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Contract Farming and Multidimensional Poverty

An Investigation of the Impact of Contract Farming on Poverty among Smallholder Farmers in Developing Countries

by

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Abstract: Poverty is a common phenomenon among rural smallholder farmer households in developing countries. A large corpus of literature suggests that contract farming -a pre-harvest agreement between farmers and buyers- can improve smallholder farmers' welfare through improved access to markets and thereby promote rural development. These findings have shaped policy recommendations. Existing studies usually focus on a single component of household welfare and concentrate on a single crop, contract scheme, or geographical area. In this thesis, the impact of contract farming on multidimensional poverty is investigated. By employing nationally representative data for six developing countries, the results are generalizable beyond a single crop type, contract scheme, or geographical area. Using household and location fixed effects, the implications of contract farming on a multidimensional poverty index are discussed. The paper finds that contract farming is associated with a decrease in poverty among smallholder farmers in developing countries. Yet, major impact differences appear between countries. Therefore, the results challenge the notion that contract farming unambiguously improves welfare.

Keywords: Contract Farming, Multidimensional Poverty, Smallholder Farmers, Developing Countries

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1 Introduction

Contract Farming (CF hereafter) and its impact on farmers' livelihoods has been studied over the past decades (Da Silva, 2005). While contracts in the agricultural sector can be fruitful for all engaging parties (Mighell & Jones, 1963) the implications for smallholder farmers in developing countries have been of particular interest (Bellemare, 2015). Indeed, for its potential in regard to rural development high hopes were placed into CF as a tool for development (Glover & Kusterer, 1990). Likewise, on a more individual level, CF has received scholarly attention for its effects on smallholder farmers. According to the World Bank (Cuesta & Negre, 2016), in 2016 two thirds of the extremely poor lived in rural areas of which many are small-scale farmers, mostly in Sub-Saharan Africa and South Asia. In that light, the potential of CF to raise smallholder's income and thereby reduce absolute poverty is of capital interest. That is why, today the effects of CF on farmers are still subject to academic debate in the agricultural economic literature (Bellemare & Bloem, 2018). Generally speaking, CF is a form of vertical integration within agricultural commodities which allows companies to have greater control over the production process and other important factors such as quality, quantity, characteristics, or time of production, and delivery of a given crop (Prowse, 2012). In the remainder of this thesis, CF is broadly defined to include any pre-harvest agreement between farmers and buyers.

1.1 Research Problem

Several studies have investigated the impact of CF on smallholder farmers' income in developing countries. Earlier studies on the topic are Glover and Kusterer (1990), Little and Watts (1994), Porter and Phillips-Howard (1997), and Singh (2002). These are cross-country studies that find positive income effects of contract farming. The main finding is that incomes become more stable. More recently, studies based on micro-data have investigated the income effects of CF (Bellemare, 2012; Birthal, Joshi & Gulati, 2005; Miyata, Minot & Hu, 2009; Rao & Qaim, 2011; Simmons, Winters & Patrick, 2005). All of these find higher incomes for farmers engaged in contract farming. In fact, in their systematic review on impact studies of CF

Wang, Wang, and Delgado (2014) computed that three-quarters of all relevant impact studies find higher incomes for contract farmers in developing countries. Another systematic review on the same topic was carried out by Ton, Vellema, Desiere, Weituschat, and D'Haese (2018). Despite also finding positive income effects, they detect the presence of publication and survivor biases among their sample studies. Further, they state that impact studies suffer from weak external validity. The last point is in line with Meemken and Bellemare (2020) but also Bellemare and Bloem (2018). Further, Meemken and Bellemare (2020) challenge the universal assumption that CF raises incomes. Unlike previous studies, the impacts of CF are analyzed on nationally representative data. The authors show that in half of the countries included in their sample, the income impacts of CF are insignificant. These findings reinforce the need for enhanced external validity of future studies.

Besides the focus on income, few attempts have been made to investigate the effect of CF on poverty among smallholder farmers. Some studies, however, exist. Dedehouanou, Swinnen, and Maertens (2013) looked at the influence of CF on farmers' subjective well-being in Senegal. Food security and labor effects of CF have also been studied (Bellemare & Novak, 2017; Meemken & Bellemare, 2020). Nonetheless, these studies also suffer from limited generalizability except for Meemken and Bellemare (2020). The effect of CF on multidimensional poverty has received little attention. In a case study on South Africa, Klasen (2000) illustrated the divergence that different poverty measurements can have. He shows that next to conceptual differences between the income and broad-based poverty measurements they also empirically reap conflicting results.

1.2 Aim and Scope

This thesis aims to better understand the impact CF has on poverty among smallholder farmers in developing countries. In order to achieve this aim, the objectives of the thesis are twofold. The first objective lies in exploring the effects of CF on a more broad-based definition of poverty. Indeed, it is of interest to figure out whether CF improves smallholder's actual welfare in terms of a multivariate poverty measure. The second objective of the thesis is to yield improved external validity of the results through the use of nationally representative data of six countries. As mentioned earlier, many previous studies are only generalizable to a certain crop

type or a specific geographical area. The nationally representative data for six developing countries allows, for the first time, a bigger picture that is not country or crop-specific.

Therefore, this research project seeks to address the following question:

What is the impact of contract farming on multidimensional-poverty reduction amongst smallholder farmers in developing countries?

In more practical terms, in order to get a wider perspective on the impact of contract farming on poverty, the goal of the thesis is to analyze CF in six developing countries. These are Bangladesh, Ivory Coast, Mozambique, Nigeria, Tanzania, and Uganda. The analysis is based on experimental survey data collected by the Consultative Group to Assist the Poor (CGAP) in 2015 and 2016. Taking advantage of the hierarchical structure of the data and following Meemken and Bellemare's (2020) methodology, household and geographical unit fixed effects are conducted to estimate the relationship between CF and poverty. Therefore, a poverty index, including five variables (income, expenditure, mobile phones, water supply, and subjective financial wellbeing) is generated. The effects of CF on the latter are analyzed. Employing fixed effects is a novelty in the literature on CF (Meemken & Bellemare, 2020). Thereby, the thesis is relevant by contributing to the knowledge about CF not only by including new variables to the analysis but also by using a statistical method that prior data-availability did not allow for.

1.3 Outline of the Thesis

This thesis is divided into five main sections. Chapter 2 reviews CF's prevalence, theories, and existing literature in the field. Chapter 3 describes the data and the employed methodology. Then, chapter 4 will present and discuss the results. Finally, a conclusion will recapitulate the key findings of the analysis.

2 Previous Research

The following section is divided into two sub-chapters. The first sub-chapter will be dedicated to CF, to its definition, prevalence, and theories on its existence. The second sub-chapter will review the existing literature on the poverty impact of CF.

2.1 Contract Farming

Definition

Defining CF is a controversial undertaking (Rehber, 2007). No consensus on the definition of CF has yet been agreed upon by the academic literature. Different definitions of CF add important nuances to the phenomenon of CF. In an often-cited report by the Food and Agriculture Organization of the United Nations (FAO) titled "Contract Farming: Partnership for Growth" Eaton and Shepherd (2001) define CF "as an agreement between farmers and processing and/or marketing firms for the production and supply of agricultural products under forward agreements frequently at predetermined prices." Forward agreements are contracts that oblige the buyer to purchase a given product at a future point in time (Cambridge Dictionnary, 2020). In this thesis, this definition will be used since it raises critical points most other definitions build on (Catelo & Costales, 2008).

Agricultural agreements can take different forms. In their seminal book "Vertical Coordination in Agriculture" Mighell and Jones (1963) define three types of agricultural contracts which also apply to agreements concluded within the realm of CF. First, market specification contracts guarantee outlet, time for sale, and sometimes price structures for farmers. In that type of contracts, farmers remain independent in terms of production processes. Second, resource-providing contracts are characterized by the procurement of some type of resources to the farmers. The latter can be of technical or physical nature. This type of agreement occurs especially for complex crops, when specific quality standards need to be met, or when input markets are imperfect. Relative to the market specification contracts farmers give up some of their decision-making power (Prowse, 2012). Third, when it comes to production management

contracts the contracting company determines production processes. Decision-making power does not lie within the farmers' hands. They only provide labor and land in the aforesaid case. Supposedly, the burden of higher costs for the control of compliance that the contracting company needs to bear is compensated by the sale of higher-quality output. This categorization into three types of agricultural contracts is not necessarily exclusive as certain types of agreements can be classified in one type of contract while sharing features with another one (Catelo & Costales, 2008). In this study all types of contractual arrangements between smallholder farmers and buyers are captured by the analysis.

Prevalence in Developing Countries

Before coming to the theoretical aspects of CF, its prevalence in developing countries, and the reasons for that will be highlighted. The prevalence of CF is subject to important inter-country variation. In fact, no representative survey exists that estimates CFs prevalence throughout the developing world. Notwithstanding, several studies have estimated the presence of CF in individual developing countries (Minot & Swayer, 2016). Table 1 displays a non-exhaustive list of estimations. As can be noticed, in the included countries usually under 15% of all farming households are engaged in contracts. With eight out of ten farming households being engaged in CF in Tanzania the percentage of contract farmers is especially high.

