24786.00 |
| | RPC | 164 | 1777.91 | 3492.92 | -1113.65 | 27695.50 |
| Livestock income | NC | 106 | 43.38 | 146.59 | 0.00 | 1000.00 |
| | MC | 190 | 29.39 | 168.34 | 0.00 | 2205.88 |
| | RPC | 164 | 44.79 | 208.99 | 0.00 | 2378.38 |
| Income from off-farm wage- and self-employment | NC | 106 | 1019.39 | 3613.58 | 0.00 | 28000.00 |
| | MC | 190 | 623.08 | 1151.75 | 0.00 | 5555.56 |
| | RPC | 164 | 638.75 | 2167.88 | 0.00 | 22800.00 |
| Household Income | NC | 106 | 3500.91 | 9505.82 | -13082.82 | 76336.90 |
| | MC | 190 | 3029.92 | 4319.79 | -2585.00 | 40608.60 |
| | RPC | 164 | 4657.72 | 8316.80 | -5583.03 | 72869.80 |
| *Income Percentages* | | | | | | |
| Oil palm profits (in GHS) | NC | 105 | 0.43 | 1.32 | -1.78 | 11.39 |
| | MC | 188 | 0.38 | 0.76 | -6.26 | 3.29 |
| | RPC | 164 | 0.72 | 2.34 | -2.19 | 28.99 |
| Profits other cash crops (in GHS) | NC | 106 | 0.29 | 0.87 | -3.73 | 2.78 |
| | MC | 188 | 0.33 | 0.72 | -7.26 | 1.78 |
| | RPC | 164 | 0.14 | 2.27 | -27.99 | 2.27 |
| Livestock income (in GHS) | NC | 106 | 0.01 | 0.09 | -0.61 | 0.38 |
| | MC | 190 | 0.01 | 0.05 | -0.07 | 0.38 |
| | RPC | 164 | 0.01 | 0.06 | -0.41 | 0.39 |
| Income from off-farm wage and self-employment (in GHS) | NC | 106 | 0.14 | 0.71 | -6.05 | 1.59 |
| | MC | 190 | 0.31 | 1.20 | -2.03 | 13.33 |
| | RPC | 164 | 0.13 | 0.39 | -3.77 | 1.33 |

Table A.3.5: Descriptive statistics of control variables

| | Mean | | | Difference | | |
|---|---|---|---|---|---|---|
| | Marketing contract (MC) | Resource-providing contract (RPC) | No contract (NC) | MC-RPC | MC-NC | RPC-NC |
| Number of observations | 190 | 164 | 106 | | | |
| Age of the household head (in years) | 53.51 | 57.24 | 50.51 | *** | ** | *** |
| | (0.78) | (0.93) | (1.12) | | | |
| Experience of the household head in oil palm farming (in years) | 19.75 | 15.69 | 16.74 | *** | *** | |
| | (0.61) | (0.75) | (0.77) | | | |
| Gender of the household head (dummy) | 0.15 | 0.20 | 0.15 | | | |
| | (0.03) | (0.03) | (0.04) | | | |
| Number of adult household members (above 18 years) | 2.64 | 2.79 | 2.66 | | | |
| | (0.10) | (0.10) | (0.12) | | | |
| Number of child household members (14 years and below) | 1.49 | 1.88 | 1.73 | ** | | |
| | (0.10) | (0.14) | (0.15) | | | |
| Official village position (dummy) | 0.20 | 0.35 | 0.19 | *** | | *** |
| | (0.03) | (0.04) | (0.04) | | | |
| Land availability 2008 (in acres) | 13.34 | 15.18 | 12.87 | | | |
| | (0.94) | (1.30) | (1.47) | | | |
| Market access (in km) | 0.86 | 1.12 | 0.12 | | *** | *** |
| | (0.15) | (0.14) | (0.05) | | | |
| Willingness-to-pay (in 500 GHS) | 2.15 | 2.08 | 2.73 | | ** | ** |
| | (0.14) | (0.16) | (0.20) | | | |
| Risk preferences | 3.02 | 2.79 | 2.75 | | | |
| | (0.10) | (0.12) | (0.15) | | | |

Note: Gender of the household head is a dummy variable that equals one if the household head is female. Official village position is a dummy variable that equals one if a household member has an official position in the village. GHS stands for Ghanaian Cedis, the local currency. Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.3.6: OLS estimates (full results)

| | Oil palm profits | Profits other cash crops | Livestock income | Income off-farm wage and self-employment | Total household income |
|---|---|---|---|---|---|
| Marketing contract | 2.29*** | -0.22* | -0.43** | 0.27** | 1.63*** |
| | (0.22) | (0.06) | (0.07) | (0.06) | (0.05) |
| Resource-providing contract | 3.90*** | 0.23 | -0.42** | 0.16 | 1.96** |
| | (0.07) | (0.14) | (0.06) | (0.11) | (0.25) |
| Age of the household head (in years) | -0.02 | 0.00 | -0.00 | -0.06*** | -0.04 |
| | (0.02) | (0.02) | (0.01) | (0.00) | (0.03) |
| Experience of the household head (in years) | -0.02 | -0.00 | 0.02 | -0.01 | -0.04 |
| | (0.07) | (0.03) | (0.01) | (0.02) | (0.03) |
| Gender of the household head (dummy) | -1.26 | -1.68 | 0.24 | -0.16 | -1.41 |
| | (0.59) | (0.72) | (0.22) | (0.84) | (1.08) |
| Number of adult household members | 0.02 | -0.14 | 0.03 | 0.28** | -0.08 |
| | (0.14) | (0.10) | (0.05) | (0.06) | (0.05) |
| Number of children | -0.10 | -0.35*** | 0.09 | -0.16 | -0.14 |
| | (0.11) | (0.03) | (0.08) | (0.08) | (0.10) |
| Official position (dummy) | 0.06 | -0.23 | 0.74 | 0.29* | 0.44 |
| | (0.07) | (0.30) | (0.36) | (0.09) | (0.47) |
| Land availability 2008 (in acres) | -0.01 | 0.14* | 0.03* | -0.06* | -0.00 |
| | (0.01) | (0.03) | (0.01) | (0.02) | (0.04) |
| Land availability$^2$ 2008 | -0.00 | -0.00 | 0.00 | 0.00** | 0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Market access (in km) | 0.01 | 0.26*** | 0.05 | 0.01 | 0.11 |
| | (0.06) | (0.02) | (0.05) | (0.08) | (0.14) |
| Constant | 3.91 | 5.10** | 0.23 | 6.91*** | 8.68** |
| | (1.63) | (1.15) | (0.55) | (0.33) | (1.00) |
| *Semi Elasticities* | | | | | |
| Marketing contract | 0.95*** | -0.09*** | -0.18*** | 0.11*** | 0.67*** |
| | (0.09) | (0.02) | (0.03) | (0.02) | (0.02) |
| Resource-providing contract | 1.39*** | 0.08* | -0.15*** | 0.06 | 0.70*** |
| | (0.03) | (0.05) | (0.02) | (0.04) | (0.09) |
| Number of observations | 460 | 460 | 460 | 460 | 460 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.3.7: Control function estimates (full results)