Table 1 Prevalence of contract farming across developing countries (compiled by author)

Country	Source	Estimated Prevalence of CF
Bangladesh	CGAP	4,3% of the smallholder farmer households
Benin	Minot and Daniels (2005)	34% of cotton growers
Côte d'Ivoire	CGAP	15% of the smallholder farmer households
Ethiopia	Stratified random sample survey of 3000 households in 2012 (Minot & Sawyer, 2016)	2,2%
Ghana (northern)	Stratified random sample survey of 1290 households in 2010 (Minot & Sawyer, 2016)	3%
Kenya	Jaffee (1994)	~25%

Kenya, Madagascar, Mali, Mexico, Morocco, Nicaragua, and Senegal	Losch, Fréguin-Gresh, White (2011) Based on a non-random survey in seven countries with 7,200 households	7,4%
Mozambique	CGAP	5,7% of the smallholder farmer households
Nigeria	CGAP	15,9% of the smallholder farmer households
Tanzania	CGAP	80,8% of the smallholder farmer households
Uganda	CGAP	10% of the smallholder farmer households
Vietnam	Stratified random sample survey in four provinces in 2011 (Minot & Sawyer, 2016)	5% with pre-planting contracts 13% received an advance payment from the buyer

Coming to the reasons for the expansion of contract farming, Prowse (2012) categorizes the reasons in demand-side and supply-side factors. There are four demand-side factors. First, a rising global population (United Nations, 2019) and urbanization (Reardon, Tschirley, Dolislager, Snyder, Hu & White, 2014) coincide with changing food preferences and diets (Reardon et al., 2014). Second, rising incomes in the developing world (Addison, Arndt & Tarp, 2011) go hand in hand with shifts in the consumer basket towards more protein, dairy, and higher quality products (Prowse, 2012). Increased demand for processed foodstuff and supermarket products strengthened the demand for vertically integrated value-chains (Michelson, 2013). Third, Catelo and Costales (2008) state that other factors such as increased female participation in the workforce have changed the global consumption basket towards more processed foodstuff. Fourth, public awareness concerning health and food safety has caused changing demand patterns. In developed countries environmental and developmental concerns also influence consumer behaviors, which has increased the demand for CF also in developing countries. Next to greater demand for quality, demand for information has increased. According to Giovannucci and Purcell (2008) increased traceability along the entire supply chain has become a virtual quality attribute. These shifts on the demand-side have urged

the retailers to restructure their agricultural supply chains for greater standard compliance and quality control, sometimes by vertically integrating production (Reardon et al., 2009).

Turning to the supply-side factors, it is to mention that with the era of liberalization and globalization in the 1980s many developing economies formerly governed by stated-owned enterprises shifted towards liberalization (Swinnen & Maertens, 2007). In turn, that increased the exchanged value of international trade in agricultural commodities (Da Silva, 2005). Increased liberal trade and public but also private requirements favored fewer but larger firms within the supply chains (Giovannucci & Purcell, 2008). Concerning traceability, safety-, and quality requirements vertical integration through CF is a tool for firms that ensures the provision of the necessary information to comply with the markets in terms of product differentiation (Giovannucci & Purcell, 2008). Further, improved transportation technologies have strengthened link sales, inventory, and ordering systems that improve efficiency in procurement. This is a selection of arguments as to why CF has also been favored by the supply-side.

Theories

In the following section two theories that attempt to explain why CF exists will briefly be described. It is important to highlight that in this paper no hierarchy between the different perspectives will be established. Both of them raise valid perspectives which will allow to better comprehend CF and its implications on poverty. Other theories as to why CF exists are deemed less relevant in the context of poverty impacts of CF and therefore not included.

Transaction Cost Approaches

Certainly, the most prominent approach as to why CF exists is the transaction cost approach. It emanates from transaction cost economics which itself is part of new institutional economics (ed. Ménard & Shirley, 2005). The starting point of the transaction cost approach is Coase's (1937) idea that any firm's existence can be explained by their search to reduce transaction costs. Here, the main idea is that firms will integrate production processes as soon as it is cheaper to integrate backward production processes than to purchase the very same products on the market. The transaction cost approach, prominently posited by Williamson (1979), distinguishes itself from neoclassical approaches in the understanding of firms since it does not neglect transaction costs. Indeed, neoclassical approaches deem that on spot market prices

perfectly carry all information that one needs to take decisions (Rehber, 2007). That is untrue in the eyes of transaction cost approach defenders. For them, economic actors are characterized by bounded rationality and opportunistic behavior in the pursuit of their self-interest (Young & Hobbs, 2002). Market transactions are viewed as hazardous endeavors in which substantial losses occur because every actor maximizes their self-interest (Da Silva, 2005). Attempts to minimize the losses result in transaction costs (Rehber, 2007). Williamson (1979) suggests two forms in which transaction costs occur. Ex-ante, these are the costs of finding trading partners, a suitable agreement, and monitoring the compliance of the contract. Ex post costs occur when settling a dispute for instance. Transaction costs are especially high in imperfect markets, such as agricultural markets in many developing countries (Prowse, 2012). Here, imperfect markets can cause market failures. According to Williamson (1979) transaction costs are influenced by three characteristics: Uncertainty, asset specificity, and frequency of exchange. Uncertainty, which reflects itself in incomplete information on current and future prices and the uncertainty about the contracting partner to breach the contract. Asset specificity, that is the extent to which a firms' investment finds applicability. The more restraint its application, the higher the dependency on a potential contractual agreement. The frequency of exchange is the frequency in which exchange occurs between trading partners. Legal systems, trade association grading, and standards systems, etc. are economic institutions and practices that have been created to reduce uncertainty (Minot, 2007). They ensure that firms can specialize and invest in specific assets and increase the frequency of exchange (Williamson, 1979)

In the case of CF vertical integration can be understood as a remedy for a variety of risks and offers a way of reducing transaction costs. CF decreases uncertainties by providing guaranteed marketing channels for the farmers and by assuring the quality and quantity of the contracted crop to the firm (Prowse, 2012). Moreover, it allows for investments in specific assets by guaranteeing purchase. It thereby also favors repeated exchange. Besides, CF reduces uncertainties related to credibility since retailers and firms can get insights into valuable information about production processes.

Political Economy of Agrarian Change

The second theory that will be described is entitled political economy of agrarian change. It is relevant in developing countries, as in these economies the agricultural sector is often important (Perkins, Radelet, Lindauer & Block, 2013). The theory was prominent in the 1970s and 1980s (Prowse, 2012). It is a theory that argues in terms of classes, gender, kinships, and household

reproduction (Hartmann & Boyce, 1983; Mackintosh, 1989; Murray, 1987; Shanin, 1988) and is thereby close to Marxist and neo-Marxist theories. Here, it is argued that CF solely develops in agricultural markets with failed or limited input and output markets (Little & Watts, 1994). According to Singh (2002), often, a monopsonistic structure arises at the expense of the smallholder farmers. In this way, he states, CF turns into self-exploitation of farmers who willingly give up control and decision-making power. For the value added to the crop, farmers are not well enough paid. Hence, the term exploitation. Furthermore, as in practice production risks are often passed on to smallholder farmers who do not always benefit from stable wages and lose the managing control over their firms, they "become semi-proletarianized peasants" (Prowse, 2012, p. 36). The defenders of this theory also see disadvantages CF creates outside the contractual relationship between farmers and firms. In fact, they contend that CF can modify intra-household distribution of income and labor out of which greater gender inequalities and child labor arise (Little & Watts, 1994). Inter-household inequalities might also grow with the successful implementation of CF. Non-participating farmers are left out and might lose their land to capitalist farmers (Prowse, 2012). Lastly, CF can have negative spill-over effects on local markets (Little & Watts, 1994). Reduced food production for local markets might cause higher prices for local foodstuffs. Besides, through the equipment of input for contracting farmers input spot markets might alter at the expense of non-participating farmers. Some points (spillover effects, inter-, and intra-household inequalities for instance) raised by the theory of political economy of agrarian change are still debated in current discussions (Meemken & Bellemare, 2020; Ton et al., 2018). However, the theory is also criticized for its "lack of attention to the inter- and intra-firm aspects of contract farming, the characteristics of particular commodities, and the role of regulation and standards" (Prowse, 2012, p.36).

As these two theories have already implied, CF has potential advantages and disadvantages for both, firms and farmers. Among other advantages for firms, increased vertical integration of the value chain can facilitate the exchange of information, which might be necessary for traceability requirements among others. On the other hand, they might lose competitiveness by being bond to a specific contract, especially when external circumstances cause high opportunity costs (Henson & Jaffee, 2004). According to Da Silva (2005) one disadvantage among others for farmers could be that they might build dependency on buyers and thereby become vulnerable to exploitation. A potential advantage, on the other side, is that a reliable contractual arrangement with a buyer can hold as collateral for access to credit. In this way farmers have the opportunity to invest in productive capital for example (Da Silva, 2005). A

further advantage is the potential of CF concerning poverty alleviation. A review of the existing literature on that very topic is presented in the next section.

2.2 Contract Farming and Poverty

The question of the impact of CF on smallholder farmers' welfare is not new. Indeed, large scale studies in the 1980s already attempted to answer if farmers' welfare is affected by CF. Here, in line with the World Bank (1997), poverty is usually measured in terms of income. Bijman (2008) discerns two waves of econometric analysis on the effect of CF on farmers' income. The first wave can timewise be located in the late 1980s to the mid-1990s. In order to analyze the income effects of CF, large cross-country studies were conducted (Bijman, 2008). Further socio-economic impacts of CF such as gender relationships and communal development were also considered (Porter & Phillips-Howard, 1997; Singh, 2002; Glover & Kusterer, 1990; Little & Watts, 1994). Generally, the studies find positive effects for contract farmers one of which is a more reliable income.