| | Oil palm profits | Profits other cash crops | Livestock income | Income off-farm wage and self-employment | Total household income |
|---|---|---|---|---|---|
| Marketing contract | 2.32** | -0.15 | -0.40** | 0.40 | 2.36** |
| | (0.26) | (0.14) | (0.08) | (0.16) | (0.41) |
| Resource-providing contract | 4.06** | -0.01 | -0.56** | 0.56 | 1.94** |
| | (0.68) | (0.31) | (0.09) | (0.25) | (0.22) |
| Age of the household head (in years) | -0.02 | 0.00 | -0.00 | -0.06*** | -0.03 |
| | (0.01) | (0.02) | (0.01) | (0.01) | (0.03) |
| Experience of the household head (in years) | -0.02 | -0.00 | 0.02 | -0.01 | -0.04 |
| | (0.08) | (0.02) | (0.01) | (0.02) | (0.03) |
| Gender of the household head (dummy) | -1.26 | -1.67 | 0.24 | -0.16 | -1.38 |
| | (0.58) | (0.71) | (0.22) | (0.84) | (1.08) |
| Number of adult household members | 0.02 | -0.14 | 0.02 | 0.28** | -0.08 |
| | (0.14) | (0.10) | (0.05) | (0.06) | (0.04) |
| Number of children | -0.10 | -0.35*** | 0.09 | -0.16 | -0.15 |
| | (0.11) | (0.03) | (0.08) | (0.08) | (0.10) |
| Official position (dummy) | 0.05 | -0.22 | 0.74 | 0.27* | 0.39 |
| | (0.05) | (0.31) | (0.35) | (0.07) | (0.45) |
| Land availability 2008 (in acres) | -0.01 | 0.14* | 0.03* | -0.06* | -0.00 |
| | (0.01) | (0.03) | (0.01) | (0.02) | (0.04) |
| Land availability$^2$ 2008 | -0.00 | -0.00 | 0.00 | 0.00** | 0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Market access (in km) | 0.03 | 0.23* | 0.03 | 0.08 | 0.22 |
| | (0.11) | (0.07) | (0.05) | (0.10) | (0.14) |
| Generalized residuals (MC) | -0.00 | -0.02 | -0.01 | -0.02 | -0.18 |
| | (0.04) | (0.04) | (0.03) | (0.04) | (0.10) |
| Generalized residuals (RPC) | -0.05 | 0.07 | 0.04 | -0.11 | 0.01 |
| | (0.17) | (0.05) | (0.03) | (0.06) | (0.06) |
| Constant | 3.86 | 5.10** | 0.24 | 6.76*** | 8.27** |
| | (1.71) | (1.08) | (0.60) | (0.16) | (1.17) |
| *Semi elasticities* | | | | | |
| Marketing contract | 0.97*** | -0.06 | -0.17*** | 0.17*** | 0.98*** |
| | (0.11) | (0.19) | (0.03) | (0.0.6) | (0.17) |
| Resource-providing contract | 1.44*** | -0.00 | -0.20 | 0.20** | 0.69*** |
| | (0.24) | (0.11) | (0.03) | (0.09) | (0.08) |
| Number of observations | 460 | 460 | 460 | 460 | 460 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.3.8: OLS estimates (including willingness-to-pay and risk preferences)

| | Oil palm profits | Profits other cash crops | Livestock income | Income off-farm wage and self-employment | Total household income |
|---|---|---|---|---|---|
| Marketing contract | 2.31** | -0.27** | -0.43** | 0.33** | 1.64*** |
| | (0.24) | (0.06) | (0.07) | (0.03) | (0.03) |
| Resource-providing contract | 3.95*** | 0.20 | -0.40** | 0.20 | 1.98** |
| | (0.10) | (0.14) | (0.05) | (0.16) | (0.24) |
| Age of the household head (in years) | -0.02 | 0.00 | -0.00 | -0.06*** | -0.04 |
| | (0.01) | (0.02) | (0.01) | (0.01) | (0.04) |
| Experience of the household head (in years) | -0.02 | -0.01 | 0.02 | -0.01 | -0.04 |
| | (0.07) | (0.03) | (0.01) | (0.02) | (0.02) |
| Gender of the household head (dummy) | -1.10 | -1.60 | 0.31 | -0.21 | -1.35 |
| | (0.63) | (0.71) | (0.28) | (0.84) | (1.05) |
| Number of adult household members | 0.04 | -0.13 | 0.04 | 0.27* | -0.07 |
| | (0.12) | (0.11) | (0.04) | (0.07) | (0.05) |
| Number of children | -0.10 | -0.34** | 0.09 | -0.17 | -0.14 |
| | (0.12) | (0.04) | (0.09) | (0.09) | (0.11) |
| Official position (dummy) | 0.03 | -0.30 | 0.73 | 0.35* | 0.43 |
| | (0.07) | (0.34) | (0.39) | (0.11) | (0.43) |
| Land availability 2008 (in acres) | -0.01 | 0.14* | 0.03 | -0.07* | -0.00 |
| | (0.01) | (0.03) | (0.01) | (0.02) | (0.05) |
| Land availability$^2$ 2008 | -0.00 | -0.00 | 0.00 | 0.00*** | 0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Market access (in km) | 0.03 | 0.27*** | 0.06 | -0.00 | 0.12 |
| | (0.04) | (0.03) | (0.05) | (0.07) | (0.12) |
| Willingness-to-pay | 0.14 | -0.01 | 0.06 | 0.03 | 0.05 |
| | (0.12) | (0.05) | (0.06) | (0.10) | (0.07) |
| Risk preferences | 0.14 | 0.20 | 0.07 | -0.18* | 0.04 |
| | (0.24) | (0.10) | (0.11) | (0.04) | (0.13) |
| Constant | 3.02 | 4.57* | -0.17 | 7.27*** | 8.40*** |
| | (2.59) | (1.15) | (1.07) | (0.40) | (0.83) |
| *Semi elasticities* | | | | | |
| Marketing contract | 0.96*** | -0.11*** | -0.18*** | 0.14*** | 0.68*** |
| | (0.10) | (0.03) | (0.03) | (0.01) | (0.01) |
| Resource-providing contract | 1.40*** | 0.07 | -0.14*** | 0.07 | 0.71*** |
| | (0.03) | (0.05) | (0.02) | (0.06) | (0.08) |
| Number of observations | 460 | 460 | 460 | 460 | 460 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A.3.9: Full OLS estimation results (inverse probability of treatment weighting)

| | Oil palm profits | Profits other cash crops | Livestock Income | Income off-farm wage and self-employment | Total household income |
|---|---|---|---|---|---|
| Marketing contract | 2.07*** | -0.45** | -0.37*** | 0.65* | 1.31*** |
| | (0.04) | (0.05) | (0.01) | (0.15) | (0.06) |
| Resource-providing contract | 3.99*** | 0.08* | -0.45*** | 0.32 | 1.97*** |
| | (0.17) | (0.03) | (0.02) | (0.22) | (0.15) |
| Age of the household head (in years) | -0.03 | 0.01 | -0.01 | -0.08** | -0.01 |
| | (0.02) | (0.01) | (0.01) | (0.01) | (0.07) |
| Experience of the household head (in years) | -0.06 | 0.02 | 0.01 | -0.01 | -0.06 |
| | (0.06) | (0.03) | (0.01) | (0.01) | (0.04) |
| Gender of the household head (dummy) | -1.88 | -0.97 | 0.10 | -1.04 | -1.99 |
| | (1.00) | (0.98) | (0.10) | (0.68) | (1.10) |
| Number of adult household members | 0.15 | -0.10 | 0.18* | 0.25** | -0.07 |
| | (0.14) | (0.05) | (0.06) | (0.05) | (0.17) |
| Number of children | -0.23 | -0.33** | 0.05 | -0.33* | -0.20 |
| | (0.12) | (0.06) | (0.06) | (0.10) | (0.09) |
| Official position (dummy) | -0.54 | 0.03 | 1.13 | 0.72 | 0.17 |
| | (0.28) | (0.51) | (0.53) | (0.40) | (0.36) |
| Land availability 2008 (in acres) | 0.05 | 0.10 | 0.01 | -0.10*** | -0.01 |
| | (0.04) | (0.06) | (0.01) | (0.01) | (0.04) |
| Land availability$^2$ 2008 | -0.00 | -0.00 | 0.00* | 0.00** | 0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Market access (in km) | -0.12* | 0.27*** | 0.04 | -0.08 | 0.08 |
| | (0.03) | (0.01) | (0.03) | (0.16) | (0.12) |
| Constant | 4.52* | 4.98** | 0.28 | 8.56** | 7.94 |
| | (1.35) | (0.86) | (0.57) | (0.91) | (2.95) |
| *Semi Elasticities* | | | | | |
| Marketing contract | 0.86*** | -0.18*** | -0.15*** | 0.27*** | 0.54*** |
| | (0.02) | (0.02) | (0.00) | (0.06) | (0.02) |
| Resource-providing contract | 1.65*** | 0.03*** | -0.19*** | 0.13 | 0.81*** |
| | (0.07) | (0.01) | (0.01) | (0.09) | (0.06) |
| Number of observations | 460 | 460 | 460 | 460 | 460 |

Note: Cluster corrected standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

# Appendix B

# Questionnaires

Note: The questionnaires presented here are the paper versions. For the survey, each questionnaire was programmed with Open Data Kit (ODK) and uploaded on tablet computers.

## B.1 Household questionnaire

Main Respondent: The main respondent is in charge of the oil palm production and can answer the oil palm production related modules. Thus, it is either the contracting farmer (outgrower), or the farmer in charge of production decisions regarding the oil palm plots. Keep in mind, the main respondent is not necessarily the household head, and not necessarily a male farmer. The respondent has to be the farmer, not a caretaker or else. We are looking at farming households. If this is not the case in your household than contact the supervisor and we will provide you with a back-up household.

### Identification

1. **Interviewer ID**: _____
2. **Village ID**: _____
3. **Village name [see list]**: _____
4. **Household ID**: _____
5. **Name of the main respondent**: _____
6. **Mobile number of the main respondent**: _____
7. **Address of the main respondent's homestead**: _____
8. **GPS Coordinates [Will be taken automatically]**: _____
9. **What is the distance between your homestead and the village chief's homestead? (in walking minutes)** _____
10. **Do you or any other member in this household hold an official position in this village? (Assembly Man, Chief, Elder...)**
    - ☐ Yes
    - ☐ No
11. **Does this household own a radio?**
    - ☐ Yes
    - ☐ No

**12. How often do you participate in town meeting?**
- ☐ Always
- ☐ Most of the Time
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

**13. Status of the household**:
- ☐ TOPP Outgrower
- ☐ BOPP Outgrower
- ☐ Comparison

## Household roster

Household: Please list all the people present or absent, who are part of this household, sorted by their age. Household members are under the care of the household head in terms of food and shelter provision, pool parts of their assets and eat their meals together. This question set will be repeated for every household member. The household member ID will be generated automatically.

**14. How many members belong to this household? [Please consider carefully, this number will determine the automatic repetitions of the roster]**

**15. Name**:
_____

**16. Gender**:
- ☐ Male
- ☐ Female

**17. Age (in years)**:
_____

**18. Relationship to the household head**:
- ☐ Head
- ☐ Spouse
- ☐ Son/Daughter
- ☐ Son/Daughter in law
- ☐ Father/Mother
- ☐ Father/Mother in law
- ☐ Brother/Sister
- ☐ Grandchild
- ☐ Other relative
- ☐ Other non-relative

**19. Full years of completed education**:
_____

**20. Highest level of formal education completed**:
- ☐ None
- ☐ Primary school
- ☐ MSLC
- ☐ JSS/JHS
- ☐ SSS/SHS
- ☐ Post-Sec. Dip (HND)
- ☐ University diploma (Bachelor, Master, PhD)

**21. Is the household member currently enrolled in school?**
- ☐ Yes
- ☐ No [Skip to question 25]

**22. In which level is the household member currently enrolled?**
- ☐ Primary School
- ☐ MSLC
- ☐ JSS/JHS
- ☐ SSS/SHS
- ☐ Post-Sec Dipl. (HDM)
- ☐ University diploma (Bachelor, Master, PhD)

**23. What is the distance to the school? (in walking minutes)**
_____

**24. In total, how many weeks during the last 12 months did the household member stay home from school to help on the farm?**
_____

**25. Has this household member been away in the last 12 months?**
- ☐ Yes
- ☐ No [Skip to the next person]

**26. How many weeks, out of the last 12 months has this household member been away?**
_____

**27. Why was this household member away?**
- ☐ Other agricultural wage employment
- ☐ Other agricultural self-employment
- ☐ Non-agricultural wage employment
- ☐ Non-agricultural self-employment
- ☐ School/ University
- ☐ Other: _____

## Total land holdings

**28. In total, how many acres of land did the household own in the last 12 months?**
_____

**29. In total, how many acres of land did the household rent-in/ sharecrop-in in the last 12 months?**
_____

**30. In total, how many acres of land did the household rent-out/sharecrop-out in the last 12 months?**
_____

**31. In total, how many acres of land did the household cultivate in the last 12 month?**
_____

**32. In total, on how many acres of land did this household plant palm oil in the past 12 months?**
_____

**33. In total, how many acres of land did the household acquire for the production of oil palm in the last 10 years?**
_____

**34. In total, how many acres of oil palm plantation did the household sell in the last 10 years?**
_____

**35. In total, how many plots did the household cultivate in the last 12 months?**
_____

The following question set will be repeated for each plot the household has the right to cultivate on. Also include the land that the household has rented or lent in, from another person. Collect the information for each plot separately. The plot ID will be generated automatically.

**36. What is the total size of the plot in acres?**

_____

**37. Land tenure**:

- ☐ Owned by the household
- ☐ Community land, distributed by chief
- ☐ Rented-in for fixed pay
- ☐ Sharecropped-in
- ☐ Other: _____

**38. In total, how much rental costs did you pay for this land in the last 12 month? [If in-kind payment, please estimate the value in GHS]**

_____

**39. Do you have the right to sell the land?**

- ☐ Yes
- ☐ No
- ☐ Dont know

**40. Do you have the right to use the land as collateral?**

- ☐ Yes
- ☐ No
- ☐ Dont know

**41. Do you have a formal land title for this plot?**

- ☐ Yes
- ☐ No
- ☐ Dont know

**42. Is the plot irrigated?**

- ☐ Yes, naturally
- ☐ Yes, artificially
- ☐ No

**43. How long does it take to travel from the plot to the next road (in walking minutes)?**

_____

**44. How long does it take to travel from the plot to the homestead? (in walking minutes)**

_____

**45. Can the plot be accessed with a tractor?**

- ☐ Yes
- ☐ No

**46. How is the soil on this plot?**

- ☐ Loamy
- ☐ Clayey
- ☐ Sandy
- ☐ Waterlogges
- ☐ Stagnant water

## Farmer information and preferences

This module has to be repeated for every independent oil palm farmer in the household.

**47. How many independent oil palm farmers are in this household? [Please consider carefully, this number will determine the automatic repetitions of the roster]**

**48. Household ID of the farmer [Select from the household roster]:**

**49. Years of experience in oil palm farming:**
_____

**50. Ethnicity [see list]:**
_____

**51. Religion [see list]:**
_____

**52. How frequently do you listen to the radio?**
- ☐ 6-7 days a week
- ☐ 3-5 days a week
- ☐ 1-2 days a week
- ☐ less than 1 time a week
- ☐ I don't listen to the radio

**53. Do you have a personal relationship to the village chief?**
- ☐ Yes, family ties
- ☐ Yes, friendship
- ☐ No

**54. Do you consume alcohol?**
- ☐ Yes
- ☐ No

**55. How often do you drink alcohol?**
- ☐ Daily
- ☐ 2-3 Times a week
- ☐ 4-5 Times a week
- ☐ Once a week
- ☐ Rarely

**56. Are you an outgrower for TOPP [Twifo Oil Palm Plantations]?**
- ☐ Yes
- ☐ No [Skip to Question 66]

**57. In which year did you sign the contract with TOPP?**
_____

**58. How many acres of oil palm do you have registered with TOPP? [In total, under this farmers cultivation]**
_____

**59. Can you read and write English?**
- ☐ Yes
- ☐ No

**60. Did you fully read and understand the contract you signed?**
- ☐ Yes
- ☐ No

**61. If you had the chance to go back in time, would you sign the contract again?**
- ☐ Yes [Skip to question 63]
- ☐ No