The second wave of case studies, that Bijman (2008) sees, use micro-level data. The availability of extensive survey data has facilitated broader analyses of CF. These studies usually concentrate on a certain area or crop for their analysis (Ton et al., 2018). Miyata et al. (2009) found that apple and green onion contract farmers in China earned significantly more money compared to non-participating farmers. Additionally, they observed differences in farm incomes by crop types. While apple contract farmers benefitted from CF through higher yields, green onion farmers with contracts sold their produce to higher prices thanks to increased quality. It shows that input provision and technological assistance potentially improve farmers income through two channels, through increased yields and improved quality of the crop. Further, Birthal et al. (2005) studied the impact of CF on Indian dairy farmers. They found significantly higher income for contract dairy farmers. The same goes for Warning and Key (2002) who studied peanut production in Senegal. Simmons et al. (2005) observed three types of contracts in Indonesia: poultry, rice, and maize seed contracts. The investigation showed increased returns to capital for poultry and maize agreements, though not in the case of the rice contract farmers. Nonetheless, the latter still benefited from other advantages of contract farming, namely access to new markets. All three types of arrangements decreased absolute poverty. Increased efficiency in production does not always translate into higher income, as

Ramaswami, Birthal, and Joshi (2006) showed. They add to the debate with an investigation about poultry production in Andhra Pradesh, India. They found that production under contract is more efficient than without. Most of the production surpluses in the case of poultry production in Andhra Pradesh were, however, appropriated by the contracting firm. In a recent study, Meemken and Bellemare (2020) revealed that small-scale farms in developing countries, which are usually run by the poor, hired more labor when they engaged in CF. In that line, Hazell, Poulton, Wiggins, and Dorward (2006) state the potential for multiplier effects which might be beneficial for individuals outside the CF households. Other studies that find positive income effects of CF are Ashraf, Gine, and Karlan (2009), Bellemare (2012), Minten, Randrianarison, and Swinnen (2009), Miyata et al. (2009), Narayanan (2014), Rao and Qaim (2011), Schipmann and Qaim (2010).

Within the realm of farmers' welfare, studies exist that focus on the impact of CF on welfare other than income. Michelson (2013) found an increase in productive household assets for households contracting with supermarkets in Nicaragua. In addition, Bellemare and Novak's (2017) paper on the relation between CF and food security found that contracting households in Madagascar experience an average of eight days less of hungry season per year. Briones (2015), Huddleston and Tonts (2007) and Mishra et al. (2016) are case studies that commonly found increases in smallholder farms' profitability in developing countries. Dedehouanou, Swinnen, and Maertens' (2013) work concentrates on subjective wellbeing which might be affected by contract farming. While they found heterogeneous income effects by crop type, their overall postulate is that CF increases the subjective wellbeing of Senegalese high-value crop contract farmers who cultivate for export purposes.

In their systematic review of CF impact studies Wang, Wang, and Delgado (2014) computed that 92% of all relevant impact studies find positive effects of CF on farm productivity. Also, three-quarters of the impact studies find positive income effects. Ton et al. (2018) published a meta-analysis of impact studies on contract farming. In their analysis, they detect the presence of publication and survivor bias. The latter occurs "when studies [...] neglect the empirical instances of contract farming that failed in the first few years" (Ton et al., 2018, p.50). Indeed, it is conceivable that CF agreements fail due to poor performance. Hence, only CF schemes that "survived" are going to be studied which introduces a positive bias. The publication bias occurs due to the fact that studies that show significant results are more likely to get published

(Ioannidis & Trikalinos, 2007). Therefore, academic literature tends to be biased towards significant results (Ton et al., 2018).

Meemken and Bellemare (2020) but also Ton et al. (2018) note methodological limits to previous impact studies on contract farming. Indeed, many of the above-mentioned studies highlight the limited generalizability of their findings (Dedehouanou, Swinnen & Maertens, 2013). Data availability only allowed for impact studies in limited geographical areas or on specific crop types (Meemken & Bellemare, 2020; Ton et al., 2018). Statistical instruments employed such as instrumental variables, Propensity Score Matching, or Heckman-approaches often present flaws (Ton et al., 2017).

The review of the literature has shown that income impacts of CF have extensively been studied. However, the way CF affects smallholder farmers' lives through a multidimensional poverty measure has not yet been investigated. By doing so in a manner that allows for greater generalizability than previous case studies, this thesis aims at contributing to the literature. In the following chapter the data collection and methodology to achieve this goal will be described.

3 Data and Methodology

In order to provide an answer to the research question, a quantitative research design appears to be the most suitable. It allows measuring the impact of CF on poverty. In that sense, household and geographical unit fixed effects have been employed on household survey data from six developing countries. The present section on data is organized as follows. In a first step, the data collection, sampling strategy as well as strengths and weaknesses of the employed data will be laid out. In the second step, the model which captures the relationship of interest will be specified. Then, the choice of methodology will be motivated.

3.1 Source Material

The datasets used for the analysis were provided by the CGAP. The latter is an independent think tank with the aim to improve access to financial services for the poor (CGAP, 2020). Within the realm of a smallholder household survey titled "Building the Evidence Base on the Agricultural and Financial Lives of Smallholder Households", between 2015 and 2016, CGAP collected experimental smallholder household data in six developing countries. These countries are Bangladesh, Côte d'Ivoire, Mozambique, Nigeria, Tanzania, and Uganda. In fact, the household surveys provide data of nationally representative samples for the population of smallholder households. All datasets used are publicly available on the World Bank's microdata library.

Nationally representative samples were obtained by applying a multistage stratified sampling strategy. For each country, a target of 3000 responses was set (CGAP, 2016). Depending on the country, the expected nonresponse rate varied between 5 and 10%. Stratification was achieved by subdividing each geopolitical zone into urban and rural areas. Hence, depending on the country, 6 to 14 strata were created within which the sample was independently selected. Concerning the multistage sampling, the primary sampling frame were enumerated areas. These

are small areas that have been determined by previous population censuses. CGAP only took into account enumerated areas that contained agricultural households. That is why the survey is representative only for the smallholder farmer populations of the countries. Weighted by their population size, 200 enumerated areas were randomly selected in the sample. Within each enumerated area and with equal chances, 15 households were randomly selected.

The surveys conducted by CGAP include three different questionnaires. All interviews were conducted in the main local language to avoid misunderstandings that language barriers might create. First, the household survey questionnaire has been administered to the head of the household, their spouse, or any knowledgeable household member above 15 years (CGAP, 2016). The questions in that questionnaire aimed at obtaining basic information on all household members as well as on household assets and dwelling characteristics. Second, for the multiple respondent survey questionnaire, every adult household member (>15 years) who contributed to the household's income or participated in its farming activities was interviewed. Topics covered by that questionnaire were related to demographics, agricultural activities, and household economics. Third, the single respondent survey questionnaire was carried out with one randomly allocated adult person in each household. Here, questions regarding the agricultural activities, household economics, mobile phones, and financial tools were asked. Since all three questionnaires contain valuable information, the thesis is based on information retrieved from all three questionnaires. Relevant variables retrieved from all three questionnaires across the six countries have been merged into a common dataset and clustered around household identifications. Further details on the procedure are laid out in the methodology part.

In their survey, CGAP defined smallholder farmers as farmers with less than 5 hectares of land or fewer than 50 heads of cattle, 100 pigs, sheep, or goats or fewer than 1000 chicken. Also, agriculture must provide a meaningful contribution to the households' livelihood, income, or consumption (CGAP, 2016). Constraint by the available data, the present study employs the same definition while being aware of the difficulty of defining smallholder farmers.

The country choice stems from two reasons. Firstly, the six countries are the ones in which the CGAP Smallholder Household Survey was conducted. In terms of data availability and conformity of the data, it has been decided to opt with the data provided by CGAP. Secondly, the countries in the sample are diverse. Three out of six countries (Tanzania, Uganda, and Mozambique) are classified as low-income countries, the other three (Nigeria, Bangladesh, and

Côte d'Ivoire) are categorized lower-middle-income countries by the World Bank (2020). The diversity of the countries included allows giving a hint of the effect of CF in the developing world. Therefore, the country choice seems to be appropriate.

3.2 The Model

As indicated above, household and location fixed effects have been employed to answer the research question. Hereafter, the methodology will be described in greater detail. The following equation demonstrates the relationship of interest:

$$(1) \qquad Y_{jk} = ß_0 + ß_1 C_j + ß_2 HH_j + \gamma_k + \varepsilon_{jk}$$

where Y_{jk} is the dependent variable describing different levels of poverty of household $_j$ within the specified geographical location $_k$. Multiple regressions are carried out, having different outcome variables, the most important being the multidimensional poverty index. The outcome variables will be described and explained below. C_j is the independent variable of interest, a dummy variable indicating whether household $_j$ participates in CF or not. HH_j is a set of household *j's* characteristics that may simultaneously determine a household's propensity to participate in CF and poverty. The set of control variables is the same as in Meemken and Bellemare (2020) and is specified in table 2. Furthermore, γ_k represents the unobserved geographical effects (i.e. country, administrative, or cluster unit) that are constant between households within the same location. ε_{jk} is an error term, which is supposed to be uncorrelated with C and HH and has a mean of zero. The standard errors are clustered at the country, administrative unit, or cluster level, conditional on the fixed effects unit.

Coming to the independent variables of interest. As the equation capturing the relationship of interest shows, the main independent variable of interest is whether a household participates in CF. It indicates whether a household has a selling contract for their produce (crop or livestock). Households are considered to be contracting households when at least one adult household member reports to have a selling contract. This is in line with the analysis of Meemken and Bellemare (2020) who proceeded in the same manner. A weakness of the analysis, which is due to data limitation, is the absence of any variable providing information about the type of contract

in which the households are engaged. Indeed, as mentioned in the part on previous research, several types of agricultural agreements exist (Mighell & Jones, 1963) which might affect smallholders differently (Meemken & Bellemare, 2020). To remedy that lack of information, Meemken and Bellemare (2020) demonstrate in their analyses that it is possible to proxy the degree of formality of a contract by the type of buyer and by the delivery of inputs. Accordingly, in this study, when households indicated to have a selling contract, sell to large retailers or buyers, and are provided with input, they are considered to be in a more formal contract. The latter variable will be included in regressions in order to figure out whether heterogeneous effects exist at this level.

Table 2 Set of control variables

Variable	Type of variable	Definition
Female-headed household	Dummy	Is the head of the household female? 1 if yes, 0 if no
Age of head of household	Continuous	Age of head of household
Education of head of household	Dummy	Has the head of the household ever attended school? 1 if yes, 0 if no
Number of household members	Categorical	How many persons live in the household?
Acres of land owned by household	Continuous	How many acres of arable land is owned by the household?
Rural household	Dummy	Is the household rurally or urbanely located? 1 of rural, 0 if urban
Household income*	Continuous	Monthly household income across all income-sources *Only included for regression with expenditure per capita as the outcome variable.