**62. Why would you not sign the contract again?**
- ☐ Unfair contract terms
- ☐ Too high input prices
- ☐ Too low output prices
- ☐ Set-up of plantation is too expensive
- ☐ Interest rates are too high
- ☐ Other: _____

**63. After this contract has ended, would you sign up for another 20 years? (Assuming the contract terms stay the same)**
- ☐ Yes
- ☐ No

**64. In case you miss a payment and are not able to pay TOPP in over 60 days, what is specified in the contract to happen?**
- ☐ TOPP takes over the oil palm plantation
- ☐ They give me more time but I pay more interest rates
- ☐ Nothing happens
- ☐ Other: _____

**65. In case of your death, what is specified in the contract to happen with the oil palm production?**
- ☐ My predecessor is under contract automatically
- ☐ The contract is ended
- ☐ I never thought about this
- ☐ Other: _____

**66. Are you an outgrower of BOPP [Benso Oil Palm Plantation]?**
- ☐ Yes
- ☐ No [Skip to question 74]

**67. In which year did you start being an outgrower for BOPP/ selling regularly to BOPP?**

_____

**68. Did you ever receive support from BOPP on credit?**
- ☐ Yes
- ☐ No [Skip to question 71]

**69. What kind of support did you receive on credit?**
- ☐ Tools
- ☐ Agrochemical Inputs
- ☐ Labor
- ☐ Transportation
- ☐ Other: _____

**70. Was this a regular/ frequent support?**
- ☐ Yes
- ☐ No

**71. Did you ever receive support from the middlenem on credit?**
- ☐ Yes
- ☐ No [Skip to Question 74]

**72. What kind of support did you receive on credit?**
- ☐ Tools
- ☐ Agrochemical Inputs
- ☐ Labor
- ☐ Transportation
- ☐ Other: _____

**73. Was this a regular/ frequent support?**
- ☐ Yes
- ☐ No

## Choice Sets

**74. When decisions were made regarding the [ACTIVITY] on your plots, who is it that normally takes the decision?**

- ☐ **Respondent him/herself**
- ☐ **Other hh member [select from household roster]**
- ☐ **Joint decision (Including the respondent)**
- ☐ **Other:**_____

Note: This Question is asked for the following ACTIVITIES:
(A) Clearing the plot
(B) Planting, including the purchase of material
(C) Spraying/ applying agrochemicas, including the purchase of material
(D) Hiring labor, inlcuding payment decisions
(E) Selling/ Marketing
(F) Spending of the revenues

**75. In the following, you will be presented with a choice between 2 crops that have different outputs in good and bad years. We assume that a bad year occurs one out of 5 years. Please indicate the crop you prefer to plant in the next season. [Present the choice sets to the farmers]:**

- ☐ Crop 1
- ☐ Crop 2

Note: This question is asked for 5 different choices. Please find the according choice sets attached to the questionnaire

**76. Would you be willing to enter a contract agreement with a firm that would increase your annual income from oil palm production by setting-up an entire acre of oil palm plantation, but would necessitate an initial investment of...?**

- ☐ Yes
- ☐ No

Note: This question is asked for the following inititial investments:
(1) An initial investment of 500 GHS
(2) An initial investment of 1000 GHS
(3) An initial investment of 1500 GHS
(4) An initial investment of 2000 GHS
(5) An initial investment of 2500 GHS
(6) An initial investment of 3000 GHS
(7) An initial investment of 3500 GHS
(8) An initial investment of 4000 GHS

**77. If you were offered a credit over 3000 GHS, to set up an additional acre of oil palm plantation with a X percent interest rate, using this oil palm as collateral, would you accept it? (The credit duration is 20 years)**

- ☐ Yes
- ☐ No

Note: This question is asked for the following interest rates:
(1) 5 percent interest rate
(2) 8 percent interest rate
(3) 11.5 percent interest rate
(4) 15 percent interest rate
(5) 20 percent interest rate
(6) 25 percent interest rate
(7) 30 percent interest rate
(8) 35 percent interest rate
(9) 40 percent interest rate

The following questions refer to the household:

**78. Prior to becoming an outgrower, which other cash-crops did this household produce?** [see list]

**79. Did you produce oil palm commercially, prior to becoming an outgrower?**

- ☐ Yes
- ☐ No

**80. How many hours per week does this household spend for church? (Including the travel to the church and back) per person, on average**

**81. When your household is in crisis, how do you cope with it? (Low income, unemployment, hunger...) [Multiple answers possible]**
- ☐ Diversifying income (Sources)
- ☐ Praying
- ☐ Insurance
- ☐ Savings
- ☐ Relying on the community (welfare dues)
- ☐ Relying on the church community (welfare dues)
- ☐ Reducing consumption
- ☐ Selling assets
- ☐ Other: _____

**82. When your production is in crisis, how do you cope with it? (Low income, unemployment, hunger...) [Multiple answers possible]**
- ☐ Diversifying Income (Sources)
- ☐ Praying
- ☐ Insurance
- ☐ Savings
- ☐ Relying on the community (welfare dues)
- ☐ Relying on the church community (welfare dues)
- ☐ Reducing Consumption
- ☐ Selling Assets
- ☐ Other: _____

## Oil palm production

This module refers to the last 12 months of oil palm cultivation, and the set-up of the plantations. Also include plots which are only partially cultivated with oil palm. Please answer the questions for each plot separately, using the previously generated plot IDs. Plots without oil palm are not entered into this module and the next.

**83. In total, how many oil palm plots did the household cultivate in the last season? [Please consider carefully, this number will determine the automatic repetitions of the roster]**

### Production and sales

**84. Enter the Plot ID**:

**85. Which household member is in charge of the oil palm cultivation on this plot? [Select from the household roster]**

**86. What is the area cultivated with oil palm on this plot? (in acres)**

_____

**87. How many palms are planted on this plot?**

_____

**88. Is the oil palm planted in rows?**

_____

**89. Which variety is planted on this plot?**
- ☐ Tenera (D+P)
- ☐ Dura
- ☐ Pesiphera

**90. In which year were the palms planted?**

_____

**91. What was the use of the plot prior to oil palm cultivation?**
- ☐ Forest
- ☐ Pasture
- ☐ Cultivation of other tree cash-crops
- ☐ Cultivation of other cash-crops
- ☐ Cultivation of crops for home consumption
- ☐ Other: _____

**92. Is this plot currently a monoculture?**
- ☐ Yes [Skip to question 94]
- ☐ No

**93. What other crops are planted on this plot?[see list] [Multiple answers possible]**

_____

**94. Was/ is this plot intercropped in the first years until maturity?**
- ☐ Yes
- ☐ No [Skip to question 96]

**95. With what is/ was this plot intercropped? [see list] [Multiple answers possible]**

_____

**96. Was this plot set-up and planted by TOPP?**
- ☐ Yes [Skip questions 98 to 103]
- ☐ No [Skip to question 98]

**97. What were the charges for the set-up of plot, including labor, planting material and agrochemicals?**

_____

**98. Was this plot set up prior to the last 12 months?**
- ☐ Yes
- ☐ No [Skip to question 104]

**99. In total, how much cost did incur for labor for land preparation and planting? (In GHS)**

_____

**100. In total, how much cost did incur for machinery (including fuel) for land preparation and planting? (In GHS)**

_____

**101. In total, how much cost did incur for planting material? (In GHS)**

_____

**102. In total, how much cost did incur for agrochemicals for land preparation and planting? (In GHS)**

_____

**103. In total, how much cost did incur for agrochemicals in the first years until the oil palm started bearing fruit? (In GHS)**