Turning to the outcome variables, they can be understood in two categories. First, income-based poverty measures as well as expenditure and, second, the multidimensional poverty index. Both

types of outcome variables correspond to different approaches on how to measure poverty. Before explaining the methodology of the outcome variables these two approaches will briefly be displayed. Broadly speaking, two main schools exist for the measurement of poverty (Klasen, 2000). The one measures poverty in financial terms, the other uses broader-based terms for its measurements. Concerning the former, poverty is primarily seen as a lack of consumption caused by a lack of income (Ravallion & Chen, 1997). Here, one speaks of income poverty (World Bank, 1997) and expenditure poverty (Deaton, 1997). The idea is that income is a means to welfare since it enables to purchase basic needs. Income poverty measurements depart from the utilitarian welfare function by concentrating on the individual welfare function (Klasen, 2000). The latter are taken as the main measurement for welfare. Several assumptions (no increasing returns to scale, no externalities or public good, complete markets, a specification of cardinal utility function) are needed so that the assumption that a lack of income translates into a lack of welfare holds (Klasen, 2000). Deaton (1997) notices that researchers are usually more interested in long-term resources than in fluctuant income, that is why some do employ expenditure poverty instead of income poverty. Indeed, expenditure levels are supposed to be less prone to volatile changes than income (Deaton, 1997), this holds especially for farmers whose income streams are season dependent. However, for Klasen (2000) there appear to be four problems with this axiomatic welfare economic approach to measure poverty. ”The first difficulty relates to the appropriateness and interpretation of utility as the measure for welfare” (Klasen, 2000, p. 35). Second, there are interpersonal variations in the ability to translate income utility (Friedman, 1947). Third, there are also interpersonal variations in the comparability of utilities. Yet, no procedure exists to compare interpersonal utilities (Sen, 2001). Fourth, for Klasen (2000) assuming completeness of markets is wrong. According to him, returns to economies of scale are increasing, and externalities exist, especially in developing countries. This is to highlight that conceptual difficulties exist in making assumptions from income to welfare.

In consequence of the previous paragraph and in the aim to have a broader picture of the impact of CF on poverty, the first two regressions have income per capita and expenditure per capita as outcome variable. Following Meemken and Bellemare (2020), regarding income per capita, monthly households’ incomes were divided by the number of household members. This has been computed so that the household-size does not influence the results. All incomes per capita were converted into US$ with the exchange rate of the day the interview has been conducted. Further, the monthly income per capita was divided by 30,4167, the average days per month.

Here, the goal was to receive daily income per capita. Thus, the first regression regresses CF and the control variables on the logarithmic form of daily income per capita to yield results that are interpretable in terms of percentage. Further, and this holds for all continuous outcome variables, the outliers were removed by employing the interquartile range procedure.

The second outcome variable is expenditure per capita. More specifically, the variable measures the reported households' estimation of the monthly minimum expenditure needed. While expenditure is already less volatile than income (Deaton, 1997) the minimum expenditure needed this even less so. Consequently, changes in the minimum expenditure needed can be understood as a clear trend of changes in the living standards of a household. Similarly to the outcome variable income per capita, daily expenditure per capita has been computed. Outliers were also removed.

Another approach to measure poverty is broad-based poverty. Proponents of the broad-based poverty measurements include more indicators than solely income to their poverty measurement (Drèze & Sen, 1989; United Nations Development Programme, 1997). These approaches rely on the idea that poverty is a lack of "basic goods" (Rawls, 2005) or "basic capabilities" (Sen, 1992). For them, financial resources are a means to achieve wellbeing (Klasen, 2000). The outcome of wellbeing are the capabilities or basic goods that the individuals receive through their financial resources. Therefore, instead of measuring a proxy, they aim at measuring the actual outcome of poverty which is the lack of capabilities (Klasen, 2000). Attempts to establish indicators on the basis of the broad-based measurements are the Human Development Index, the Human Poverty Index, or the Physical Quality of Life Index. Critics on these indicators concern the choice of components, their weighting, estimation procedures, and aggregation rules among others (Ravallion, 1997). In a book chapter entitled "The Political Economy of Targeting" Sen (1995) proposes to measure poverty by considering individuals' capabilities, which is the ability to do or access things. In Sen's view poverty is being unable to access the minimum capabilities required to function (Klasen, 2000). By focusing on the achievements rather than on financial resources the problem of individual heterogeneity is avoided. Also, problems associated with aggregation and equivalence scales are overcome (Sen, 1996).

Multidimensional Poverty Index

In order to estimate the impact of contract farming on multidimensional poverty, this paper creates an index. This index is supposed to capture poverty in a wider sense than only income,

or expenditure. Instead, it integrates five variables that are available in the CGAP surveys across all six countries. Those variables are income per capita, expenditure per capita, water supply, mobile phones per capita, and subjective financial wellbeing. Prior to the explanation of the practical aspects of the index, the components themselves will be highlighted. In the search for a multidimensional measurement of poverty, data availability limited the undertaking. Nonetheless, the five variables included are uniform across all six countries. They attempt to capture a broader-based reality of poverty.

The first two variables included in the index are income per capita and minimum expenditure per capita. Similarly, as to above, daily income and expenditure per capita are computed. However, in both cases the logarithmic form is not taken. Their inclusion in the index draws from the reasons mentioned above. Third, mobile phones per capita are included. Mobile phones are an essential household asset for smallholder farmers (Sife, Kiondo & Lyimo-Macha, 2010). Indeed, they can be used for the provision of important information for farming-related activities, but also for other aspects of a farmers' life. Fourth, water supply is included in the index. Water access presents instrumental and intrinsic reasons for welfare with its significant impact on health (World Bank, 1993). Further, access to water is increasingly regarded as right on its own. Besides, continuous water supply frees up time that instead would have been spent on the water provision (Klasen, 2000). Therefore, water supply is included as a component of the index. Lastly, subjective financial wellbeing is the fifth component of the index. Appendix A displays the response options of the variable. The variable measures the outcome of the financial situation as to the utility that the household is able to acquire with its financial resources. It can be assumed that households that indicate response options 1 and 2 in Appendix A suffer from increased stress related to financial shortcomings.

Coming to the practical aspects of the index. The index allocates equal weight to every component. Every component can take up to 3 points. Thus, the maximum number the index can reach is 15 points. The variables income and expenditure are continuous variables whereas the variables mobile phones, water supply, and financial status are categorical variables. In the aim to include all the five variables, in the index the following steps have been undertaken.

The continuous variables maintain their continuous character in the index. This is to keep a maximum of precision in the analysis. It is achieved by compressing their distribution into 3 points which are the weights each component of the index takes. The interquartile rule method was applied to determine outliers (Vinutha, Poornima & Sagar, 2018). Excluding outliers of

each country for the variables “income per capita and day” and “minimum expenditure required per capita and day” allows for less variation of the observations within the variables. Hence, the statistical power of the analysis is increased. Indeed, concerning daily income per capita, one can assume that the outliers are different. Table 3 indicates that among the outliers the share of those individuals with a waged job as the main source of income is approximately eight percent higher. This is to show that the outliers are less reliant on farming. Further, the observations of non-outliers with 23,982 are still high enough and do not present any threat to statistical power. Therefore, it appears to be reasonable to exclude the outliers. The income distribution of all households considered to be non-outliers will be continuously distributed between 0 and 3 which will make up their respective scores in the index.

Table 3 Is the main source of income a waged job? Income outliers and non-outliers

Main source of income is a waged job?	Frequency No outliers	Percentage No outliers	Frequency Outliers	Percentage Outliers
No	21,385	89.17	3,474	81.05
Yes	2,597	10.83	812	18.95
Total	23,982	100	4,286	100

Next to income, the variable minimum expenditure needed per capita was kept continuous. Here as well, the outliers of each country were excluded which leaves 24,791 observations for the analysis. Likewise, as for the daily income per capita, the minimum daily expenditure per capita was continuously distributed between the values 0 and 3.

Moreover, regarding the categorical variable indicating the households’ possession of mobile phones the number of mobile phones per capita was computed. This was done so that the household-size does not influence the number of phones. Then, the distribution of mobile phones per capita was distributed between 0 and 3 so that it can be included in the index. Here as well, the outliers are of each country are excluded for the same reasons as above. An exception appears with the number of mobile phones per capita for the observations in Nigeria. Unlike in the other five countries, when a household reported to own 3 or more phones in Nigeria these observations were all assembled in one answer option (3 or more). The possession of mobile phones per capita was nonetheless computed. Since the distribution of mobile phones per household is imprecise for all households with more than 3 mobile phones the same cutoff line for the outliers as in Côte d’Ivoire was applied for Nigeria. Indeed, mobile phones per

capita in Nigeria even with the assembled response option 3 or more mobile phones per household were not greatly diverging from Côte d'Ivoire's sample. Further, both west-African countries have similar GDP per capita and agriculture contributes to similar shares to the overall GDP in both countries. Therefore, it can be assumed that the distribution of mobile phones is similar in both countries. Thus, the same boundary for the outliers in regard to mobile phones per capita was applied.

Two categorical variables will be included in the poverty index: Water supply and subjective financial situation. With regards to water supply, in the survey the question offers four response options which will simply be transferred to the index. Per response option one point was allocated to the index. In that light, 0 points were given to those with the worse water supply situation, 3 to those with the best. It is handled similarly concerning the subjective evaluation of the households' financial situation. 0 points were allocated to the households having reported being in the worst financial situation the response options are displaying, 3 for the best. One and two points were respectively assigned to the intermediate financial situations.

This thesis takes advantage of the hierarchical structure of the CGAP-data and applies household and location fixed effects. Thereby, it follows Meemken and Bellemare's (2020) paper "Smallholder farmers and CF in developing countries". Next to the latter study, only Dedehouanou et al. (2013) also use fixed effects. In fact, in the CF literature employing fixed effects it is rather an exception which is mainly due to the lack of data allowing for fixed effects methods. Thanks to improved data quality in terms of external validity, employing fixed effects overcomes difficulties such as selection bias and omitted variable bias problems that prior studies using IV and matching approaches had faced (Ton et al. 2017, Meemken & Bellemare 2020). Michelson (2013) raises doubts about preconditions to selection into CF, suggesting that farmers with necessary endowments or assets are more prone to participation in CF. Through random sampling and controlling for unobserved variables by using fixed effects, Michelson's point is addressed.

There will be three different types of location fixed effects in each regression. Households are always the unit of reference. First, the cluster level is the smallest entity. Here, groups of households from the same enumerated area are compared to each other. These groups are composed of 15 households that are located close to each other. Second, administrative units are politico-administrative divisions that vary in names between countries (District in Bangladesh, Tanzania, Uganda and Mozambique, Local Government Area in Nigeria and Sous-

Préfécture in Côte d'Ivoire). Within these administrative units, households are compared to each other. Lastly, the country level is the highest. All households within a country are compared.

Several robustness checks are done in order to figure out whether the here-above described methodology holds. Further details on that issue are provided in Appendix B.

4 Empirical Analysis

The results of the above-described methodology are laid out in the succeeding chapter. First, the results will be presented, then follows the discussion. As to the results, in the first instance, descriptive statistics will be displayed. These have the purpose to provide an overview of the sample. Then, the results of the regressions will be presented.

4.1 Results

Descriptive Statistics

Table 1 displays the prevalence of CF in different countries. In all six countries there were smallholder farmers that engaged in CF. In the sample, the country with the highest share of smallholder contract farmers was Tanzania, where more than eight out of ten of the smallholder households were engaged in CF. Lower shares of CF households were to be observed in Bangladesh with 4,3% and in Mozambique with 5,7%. Nevertheless, even in countries with low shares of households engaged in a contract, more than one out of three clusters and over three out of five administrative units contain at least one contracting household. That shows that CF was not limited to a geographically concentrated area. Several clusters exist within single administrative units which explains why there were different shares of clusters and administrative units with at least one CF household.

Table 4 *Sample size and prevalence of contract farming*

Country	Individual		Households		Clusters		Administrative units	
	N	% with contract	N	% with contract	N	% with contract	N	% with contract
Bangladesh	3.951	3,2	2.689	**4,3**	201	**31,8**	61	**63,9**

Côte d'Ivoire	5.354	10,5	2.912	15,0	210	73,3	151	79,5
Mozambique	3.979	4,2	2.331	**5,7**	206	**36,9**	11	**90,9**
Nigeria	4.532	13,2	2.737	15,9	214	66,4	199	68,3
Tanzania	4.742	77,3	2.706	**80,8**	209	99,5	135	100
Uganda	5.203	7,0	2.765	10,0	215	66,0	104	74,0
Total	27.761	**19,8**	16.140	**22,2**	1.255	**62,6**	661	**78,2**

Moreover, observing the overall sample, nearly three out of five smallholder farmer households lived with less than 1.9 US$ per capita in purchasing power parity (PPP) daily (Figure 1). Having gone through the literature which mainly finds positive income effects of contract farming, it might come as a surprise that the share of contracting households below the international poverty line was six percent higher compared to non-contracting households. Here, one should refrain from jumping to conclusions too quickly. Simply comparing means of contracting and non-contracting households does in most cases not yield causality (Ton et al., 2018). Indeed, no confounding variable has been controlled for in figure 1. Additionally, among the six countries differences are to be noticed. While in Bangladesh the percentage of smallholder households below the international poverty line was relatively equal, this was not the case in Uganda and Nigeria. Here, the share differed by 11 and 7 percentage points respectively.

As mentioned earlier, different types of agricultural contracts exist. In this thesis, more formal contracts are proxied. Overall, the share of formal contracts among all contracts stands at 15 percent (figure 2). In Bangladesh it is highest, with 63 percent of all contracting households having a formal contract.

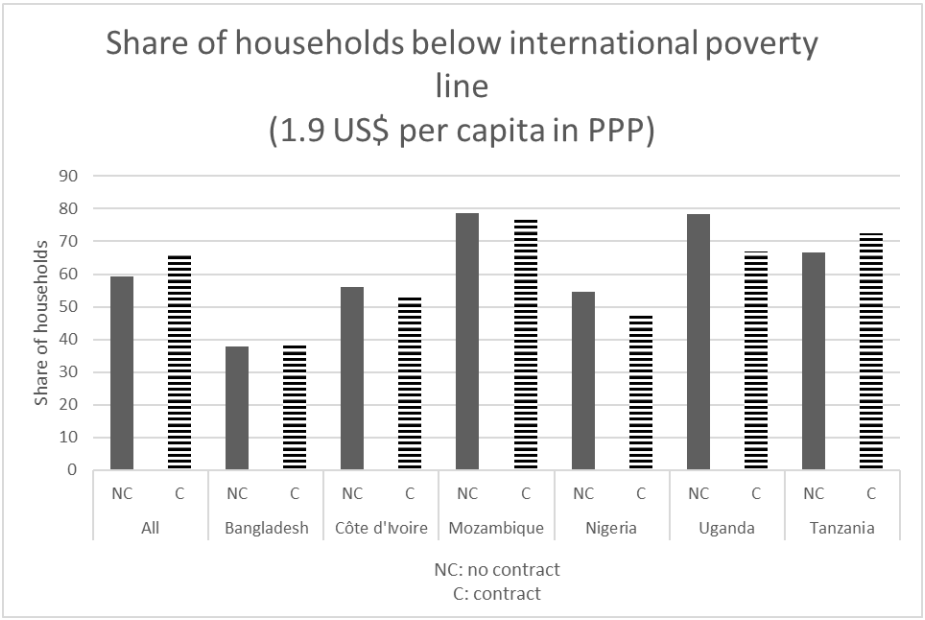

Figure 1 Share of households below the international poverty line of 1.9 US$ per capita in PPP by country and contract status

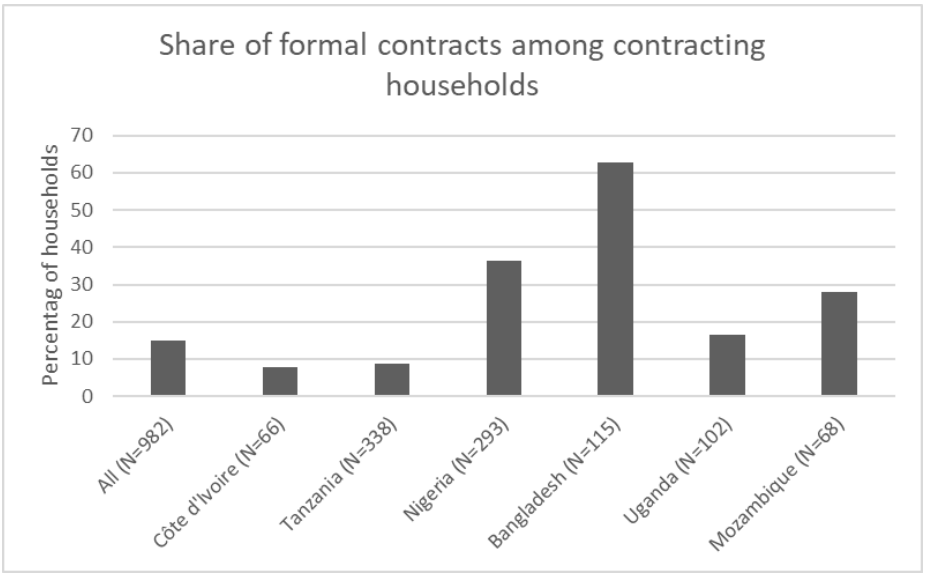

Figure 2 Share of households with formal contract (proxied) among contracting households

Descriptive Results

As stated in the methodology, the first regressions have income and expenditure as the outcome variable. In a second step the poverty index will be looked at.

To begin with, table 5 shows the relationship between CF and daily income per capita that the previously specified model predicts. It includes all countries. There appears to be a significant

association between contracting households and income on all location fixed effects (country FE, admin, FE cluster FE). Indeed, according to the model, on the country level, households that have a selling contract are related to 11,4% higher incomes. Other factors that have a significantly negative influence on income are female-headed households, and households located in rural areas. Considering all location fixed effects, it is suggested that female-headed households make roughly 15 percent less income. Further, the model predicts that rurally located smallholder farmer households make over 40 percent less income. As specified above, clusters are composed of 15 neighboring households. Therefore, the variable rural or urban is not likely to vary within the same cluster. This is why, in cluster fixed effects, the variable rural is not significant even though it is on the other levels. In fact, when considering table 11, in Appendix C, it becomes clear that the regressions including all countries hide national differences. When considering the countries individually, only two of them turn out to show positively significant associations between CF households and income per capita. These are Uganda and Côte d'Ivoire, wherein the administrative unit fixed effects regression, CF is associated with 22,6% and 10,2 % higher income respectively. As appendix D illustrates, the results are robust.

Table 5 CF and log of income per capita & day, outliers excluded

Log income per capita	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
Contract household	0.114**	0.094***	0.077***
	(0.040)	(0.029)	(0.025)
Female headed household (1/0)	-0.141***	-0.160***	-0.157***
	(0.035)	(0.023)	(0.022)
Age of household head	0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Household head ever attended school (1/0)	0.183**	0.122***	0.106***
	(0.049)	(0.018)	(0.017)
No. of household members	-0.115***	-0.111***	-0.111***
	(0.007)	(0.003)	(0.003)
Land owned (ha) by household	0.008***	0.009***	0.009***
	(0.002)	(0.002)	(0.002)
Rural (1/0)	-0.444***	-0.429***	-0.070
	(0.107)	(0.058)	(0.332)

Constant	0.002	0.093	-0.207
	(0.137)	(0.059)	(0.284)
Observations	13469	13469	13469

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

Turning to the effects of CF on expenditure. In the regressions including all countries there is no significant association between contract households and expenditure per capita (Table 6). The set of control variables on the administrative unit level indicates that if household heads have ever attended school, expenditure per capita rises by 12,8%. Besides, expenditure is negatively related to a higher number of household members and rural households. As table 22 in appendix E shows, when observing the countries individually, only in Tanzania, on the administrative unit fixed, CF is significantly associated with expenditure. At a 10% level of confidence, the regression predicts 7,7% higher expenditure for contracting households.