_____

**104. Do the trees on this plot already bear fruits?**
- ☐ Yes
- ☐ No [Skip to the next Plot]

**105. How many tons of oil palm did you harvest on this plot in the last 12 month? (In tons)**

_____

**106. Did you sell any oil palm to BOPP/ TOPP?**
- ☐ Yes
- ☐ No [Skip to question 110]

**107. How many tons of oil palm did you sell to TOPP/ BOPP?**

_____

**108. What was the price per ton in the last 12 months? (not considering the 25 percent deduction)**

_____

**109. What was the price you received per ton, considering the 25 percent deduction?**

_____

**110. Did you sell any oil palm to another processing company?**
- ☐ Yes
- ☐ No [Skip to question 113]

**111. How many tons of oil palm did you sell to other processing companies?**
_____

**112. What was the price per ton you received in the last 12 months?**
_____

**113. Did you sell any oil palm on the local market?**
- ☐ Yes
- ☐ No [Skip to question 116]

**114. How many tons of oil palm did you sell on the local market?**
_____

**115. What was the price per ton you received in the last 12 months?**
_____

**116. Did you process any oil palm into palm oil yourself in the last 12 months?**
- ☐ Yes
- ☐ No [Skip to question 120]

**117. How many tonnes of oil palm did you process into palm oil yourself?**
_____

**118. How many litres of palm oil did you sell on the local market?**
_____

**119. What was the price per liter you received in the last 12 months?**
_____

**120. Did the oil palm suffer from any diseases in the last 12 months?**
- ☐ Yes
- ☐ No [Skip to question 123]

**121. How many acres were affected?**
_____

**122. What is the estimated loss in output? (in tons)**
_____

**123. How much oil palm did go to waste, because it could not get sold or consumed? (in tons)?**
_____

**124. How many tonnes of oil palm did you lose due to weighing delays?**
_____

## Agrochemical input expenditure

**125. How often did you weed the plot by hand during the last 12 months?**
_____

**126. How often did you apply organic fertilizer on this plot during the last 12 months?**
_____

**127. What was the total expenditure of organic fertilizer in the last 12 months? (in GHS)**
_____

**128. Did you apply chemical fertilizer on this plot, during the last 12 months?**
- ☐ Yes
- ☐ No [Skip to question 132]

**129. How many times did you apply chemical fertilizer on this plot, during the last 12 months?**
_____

**130. In total, what quantity of the chemical fertilizer did you apply on this plot, during the last 12 months? (in kg)**
_____

**131. What was the total expenditure of the chemical fertilizer applied on this plot, in the last 12 months? (in GHS)**
_____

**132. Did you apply weedicides/herbicides on this plot, during the last 12 months?**
- ☐ Yes
- ☐ No [Skip to question 136]

**133. How many times did you apply weedicides/herbicides on this plot, during the last 12 months?**

_____

**134. In total, what quantity of the weedicides/herbicides did you apply on this plot, during the last 12 months? (in liters of mixture)**

_____

**135. What was the total expenditure of the weedicides/herbicides applied on this plot, in the last 12 months? (in GHS)**

_____

**136. Did you apply insecticides on this plot, during the last 12 months?**
- ☐ Yes
- ☐ No [Skip to question 140]

**137. How many times did you apply insecticides on this plot, during the last 12 months?**

_____

**138. In total, what quantity of the insecticides did you apply on this plot, during the last 12 months? (in liters of mixture)**

_____

**139. What was the total expenditure of the insecticides applied on this plot, in the last 12 months? (in GHS)**

_____

**140. Did you apply fungicides on this plot, during the last 12 months?**
- ☐ Yes
- ☐ No [Skip to question 144]

**141. How many times did you apply fungicides on this plot, during the last 12 months?**

_____

**142. In total, what quantity of the fungicides did you apply on this plot, during the last 12 months? (in liters of mixture)**

_____

**143. What was the total expenditure of the fungicides applied on this plot, in the last 12 months? (in GHS)**

_____

**144. In total, how much GHS did you spend on rental cost for machinery and fuel on this plot?**

_____

**145. In total, how much GHS did you spend on processing/ milling services?**

_____

## Family labor and hired labor

**146. Was this [ACTIVITY] done in the last 12 months?**
- ☐ Yes
- ☐ No [Skip to the next ACTIVITY]

**147. How many household members worked on this plot for this [ACTIVITY]? (Including the respondent)**

_____

**148. Select household members from the household roster**

**149. How many days did they work, all together? [Add up all the days]**

_____

**150. How many hours per day did they work on average?**

_____

**151. How many of the household workers were male adults [above 18]?**

_____

**152. How many of the household workers were female adults [above 18]?**
_____

**153. How many of the household workers are youth workers [between 17 and 15]?**
_____

**154. How many of the household workers are young workers [14 and below]?**
_____

**155. Did you hire any labour for this [ACTIVITY] on this plot in the last 12 months?**
□ Yes
□ No [Skip to the next ACTIVITY]

**156. How many laborers did you hire for this [ACTIVITY] on this plot?**
_____

**157. How many days did they work, all together? [Add up all the days]**
_____

**158. How many hours per day did they work on average?**
_____

**159. How many of the hired workers were male adults [above 18]?**
_____

**160. How many of the hired workers were female adults [above 18]?**
_____

**161. How many of the hired workers are youth workers [between 17 and 15]?**
_____

**162. How many of the hired workers are young workers [14 and below]?**
_____

**163. How much did you pay one male adult worker for this [ACTIVITY] per day?**
_____

**164. How much did you pay one female adult worker for this [ACTIVITY] per day?**
_____

**165. How much did you pay one youth worker for this [ACTIVITY] per day?**
_____

**166. How much did you pay one child worker for this [ACTIVITY] per day?**
_____

Note:

This question set is asked for the following ACTIVITIES:
(A) Clearing the plot
(B) Planting, including the purchase of material
(C) Spraying/ applying agrochemicas, including the purchase of material
(D) Hiring labor, inlcuding payment decisions
(E) Selling/ Marketing
(F) Spending of the revenues

## Production of other crops, inputs and sales

In this module, the production of all other commercial crops cultivated in the last 12 months is captured, independent of whether the plot is partly cultivated with oil palm. All crops that are (partly) sold on the market should be entered here. Please separate the plots and crops (one row for each crop on one plot). Plot IDs can be entered several times. If this plot is intercropped or a mixed culture, only capture the inputs (particularly agrochemicals) once, for the intended crop.

**167. Overall, how many other crops did the household cultivate commercially in the last 12 months? [Please consider carefully, this number will determine the automatic repetitions of the roster]**

**168. Select crop grown on this plot**

**169. Area dedicated to the crop (in acres)**
_____

**170. Which household member is in charge of the production? [Select from the household roster]**

_____

**171. Total harvest of the crop in the last 12 months (a) Quantity (b) Unit [see list]**

_____

**172. Quantity sold (in specified unit)**

_____

**173. Received price per sold specified unit (in GHS)**

_____

**174. Total expenditure for planting material in the last 12 months?**

_____

**175. Is this plot intercropped?**

- ☐ Yes
- ☐ No

**176. What was the total additional expenditure for organic fertilizer?**

_____

**177. What was the total additional expenditure for chemical fertilizer on this plot in the last 12 months?**

_____

**178. What was the total additional expenditure for weedicide/ herbicide on this plot in the last 12 months?**

_____

**179. What was the total additional expenditure for insecticide on this plot in the last 12 months?**

_____

**180. What was the total additional expenditure for fungicide on this plot in the last 12 months?**

_____

**181. What was the total expenditure for hired labor on this plot in the last 12 months?**

_____

**182. What was the total expenditure for machinery and fuel on this plot in the last 12 months?**

_____

The following questions refer to the household:

**183. Which other crops does this household produce only for home consumption [Multiple answers possible]**

_____

**184. In total, how much area is dedicated for the production of other food crops for home consumption?**

_____

**185. Which household member is in charge of the cultivation of those crops? [Select from the household roster]**

_____

**186. How many goats are owned by this household?**

_____

**187. How many sheep are owned by this household?**

_____

**188. How many cows/cattle are owned by this household?**

_____

**189. How many donkeys are owned by this household?**

_____

**190. How many turkeys are owned by this household?**

_____

**191. How many guinea fowl are owned by this household?**

_____

**192. How many chicken are owned by this household?**

_____

**193. How many goose are owned by this household?**

_____

## Pesticide access, handling and poisoning

Please answer this module for every oil palm farmer (from above) in the household that takes part in the spraying of pesticides.