Table 6 CF and log of expenditure per capita & day, without overall outliers

Log of expenditure per capita	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
Contact households (1/0)	-0.004	0.023	0.006
	(0.026)	(0.025)	(0.023)
Female headed household (1/0)	-0.026	-0.057**	-0.063***
	(0.026)	(0.023)	(0.019)
Age of household head	0.002	0.001	0.001
	(0.001)	(0.001)	(0.001)
Household head ever attended school (1/0)	0.183***	0.128***	0.114***
	(0.036)	(0.016)	(0.015)
No. of household members	-0.106***	-0.108***	-0.107***
	(0.012)	(0.004)	(0.003)
Land owned (ha) by household	0.007**	0.006***	0.006***
	(0.002)	(0.001)	(0.001)
Rural (1/0)	-0.372**	-0.353***	-0.576*
	(0.104)	(0.051)	(0.299)
Constant	-0.360*	-0.292***	-0.089
	(0.169)	(0.057)	(0.256)

Observations	13954	13954	13954

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

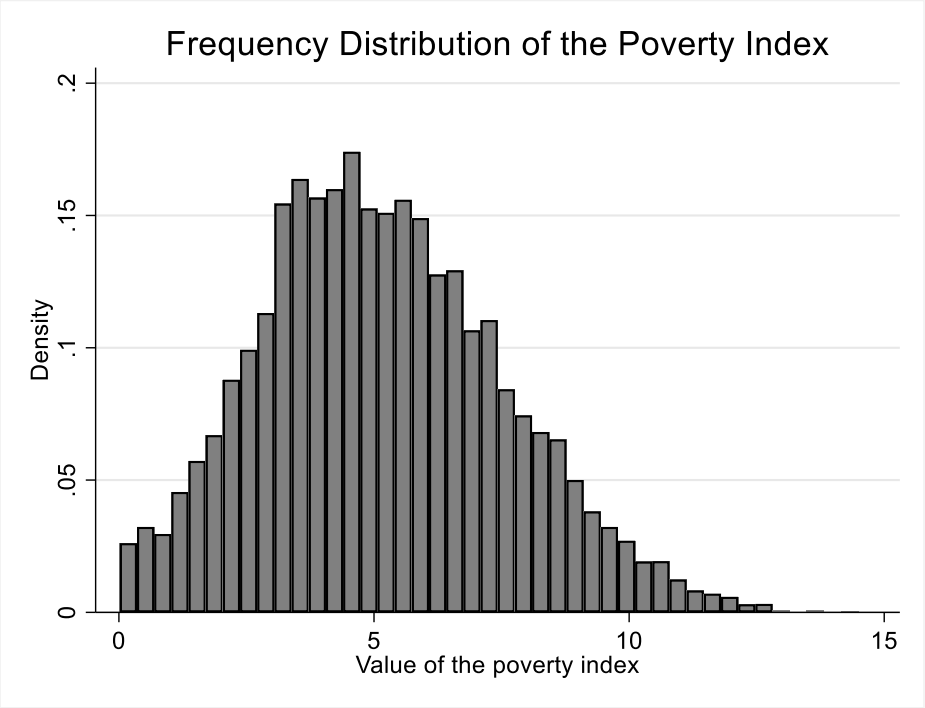

Figure 3 Frequency distribution of poverty index

Henceforth, the effects of CF on the poverty index will be shed light on. In Figure 3, the frequency distribution of the poverty index can be observed. The average outcome of the index across all countries is 5,2. Differences across countries appear. For instance, in Bangladesh the average outcome of the poverty index stands at 7,4. Table 7 depicts the relationship between CF and the previously established poverty index. At the level of administrative unit fixed effects, households engaged in CF are associated with a 0,218 points higher outcome on the index. While the association is not significant on the country fixed effects level, it is on the cluster level. Again, rural households are related to a lower outcome on the index (country & admin. unit FE). Whilst female-headed households and a higher number of household members are significantly related to a lower outcome of the poverty index (except for female-headed households in country FE), educated household heads tend to significantly raise the index's outcome. Here as well, the results are robust to alternative specifications (Appendix D).

Table 7 Contract Farming and Poverty Index

Poverty Index	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
Contract household (1/0)	0.301	0.218***	0.191***
	(0.179)	(0.065)	(0.059)
Female headed household (1/0)	-0.213	-0.343***	-0.355***
	(0.106)	(0.055)	(0.050)
Age of household head	0.005	0.000	-0.000
	(0.005)	(0.001)	(0.001)
Household head ever attended school (1/0)	0.815***	0.529***	0.477***
	(0.100)	(0.049)	(0.043)
No. of household members	-0.224***	-0.201***	-0.200***
	(0.010)	(0.008)	(0.008)
Land owned (ha) by household	0.025***	0.028***	0.029***
	(0.006)	(0.004)	(0.003)
Rural (1/0)	-1.041***	-1.044***	-3.440*
	(0.202)	(0.130)	(1.793)
Constant	6.503***	6.821***	8.937***
	(0.363)	(0.134)	(1.533)
Observations	12678	12678	12678

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

National differences can be observed in table 8. There, administrative and cluster units fixed effects are indicated on country levels. Thus, the effect sizes are the mean effects that CF has on the index of all clusters and administrative units within a single country. This allows for differentiation between countries. Indeed, there are national differences to be found concerning the effects of CF on the poverty index. One can discern three categories in that regard. Firstly, the positive and significant association between CF and poverty as it appears for Mozambique, Uganda, and Nigeria. Secondly, the insignificant relationships which is the case for Bangladesh and Tanzania. Thirdly, Côte d'Ivoire shows a significantly negative association. The latter stems from the negative relationship between CF and water supply in Côte d'Ivoire. It is counter-intuitive to state that participation in CF worsens water supply. An explanation for this might be that Ivorian contract farmers cultivate more water-intensive crops and worsen their

water situation by increasing their demand. According to Vanham and Bidoglio (2013) cocoa is a very water-intensive crop. Indeed, the share of farmers that reported having cocoa as the most important crop is eight percent higher among contract farmers (43% of CF and 35% non-CF).

Table 8 CF and Poverty Index at country level, outliers excluded

Poverty Index	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
All countries (N=12,678)	0.301 (0.179)	0.218*** (0.065)	0.191*** (0.059)
Bangladesh (N=2,433)		-0.042 (0.214)	0.179 (0.182)
Côte d'Ivoire (N=2,011)		-0.303** (0.149)	-0.333** (0.154)
Mozambique (N=1,173)		0.820*** (0.255)	0.543* (0.278)
Nigeria (N=2,261)		0.528*** (0.122)	0.497*** (0.120)
Tanzania (N=2,451)		0.133 (0.107)	0.091 (0.095)
Uganda (N=2,349)		0.534*** (0.145)	0.500*** (0.135)

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

In addition, table 9 displays that every component variable of the index varies in significance between countries. Even though every component shows significant relationships in at least one sampling country, not all of them are significant on the overall level. However, income per capita, mobile phones per capita, and subjective financial wellbeing are positively significant in the overall sample. Though, this does not hold for expenditure per capita and water supply. Nonetheless, on the cluster fixed effect level, water supply has significant impacts in four countries.

Table 9 Components of the poverty index and their respective significance

	Income Admin	Expend Admin	Phone Admin	Water Admin	Financ Admin	Income Cluster	Expend Cluster	Phone Cluster	Water Cluster	Financ Cluster
All	**0.073*****	0.023	**0.039****	0.057	**0.082*****	**0.067*****	0.011	**0.032***	0.046	**0.084*****
Banglade sh	-0.002	-0.048	-0.008	-0.078	0.066	0.048	0.008	-0.006	-0.039	0.122*
Côte d'Ivoire	0.076*	-0.049	0.003	**-0.217*****	0.002	0.071*	-0.061	-0.002	**-0.233*****	-0.011
Mozambi que	0.180	0.179	0.036	0.258	0.112	0.080	0.028	0.034	**0.271****	0.138
Nigeria	0.058	-0.044	0.011	**0.257*****	0.211***	0.056	-0.047	0.008	**0.249*****	0.206***
Tanzania	0.030	**0.077****	0.065*	0.010	0.039	0.021	**0.072****	0.056	-0.006	0.036
Uganda	0.148**	**0.098****	0.119**	**0.202****	0.103	0.149***	**0.090****	0.101**	**0.176****	0.092

Table 10 displays the poverty impact of formal contracts in each of the countries individually. Overall, it can be noticed that formal contracts are associated with 0,559 more points in the poverty index. This is double the effect compared to the regression that captured all types of contracts. Further, Bangladesh and Côte d'Ivoire show insignificant relationships. In the case of Côte d'Ivoire this is an important change since the relationship between CF and the poverty index was estimated to be significantly negative. Besides, when it comes to formal contracts Tanzania also shows a significant association between formal contracts and the multidimensional poverty index, which it did not in the regression including all contracts. In the cases of Mozambique and Uganda a household engaged in a formal contract is associated with an increase of over 1 point in the index.

Table 10 Formal contract farming and poverty index, outliers excluded

Poverty Index	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
All countries (N=12,678)	0.688** (0.185)	0.559*** (0.105)	0.563*** (0.099)
Bangladesh (N=2,433)		0.013 (0.294)	0.258 (0.248)
Côte d'Ivoire (N=2,011)		0.307 (0.512)	0.468 (0.539)
Mozambique (N=1,173)		1.058*** (0.241)	0.560 (0.366)
Nigeria (N=2,261)		0.578*** (0.200)	0.556*** (0.198)
Tanzania (N=2,451)		0.554*** (0.133)	0.596*** (0.144)
Uganda (N=2,349)		1.279*** (0.269)	1.206*** (0.288)

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

The between-country-differences possibly draw from either statistical and measurement differences or from actual differences in the outcome of CF on the components that make up the poverty index. Regarding the former, it is to be noticed that there are no differences in the way the variables are measured. The same response options were applied. Nevertheless, different income distributions exist across countries. As mentioned earlier, the outliers have been excluded from each countries' sample and the income distribution has been fitted into three index-points, which is the weight every component is allocated. This engenders that the same value which is allocated to different farmers for the income-component does not necessarily reflect the same actual income across countries. In fact, the number allocated for the component income per capita is only relatively comparable to the income distribution of every individual country. That affects comparisons of different countries. For the two variables "minimum expenditure per capita and day" and "phones per capita" the same restrictions apply since the outliers have been excluded and their distribution in the respective national samples has been fitted into the value three, the weight of each component in the index. Since the fixed effects method only compares households within the same geographical unit, comparisons

within the same geographical unit are not affected by that restriction. Furthermore, the means do not differ very much between the countries as can be observed in the boxplot (figure 4).

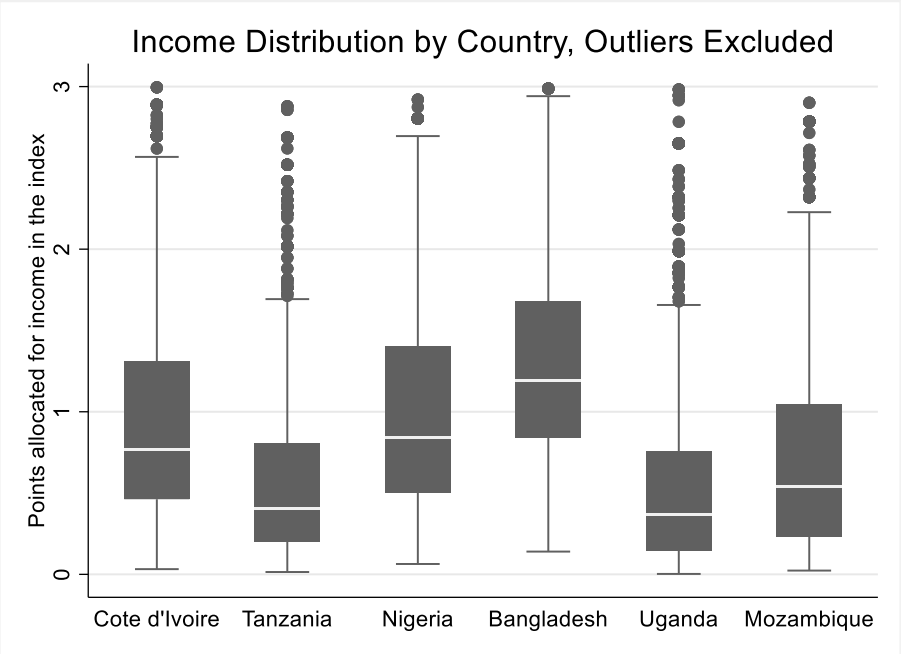

Figure 4 Income distribution, outliers excluded

Another concern of statistical nature is the difference in the prevalence of the share of contract farmers across countries and regions. Indeed, the number of contract farmers per cluster and administrative unit vary, which affects the mean outcome effect. However, as displayed in table 4 the number and prevalence of contract farmers across all countries is high enough. Besides, CF is widespread in terms of location (Table 4). Therefore, that argument is unlikely to significantly influence the results.

As mentioned above, actual outcome differences of CF are likely to yield the results. As CF models and practices diverge their outcomes do. As explained earlier, formal contracts have been proxied. Their prevalence varies across countries, just like does the share of contracting households (Figure 2). Many different types of contract models remain unobserved. Going into depth regarding heterogeneous outcomes by CF models is beyond the scope of this thesis. Besides, as explained in the methodology part, unobserved variables that are constant over time influence the outcomes of CF differently across regions. These might partly explain the different outcomes of CF on the poverty index. An example in this regard is the high popularity of CF in Tanzania which is likely due to the most often cultivated crops (maize and rice). These two crops were most often named the most important crops among all contract farmers

throughout the six countries. It is without the realm of this thesis to investigate this kind of difference more in-depth.

4.2 Discussion

The discussion will position the results in the existing body of literature. This study was set out to assess the impact of CF on smallholder farmer's poverty in developing countries. The answer to the research question is the following. Clearly, the main finding of the thesis is that CF decreases multidimensional poverty as measured by the multidimensional poverty index. Indeed, overall CF households are related to a higher outcome on the poverty index. Within the samples of Mozambique, Nigeria, and Uganda significantly positive relations between CF and the poverty index are shown. In Côte d'Ivoire the association is significantly negative. For the remaining Tanzania and Bangladesh, the effect is insignificant.

For the first time, these results describe the impact of CF on a multidimensional poverty index applied to nationally representative data of six countries. The data is broadly consistent with the major trends in the literature as to the improvement of smallholder farmers' livelihoods through CF. In fact, the published studies that investigate the impact of CF on aspects of poverty find positive impacts (Bellemare & Novak, 2017; Dedehouanou, Swinnen & Maertens, 2013). In that light, the significantly positive relation between CF and the poverty index can be seen as corroboration of the main findings in the literature.

Similar trends can be observed when it comes to the components of the poverty index. As table 9 indicates, overall income per capita, mobile phones per capita, and subjective financial wellbeing are positively related to CF on both administrative and cluster unit levels. Interestingly enough, while, according to the model, income per capita appears to significantly raise expenditure per capita does not. Instead, the ratio of phones per capita rises and the subjective financial situation is higher evaluated. Overall, the level of water supply is not significantly affected by CF.

Concerning the subjective financial wellbeing, the relationship with CF is significantly positive. The response options of that very variable include whether the household has or has not enough financial resources to acquire sufficient food, but also whether they can afford to save money. Therefore, an increase in the outcome of that variable can be perceived as improved food

security. This assumption holds since over one in every three households reported not having enough money for food. Bellemare and Novak (2017) find a positive link between CF and food safety. The present results tend to support their findings. In addition, the analysis also corroborates the results of Dedehouanou et al. (2013) who revealed a positive association between CF and subjective farmers' wellbeing. While subjective financial wellbeing cannot be put at the same level with subjective wellbeing in general, they are still related to each other (Kruger, 2011). Therefore, one can cautiously see support of Dedehouanou et al.'s (2013) findings.

Regarding household assets, the index includes the number of mobile phones per capita. The latter can be perceived as productive household assets since mobile phones can be used as essential tools for the provision of information that are relevant for farmers (Furuholt & Matotay, 2011; Sife, Kiondo & Lyimo-Macha, 2010). The results indicate that engaging in CF raises the number of mobile phones per capita. Thereby, the results are in line with Michelson's (2013) findings. In his paper he investigated the relationship between CF and productive household assets in Nicaragua. He found increased purchases of productive household assets to be related to the entering in CF. Since the minimum expenditure per capita required is not significantly rising but the number of mobile phones is, one could assume that Michaelson's findings are hereby supported.

In the index, overall, water supply and minimum daily expenditure per capita are not significantly impacted by CF. Nonetheless, on individual national levels minimum daily expenditure per capita is significant in Tanzania and Uganda. As to the water supply on the administrative level a positive association is estimated for Uganda and Nigeria as well as for Mozambique on the cluster level. Indeed, the kind of water supply that a household is able to acquire is heavily dependent on the surrounding infrastructure. Therefore, it is of interest to look at the cluster level. In three out of six countries water supply is improved for CF households. Even though the findings are not significant when all countries included in the regression, they tend to corroborate Michelson's findings that CF improves productive household assets. This holds for Mozambique, Nigeria, and Uganda only.

Regarding income per capita, one discerns a significantly positive impact of CF. Focusing on the first regression that had the logarithmic form of daily income per capita as a dependent variable allows to better position the findings in the literature. The relationship is estimated to be at an approximately 10% increase in income per capita. Two remarks are to be made here.

On the one hand, this effect size is slightly smaller relative to Meemken and Bellemare's (2020) results. Indeed, they find an 11,6% (against 9,4% here) increase in CF income (admin. unit FE). The difference draws from the exclusion of the outliers. On the other hand, the estimated impact is significantly smaller than prior studies that investigate the income impacts of CF (Wang, Wang & Delgado, 2014). That stems most likely from improved external and internal validity of the present methodology which has been rendered possible by improved data availability (Meemken & Bellemare, 2020). In addition, this paper does not suffer from publication and survivor bias by capturing every type of contract which is likely to explain a smaller impact size of CF on income. However, as this study finds a positive income impact of CF, the present results corroborate the findings of most studies as to a positive relationship of CF and income (Bellemare, 2012; Miyata, Minot & Hu, 2009; Narayanan, 2014).

Furthermore, when changing the independent variable of interest from CF households towards the proxied variable households with formal contracts its impact on the poverty index doubles. Now, four out of six countries show significant positive associations between CF and the poverty index (table 10). Mozambique and Uganda show increases greater than 1 point on the poverty index whereas Nigeria and Tanzania are at half a point increase, all significant at a 1% level of confidence. Indeed, that suggests that more vertically integrated contract schemes tend to be more beneficial to smallholder farmers in regard to poverty alleviation. These findings are in line with the transaction cost approach suggesting that more vertically integrated value chains decrease transaction costs and thereby are beneficial for the contracting parties. Since formal contracts appear to be more beneficial for poverty alleviation these findings do not find any evidence that supports the theory of the political economy of agrarian change. Indeed, instead of losing from CF the farmers are gaining in terms of poverty decrease. However, there remain unobserved aspects. Indeed, no information about the degree of dependency of the farmer on the buyer is provided. Therefore, the assumptions made by the theory of the political economy of agrarian change cannot entirely be refuted.