**194. How many times in the last 12 months, did a household member participate in training on agrochemical use from the MoFA/ Agricultural District Office?**

_____

**195. How many oil palm farmers/ household laborers in the household were actively involved in spraying/ applying pesticides in the last season? [Please consider carefully, this number will determine the automatic repetitions of the roster]**

_____

**196. Select household member from the household roster**:

**197. During spraying, do you wear a safety mask?**
- ☐ Yes
- ☐ No
- ☐ Sometimes

**198. During spraying, do you wear a safety suit?**
- ☐ Yes
- ☐ No
- ☐ Sometimes

**199. During spraying, do you wear safety goggles?**
- ☐ Yes
- ☐ No
- ☐ Sometimes

**200. During spraying, do you cover your skin with normal clothing?**
- ☐ Yes
- ☐ No
- ☐ Sometimes

**201. Do you drink or eat during spraying?**
- ☐ Yes
- ☐ No
- ☐ Sometimes

**202. Do you smoke?**
- ☐ Yes
- ☐ No [Skip to question 205]

**203. Do you smoke during spraying?**
- ☐ Yes
- ☐ No

**204. In total, how much do you spend on cigarettes per month? (in GHS)**

_____

**205. Do you taste the final mixture to check the concentration?**
- ☐ Yes
- ☐ No

**206. Do you wash your face and skin after spraying?**
- ☐ Yes
- ☐ No

**207. Where do you store/dispose the empty containers?**
- ☐ Inside the homestead
- ☐ Outside the homestead
- ☐ On the farm/ plot
- ☐ Forest
- ☐ Burning within the village
- ☐ Burning outside the village
- ☐ Other: _____

**208. Within the last 12 months, how often were you involved in the spraying of pesticides on the Oil Palm Plots?**

_____

**209. Within the last 12 months, how often were you involved in the spraying of pesticides on Other Plots?**

_____

**210. Considering all the times you sprayed agrochemicals during the last season, how often did you experience this [SYMPTOM] during or after spraying?**

_____

Note: This question set is asked for the following SYMPTOMS:
(1) Skin irritations
(2) Eye irritations
(3) Nausea
(4) Stomach pain
(5) Diarrhea
(6) Breathlessness
(7) Coughing
(8) Fever
(9) General weakness/ Diziness
(10) Sleeplessness
(11) Headache
(12) Extensive sweating

## Other income sources

Please capture all forms of employment in this module, including seasonal or casual labor.

### Wage employment

**211. How many sources of off-farm wage employment does this household have? [Please consider carefully, this number will determine the automatic repetitions of the roster]**

**212. Employer**:
- ☐ BOPP factory
- ☐ BOPP plantation
- ☐ TOPP factory
- ☐ TOPP plantation
- ☐ Other [BOPP/TOPP]
- ☐ Hired laborer on other farms
- ☐ Other: _____

**213. Type of employment**:
- ☐ Casual
- ☐ Permanent

**214. Average number of hours worked per working day**:

_____

**215. Average number of days worked per month**:

_____

**216. Number of months worked in the last 12 month**:

_____

**217. Average monthly income**:

_____

### Self- employment

**218.** How many sources of off-farm self- employment do you have? [Please consider carefully, this number will determine the automatic repetitions of the roster]

**219.** Average number of days worked per month [If more than one household member is involved, please state the total number of days worked]:
_____

**220.** Household members involved in this activity [Select from the household roster]:
_____

**221.** Total yearly income/ profit:
_____

### Other incomes

**222.** In the last 12 months, how many GHS did the household receive through income from sale of livestock?
_____

**223.** In the last 12 months, how many GHS did the household receive through income from sale of livestock products (e.g. eggs)?
_____

**224.** In the last 12 months, how many GHS did the household receive through income from sale of land?
_____

**225.** In the last 12 months, how many GHS did the household receive through income from sale of other assets?
_____

**226.** In the last 12 months, how many GHS did the household receive through rent received for land or machinery?
_____

**227.** In the last 12 months, how many GHS did the household receive through pensions?
_____

**228.** In the last 12 months, how many GHS did the household receive through insurances?
_____

**229.** In the last 12 months, how many GHS did the household receive through remittances received?
_____

**230.** In the last 12 months, how many GHS did the household receive through donations through NGOs/ aid programs?
_____

**231.** In the last 12 months, how many GHS did the household receive through funeral donations?
_____

**232.** In the last 12 months, how many GHS did the household receive through other sources, specify?
_____

## Access to credit and financial institutions

**233. Do you or any other household member have an account at a bank or other formal financial institution?**
- ☐ Yes
- ☐ No [Skip to Question 235]

**234. What is the current balance on this account? [If more than one account, please specify the total amount]**
_____

Please list all loans that the household applied for in the last 10 years, independent of whether the loan was accepted or not. The loan ID is automatically generated. The TOPP credit is not included in this module.

**235. In the last 10 years, for how many loans did the household apply? [Please consider carefully, this number will determine the automatic repetitions of the roster]**

**236. Which household member applied for the loan? [Select from household roster]**

**237. In which year did you apply for the loan?**
_____

**238. What was the amount you applied for? (in GHS)**
_____

**239. Where did you apply for a loan?**
- ☐ Bank
- ☐ TOPP
- ☐ BOPP
- ☐ Trader/ Middlemen
- ☐ Private money lender
- ☐ Other: _____

**240. Did you offer the contract (TOPP) as collateral?**
- ☐ Yes
- ☐ No [Skip to Question 242]
- ☐ Not applicable [Skip to question 242]

**241. Was the contract accepted as collateral?**
- ☐ Yes
- ☐ No
- ☐ I dont know

**242. Did you offer the land as collateral?**
- ☐ Yes
- ☐ No [Skip to question 244]

**243. Was the land accepted as collateral?**
- ☐ Yes
- ☐ No
- ☐ I dont know

**244. By the time you applied for the loan, did you still have outstanding debt? (Including TOPP debt)]**
- ☐ Yes
- ☐ No [Skip to question 247]

**245. Did the bank/ money lender know about the outstanding debt?**
- ☐ Yes
- ☐ No
- ☐ I dont know

**246. How high was the outstanding debt to the time of application? (in GHS)**
_____

**247. Do you have a written working contract?**
- ☐ Yes
- ☐ No [Skip to question 249]

**248. Did you inform the institution about your working contract?**
- ☐ Yes
- ☐ No

**249. Was the loan approved?**
- ☐ Yes, fully
- ☐ Yes, partly
- ☐ No

## Non-food expenditure

**250. In the last 30 days, what was your household's total expenditure for airtime and internet?**
_____

**251. In the last 30 days, what was your household's total expenditure for cigarettes/ tobacco?**
_____

**252. In the last 30 days, what was your household's total expenditure for personal care supplies (e.g. soap)?**
_____

**253. In the last 30 days, what was your household's total expenditure for clothes and footwear?**
_____

**254. In the last 30 days, what was your household's total expenditure for public transport?**
_____

**255. In the last 30 days, what was your household's total expenditure for electricity?**
_____

**256. In the last 30 days, what was your household's total expenditure for fuel (not for income generated purposes captured above)?**
_____

**257. In the last 30 days, what was your household's total expenditure for water?**
_____

**258. In the last 12 months, what was your household's total expenditure for curch tithe?**
_____

**259. In the last 12 months, what was your household's total expenditure for curch offertory/ donations?**
_____

**260. In the last 12 months, what was your household's total expenditure for other church expenditure?**
_____

**261. In the last 12 months, what was your household's total expenditure for schoolfees and material?**
_____

**262. In the last 12 months, what was your household's total expenditure for funeral and celebration costs?**
_____

**263. In the last 12 months, what was your household's total expenditure for remittances transferred to other hhs?**
_____

**264. In the last 12 months, what was your household's total expenditure for rent for housing (not for agricultural land)?**
_____

**265. In the last 12 months, what was your household's total expenditure for purchasing land?**
_____

**266. In the last 12 months, what was your household's total expenditure for purchasing other farm equipment not stated here?**

_____

**267. In the last 12 months, what was your household's total expenditure for purchasing vehicles (cars, motorbikes...)?**

_____

**268. In the last 12 months, what was your household's total expenditure for purchasing technical devices (mobile phones, radios, computers...)?**

_____

**269. In the last 12 months, what was your household's total expenditure for purchasing furniture?**

_____

**270. In the last 12 months, what was your household's total expenditure for purchasing jewelry and kente clothing?**

_____

**271. In the last 12 months, what was your household's total expenditure for other expenditure not mentioned here?**

_____

## Household food consumption and expenditure

This module refers to the food consumption of the whole household in the last 7 days.

**272. Within the last 7 days, was there a special day (celebration, funeral...) in terms of food consumption?**

- ☐ Yes
- ☐ No

**273. Did your household consume this [FOOD ITEM] in the last 7 days?**

- ☐ Yes
- ☐ No [Skip to the next food item]

**274. How much in total did your household consume during the last 7 days?**

_____

**275. Unit**:

- ☐ Kg
- ☐ Pieces
- ☐ Liter
- ☐ Bowl
- ☐ Gramm
- ☐ 100 Gramm
- ☐ Cup
- ☐ Other: _____

**276. Amount consumed from own production in specified unit**:

_____

**277. Amount consumed that was purchased on the market in specified unit**:

_____

**278. Average price per unit**:

_____

Note: This Question Set is asked for the following Food Items:

- **Cereals:** Maize, Rice, Sorghum, Wheat, Others, specify
- **White Roots and Tubers:** Yam, Cassava, Cocoyam, Plantain, Potatoes, Others, specify
- **Vitamin A rich Vegetables and Tubers:** Carrots, Red Pepper (sweet), Sweet Potatoes, Others, specify
- **Dark Leafy Vegetables:** Cabbage, Kale, Others, specify
- **Vegetables:** Cucumbers, Garlic, Onions, Green Pepper, Lettuce, Tomatoes, Mushrooms, Okra, Radish, Palm Hearts, Others, specify
- **Vitamin A rich Fruits:** Mango, Orange, Others, specify

- **Fruits:** Apple, Avocado, Banana, Coconut, Grapefruit, Lemon, Pineapple, Melon, Others, specify
- **Flesh Meats:** Liver/ Kidney/ Heart, Blood based foods, Chicken, Turkey, Guinea Fowl, Cow/ Beef, Pork, Goat/ Sheep, Others, specify
- **Eggs and Fish:** Eggs, Fresh/ canned or dried fish
- **Legumes, Nuts and Seeds:** Beans, Peas, Groundnut, Soybeans, Tiger Nut, Cashew Nut, Others
- **Milk and Milk Products:** Milk, Powdered Milk, Yoghurt, Ice Cream, Others specify
- **Oils and Fats:** Oil, Butter, Margerine, Others, specify
- **Sweets:** Sugar, Honey, Biscuits, Cakes, Hard Candies, Jam/ Marmelade, Sweet Drinks, Others, specify
- **Condiments and Spices:** Salt, Pepper, Ketchup/ Tomato Sauce, Fish Sauce, Herbs, Tea, Coffee, Others, specify
- **Alcoholic Drinks:** Beer, Palm Wine/ Akpteshie, Alcoholic Mixed Drinks (e.g.Smirnoff), Schnaps (e.g.Palm Schnaps, Others, specify

## Individual food consumption

In this module, we capture the food consumption of individual household members for the last 24 hours. The individual household members of interest here, are children between the ages 2 and 5 and the mother/ female adult of the children. The female adult should be in charge of food preparation. Please note down their meals of the last 24 hours on the prepared spread sheet and then fill the roster afterwards.

**279. How many individuals in this household classify as suitable for this module? [Please consider carefully, this number will determine the automatic repetitions of the roster]**

**280. Select household ID from the household roster:**

**281. Was yesterday a special day in terms of food consumption?**
- ☐ Yes
- ☐ No

**282. In the last 24 hours, did the individual consume any cereals?**
- ☐ Yes
- ☐ No

**283. In the last 24 hours, did the individual consume any white roots and tubers?**
- ☐ Yes
- ☐ No

**284. In the last 24 hours, did the individual consume any vitamin A rich vegetables and tubers?**
- ☐ Yes
- ☐ No

**285. In the last 24 hours, did the individual consume any dark green leafy vegetables?**
- ☐ Yes
- ☐ No

**286. In the last 24 hours, did the individual consume any other vegetables?**
- ☐ Yes
- ☐ No

**287. In the last 24 hours, did the individual consume any vitamin A rich fruits?**
- ☐ Yes
- ☐ No

**288. In the last 24 hours, did the individual consume any organ meat?**
- ☐ Yes
- ☐ No

**289. In the last 24 hours, did the individual consume any flesh meat?**
- ☐ Yes
- ☐ No

**290. In the last 24 hours, did the individual consume any eggs?**
- ☐ Yes
- ☐ No

**291. In the last 24 hours, did the individual consume any fish?**
- ☐ Yes
- ☐ No

**292. In the last 24 hours, did the individual consume any legumes?**
- ☐ Yes
- ☐ No

**293. In the last 24 hours, did the individual consume any nuts and seeds?**
- ☐ Yes
- ☐ No

**294. In the last 24 hours, did the individual consume any milk and milk products?**
- ☐ Yes
- ☐ No

**295. In the last 24 hours, did the individual consume any oils and fats?**
- ☐ Yes
- ☐ No

**296. In the last 24 hours, did the individual consume any sweets?**
- ☐ Yes
- ☐ No

**297. In the last 24 hours, did the individual consume any condiments and spices?**
- ☐ Yes
- ☐ No

**298. Birthmonth**: _____

**299. Birthyear**: _____

**300. Did this child/ adult suffer from any infectious diseases in the last 30 days?**
- ☐ Yes
- ☐ No

**301. What is the relationship of the female caretaker captured in this module to this child?**
- ☐ Mother
- ☐ Grandmother
- ☐ Sister
- ☐ Half sister
- ☐ Other blood related relative
- ☐ Other not-blood related household member
- ☐ Hired laborer
- ☐ Other: _____

**302. Ethnicity**: _____

**303. Waist (in cm)**: _____

**304. Height (in cm)**: _____

**305. Weight (in kg)**: _____

**306. What type of toilet facility is available?**
- ☐ No facility (bush/ field)
- ☐ Own W.C.
- ☐ Own pit latrine
- ☐ Own KVIP
- ☐ Public Toilet
- ☐ Other: _____

**307. What type of water access do you have?**

- ☐ Household Connection
- ☐ Borehole
- ☐ Dug well
- ☐ Spring
- ☐ Standpipe
- ☐ River/ Pond
- ☐ Bottled/ Bagged Water
- ☐ Other: _____

**308. What is the main source of drinking water, for this household?**

- ☐ Household Connection
- ☐ Borehole
- ☐ Dug well
- ☐ Spring
- ☐ Standpipe
- ☐ River/ Pond
- ☐ Bottled/ Bagged Water
- ☐ Other: _____

**309. Does the household have electricity?**

- ☐ Yes, grid access
- ☐ Yes, private generator
- ☐ Yes, solar panels
- ☐ No
- ☐ Yes, Other: _____

**310. What is the primary role of the female adult captured in this module?**

- ☐ Off-farm income generation
- ☐ Production of Food Crops
- ☐ Production of Cash-Crops
- ☐ Household and Child Care
- ☐ Other: _____

**311. Is she in charge of the purchase of the food?**

- ☐ Yes
- ☐ No

**312. Is she in charge of the preparation of the food?**

- ☐ Yes
- ☐ No

## Choice sets to question 75:

### Choice 1

| | Good Year | Bad Year |
|---|---|---|
| Crop 1 | 20 | 0 |
| Crop 2 | 19.5 | 2 |

### Choice 2

| | Good Year | Bad Year |
|---|---|---|
| Crop 1 | 19.5 | 2 |
| Crop 2 | 18 | 4 |

### Choice 3

| | Good Year | Bad Year |
|---|---|---|
| Crop 1 | 18 | 4 |
| Crop 2 | 16 | 6 |

### Choice 4

| | Good Year | Bad Year |
|---|---|---|
| Crop 1 | 16 | 6 |
| Crop 2 | 13 | 8 |

### Choice 5

| | Good Year | Bad Year |
|---|---|---|
| Crop 1 | 13 | 8 |
| Crop 2 | 9 | 2 |

## B.2 Village questionnaire

Main respondent: This questionnaire should be answered by the Village Chief. Alternatively, find another official representative (e.g. assembly man) who has similar knowledge about the village.

## Identification

1. **Interviewer ID**: _____
2. **Village ID**: _____
3. **Village name**: _____
4. **Respondents name**: _____
5. **Respondents position**:
   - ☐ Village chief
   - ☐ Assembly man
   - ☐ Lead farmer
   - ☐ Elder
   - ☐ Other: _____
6. **GPS Coordinates of homestead [Will be taken automatically]**: _____
7. **Mobile Number of the respondent**: _____
8. **Address of the respondent's homestead**: _____
9. **Gender of the respondent**:
   - ☐ Male
   - ☐ Female
10. **Age of the respondent**: _____
11. **Highest level of formal education completed**:
    - ☐ None
    - ☐ Primary school
    - ☐ MSLC
    - ☐ JSS/JHS
    - ☐ SSS/SHS
    - ☐ Post-Sec. Dip (HND)
    - ☐ University diploma (Bachelor, Master, PhD)
12. **Years of schooling completed**: _____
13. **Is the respondent an oil palm farmer?**
    - ☐ Yes
    - ☐ No [Skip to question 19]
14. **How many acres of oil palm does the respondent cultivate?** _____
15. **Is the respondent an outgrower for BOPP?**
    - ☐ Yes [Skip to question 19]
    - ☐ No
16. **Is the respondent an outgrower for TOPP?**
    - ☐ Yes
    - ☐ No [Skip to question 19]
17. **How many acres are registered with TOPP?** _____
18. **In which year did the respondent register with TOPP?** _____

**19. How frequently does the respondent listen to the radio?**
- ☐ 6-7 days a week
- ☐ 3-5 days a week
- ☐ 1-2 days a week
- ☐ less than 1 time a week
- ☐ I don't listen to the radio

**20. Does the respondent spray agrochemicals?**
- ☐ Yes
- ☐ No [Skip to question 24]

**21. While spraying, do you wear a safety mask?**
- ☐ Yes
- ☐ No

**22. While spraying, do you wear a safety suit?**
- ☐ Yes
- ☐ No

**23. While spraying, do you wear safety goggles?**
- ☐ Yes
- ☐ No

## General information

**24. What is the total population of this village?**
_____

**25. What was the total population of this village 10 years ago?**
_____

**26. What is the total number of households in this village?**
_____

**27. What was the total number of households in this village 10 years ago?**
_____

**28. What is the total number of oil palm farming households in this village?**
_____

**29. What was the total number of oil palm farming households in this village 10 years ago?**
_____

**30. What is the total number of commercial oil palm farming households in this village?**
_____

**31. What was the total number of commercial oil palm farming households in this village 10 years ago?**
_____

**32. What is the most common ethnicity in this village? [see list]**
_____

**33. What is the second most common ethnicity in this village? [see list]**
_____

**34. Overall, which of the following ethnicities are present in this village? [see list]**
_____

**35. What is the most common religion in this village? [see list]**
_____

**36. What is the second most common religion in this village? [see list]**
_____

**37. Overall, which of the following religions are present in this village? [see list]**
_____

## Infrastructure

**38. Is the [LOCATION] inside this village?**
- ☐ Yes [Skip to next LOCATION]
- ☐ No

**39. Distance to the next [LOCATION] from the village center (in km):**
_____

Note: This Question Set is asked for the following LOCATIONS:
(1) Bus/ Trotro Station
(2) Market
(3) Input Dealer
(4) Palm Oil Processing Mill [small/local]
(5) Palm Oil Processing Mill [large]
(6) Agricultural Extension Office
(7) Bank/ Microfinance Institution
(8) Elementary School
(9) Secondary School
(10) Hospital
(11) Pharmacy/ Drug Store
(12) Mobile Phone Network
(13) Radio Reception

**40. How far is the next paved road from this village? (in walking minutes)**
_____

**41. How far is the next dirt road from this village? (in walking minutes)**
_____

**42. For how long is the dirt road usually impassable during the year? (in months) [Due to heavy rains etc.]**
_____

**43. Does public transport pass by this village (buses, trotro, etc.)?**
- ☐ Yes
- ☐ No

## Access to land

**44. How many acres of community land are currently not under cultivation?**
_____

**45. How many acres of community land are currently free to lend out to farmers?**
_____

**46. Other than community land, is there currently available land for rent in this village?**
- ☐ Yes
- ☐ No

**47. In total, how much do you receive for one acre of rented-out land, per year? [On average, if necessary]**
_____

**48. In the last 10 years, did the demand for land increase?**
- ☐ Yes
- ☐ No

## Assistance

**49. Did farmers in this village receive free agricultural inputs in the last season [if applicable, from anyone other than BOPP/ TOPP]?**
- ☐ Yes
- ☐ No [Skip to question 52]

**50. What kind of inputs were provided free of charge?**
- ☐ Seeds/seedlings
- ☐ Fertilizer
- ☐ Other agro-chemicals (pesticides, weedicides)
- ☐ Agricultural tools (e.g. Matabi, cutlass)
- ☐ Other: _____

**51. Who provided these inputs?**
- ☐ Government
- ☐ NGO
- ☐ Cooperative or other farmer-based organization
- ☐ Other: _____

**52. Did the village or members of the village receive free inputs for oil palm cultivation in the last season?**
- ☐ Yes
- ☐ No [Skip to question 55]

**53. What kind of inputs were provided free of charge?**
- ☐ Seeds/seedlings
- ☐ Fertilizer
- ☐ Other agro-chemicals (pesticides, weedicides)
- ☐ Agricultural tools (e.g. Matabi, cutlass)
- ☐ Other: _____

**54. Who provided these inputs?**
- ☐ Government
- ☐ NGO
- ☐ Cooperative or other farmer-based organization
- ☐ Other: _____

## Shocks

**55. In the last 5 years, did this village experience a [SHOCK]?**
- ☐ Yes
- ☐ No [Skip to next SHOCK]

**56. How often did the event occur?**
_____

**57. In which year did it occur?**
_____

**58. In which month did it occur?**
_____

**59. How long did it last? (in weeks)**
_____

**60. Were the oil palm farmers in this village affected by the [SHOCK]?**
- ☐ Yes
- ☐ No

Note: This Question Set was repeated for the following Shocks:
(A) Drought
(B) Unusually late/ early rain
(C) Flood or unusually heavy rainfall
(D) Crop pest and disease
(E) Livestock pest and disease
(F) Epidemic disease affecting citizens
(G) Other Shock, specify

# Appendix C

## Declarations

1. I, hereby, declate that this Ph.D. dissertation has not been presented to any other examining body either in its present or a similar form.

   Furthermore, I also affirm that I have not applied for a Ph.D. at any other higher school of education.

   Göttingen, _____

   _____
   (Signature)

   _____
   (Name in Block Capitals)

2. I, hereby, solemnly declare that this dissertation was undertaken independently and without any unauthorised aid.

   Göttingen, _____

   _____
   (Signature)

   _____
   (Name in Block Capitals)