The study has a number of limitations. These appear for the outcome variables, control variables, as well as for the independent variables of interest and the results. Beginning with the outcome variables, the fact that an index does not allow for conclusions as to where its effect size stems from has been remedied by displaying a table that sums up the impact CF has on each component. However, the two categorical variables (water supply and subjective financial wellbeing) that have been included present a weakness by not integrally capturing all the

changes caused by CF. Instead, they only capture changes that cross the boundary of one of the four response options. Further, for the continuous variables (income, expenditure, and phones per capita) the same effect size caused by CF does not necessarily reflect the same effect in actual terms (actual dollars or phones per capita). As the country-specific outliers have been excluded for each country individually, a different frequency distribution has been stretched to three which is the weight of each component in the index. Consequently, in the index one additional point of phones per capita in two countries might have two different increases in the actual number of mobile phones. Despite that lack of comparability, the positive tendencies of the effect come across.

Still among the outcome variables, the variables income and expenditure show limitations. Both are components of the poverty index, but their logarithmic form is also individually taken as an outcome variable. Due to lack of data availability, the household income captures not only the farm-related income but income from all income sources. In fact, specifically rural households in Sub-Saharan Africa have multiple sources of income to reduce the risk of income shortfalls (Livingston, Schonberger & Delaney, 2011). Therefore, the income impact of CF is not exact, especially since entering CF can change the composition of the households' income portfolio. Here again, trends are nonetheless observable and present valuable contributions. The limitation of the expenditure variable also draws from lacking data availability. Indeed, in the dataset, solely the variables minimum expenditure per household needed exists. It might be misleading to think that the expenditure variable informs about the actual expenditure. Here it is argued that when the minimum expenditure needed raises, the living standard has significantly risen in a way that new needs have been established in the way of life of households. This is why, the variable minimum daily expenditure per capita needed is less affected by CF. Here, it is important to highlight that the proxy of formal contracts is related to a significantly positive increase in the minimum expenditure needed. Consequently, it can be suggested that formal contracts raise the standard of living of farming households.

Regarding the control variables, due to lack of data availability, not all country specificities could have been controlled for. By employing location and household fixed effects this issue is minimized. Nonetheless, the effect of farmers' entrepreneurial or farming abilities, for instance, remain unobserved. In theory, due to random sampling, this is assumed to not be an issue.

Concerning the independent variable of interest, as mentioned earlier, no information regarding the type of contract nor the CF model is provided. These, however, are potential sources of

heterogeneity. This limitation is acknowledged. Nonetheless, since the representative data captures all types of contracts, successful and failing ones, the analysis does not run any risk related to publication and survivor bias which in turn presents a strength of this paper.

Thanks to the employed data and methodology the following generalizations arise from the analysis. Overall, CF contributes to poverty alleviation in developing countries. Though, it does not unambiguously do so. In fact, major country differences prevail in terms of significance of variables and effect size. Therefore, uniform conclusions about the impacts of CF on poverty cannot be made until the drivers of the heterogeneous outcome are revealed.

Consequently, the practical implications of the thesis are twofold. In the first instance, the results incentivize a reshaping of the policy recommendation when it comes to CF. As consequences of CF differ significantly between countries, country-specific circumstances need to be taken into consideration for a complete assessment of the impact of CF. In the second instance, out of the limitations that this paper has, several opportunities for future research arise. Firstly, since it is without the realm of this paper to investigate heterogeneous outcomes future research could focus thereupon. Indeed, due to lack of data, CF households were defined as households with at least one member having any type of selling contract. Next to the proxy for formal contracts, no further specifications regarding the type of contract have been made. Different types of contracts, but also different types of CF models may potentially influence poverty alleviation outcomes for smallholder farmers in developing countries. Secondly, while this thesis demonstrates a positive general tendency of CF on poverty alleviation, future research could focus on the quantification of the actual impacts.

5 Conclusion

The purpose of this thesis was to investigate the impact of CF on multidimensional poverty in developing countries. Unlike most previous studies have done so far, the aim was to provide results that are generalizable beyond a single crop, contract scheme, or geographical area. Indeed, the most prominent proxy for poverty in the literature is income-based poverty. Consequently, the goal of the thesis was to investigate the impact of CF on a more broad-based definition of poverty. The employed dataset is nationally representative of the smallholder farmer population of six developing countries. With data collected by the CGAP, the analysis was carried for Bangladesh, Côte d'Ivoire, Nigeria, Uganda, Tanzania, and Mozambique. One novelty of the study is the construction of a multidimensional poverty index which has allowed for a broader analysis of the relationship between CF and poverty. The five variables that compose the multidimensional poverty index are income per capita, expenditure per capita, and mobile phones per capita, as well as water supply and subjective financial wellbeing. Taking advantage of the hierarchical structure of the data, household, and location fixed effects were used to estimate the impact of CF on poverty. Using fixed effects is a novelty in the literature around CF which has been rendered possible by improved data availability.

Overall, this study demonstrates that CF contributes to poverty alleviation amongst smallholder farmers in developing countries. The results support previous research which has argued that CF is associated with higher incomes, more productive household assets, and increased subjective financial wellbeing. More vertically integrated contract schemes in which the contracting households sell crops to large retailers or buyers and get provisioned with inputs, the impact on poverty alleviation is estimated to be twice as high. Yet, the results challenge the notion that CF unambiguously improves smallholder households' welfare. While the overall impact of CF on the poverty index is significantly positive, important between-country-divergences prevail. Indeed, the positive relationship between CF and the newly constructed poverty index is positive and significant in Côte d'Ivoire, Mozambique, Nigeria, and Uganda, whereas Bangladesh and Tanzania exhibit insignificant results. When it comes to more formal contracts, Tanzania also shows a significantly positive relationship between CF and the poverty

index. Due to a lack of data availability, it is beyond the scope of this thesis to explore and explain country-specific differences.

In light of these findings, the study proposes the following recommendations for further research. Through improved data availability, new opportunities to better comprehend the heterogeneous impacts of CF on poverty will be generated. Indeed, future studies could focus on potential sources of heterogeneity such as contract schemes, CF models, or crop types. Further, in the context of CF, the here-established multidimensional poverty index should continue to be applied to different contracts, countries, and crop or other forms of agricultural CF practices. This is so given that capability studies have emphasized the need to go beyond incomes if one is to fully understand the plight of the poor. Additionally, while the present results indicate a significant relationship between CF and multidimensional poverty, it might be of interest to quantify that impact more precisely by looking at different stages in such as farming input contracts and selling contracts. An important policy recommendation from this study is the potential need for a re-evaluation of policies directed to CF. Indeed, against the background of country-specific differences, CF can no longer be considered as a universal tool for poverty alleviation and rural development. Local circumstances that might affect the impact of CF need to be considered to incentivize the successful implementation of CF arrangements.

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Appendix A

Table 11 CGAP question on a household's financial situation

Please look at this card and tell me which answer best reflects your household's current financial situation.	
We don't have enough money for food	1
We have enough money for food and clothes only	2
We have enough money for food and clothes and can save a bit, but not enough to buy expensive goods such as a TV set, a refrigerator or a motorcycle	3
We can afford to buy certain expensive goods such as a TV set or a refrigerator	4
Don't know	98

Appendix B

Robustness checks

In order to figure out whether the employed methodology is valid, several robustness checks will be done. The latter are in number of three and have also been carried out in Meemken and Bellemare (2020). First, alternative outcome variables will be applied and compared to the main regressions' outcome variables. Here, the three continuous variables of the poverty index will be considered. In that light, for the variables "income, expenditure, phones per capita" an alternative outcome variable will be employed. In that regard, including the outliers, the three variables will serve as single outcome variables. Further, the monthly household income, monthly household expenditure, and phones per household will be run for an additional robustness check. Concerning, the two categorical variables of the index, such changes of the variables cannot as easily be conducted as for the continuous variables. Therefore, solely the continuous variables will be regarded here.

Second, still in line with Meemken and Bellemare (2020), in all equations the land ownership is included. Though, these variables might suffer from reverse causality. Indeed, it is conceivable that farmers purchase more land once they have engaged in contract farming. To test that, the potentially endogenous variable will be excluded from the set of control variables to observe its influence. Nonetheless, since richer farmers with greater landholdings are more likely to participate in contract farming (Olounlade, Li, Anshiso, Kokoye, Dossouhoui, Akpa & Biaou, 2020), the control variable will be kept in the main regressions.

Third, an alternative definition of the main independent variable of interest will be applied. As explained above, the definition of contracting household is broad. Therefore, a proxy for formal contracts will be employed as a robustness check. The dummy is the same as the one specified in the methodology.

The results of the robustness checks can be found in Appendix D. They do not change the main results and conclusions of the study.

Appendix C

Table 12 CF and log of daily income per capita, outliers excluded

Log of income per capita and day outliers excluded	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
All countries (N=13,469)	0.114** (0.040)	0.094*** (0.029)	0.077*** (0.025)
Bangladesh (N=2,495)		0.002 (0.062)	0.055 (0.050)
Cote d Ivoire (N=2,346)		0.102** (0.051)	0.081 (0.050)
Mozambique (N=1,372)		0.283 (0.185)	0.155 (0.113)
Nigeria (N=2,324)		0.025 (0.045)	0.021 (0.046)
Tanzania (N=2,514)		0.037 (0.058)	0.024 (0.053)
Uganda (N=2,418)		0.226** (0.088)	0.206*** (0.076)

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

Appendix D

Robustness checks output

- Contract farming on daily income per capita, outliers included

Table 13 Contract farming and income (log of income per capita and day), outliers included

Log of income pc and day	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
Contract household (1/0)	0.140**	0.116***	0.095***
	(0.044)	(0.031)	(0.026)
Female headed household (1/0)	-0.161***	-0.186***	-0.188***
	(0.039)	(0.025)	(0.023)
Age of household head	0.001	-0.000	-0.000
	(0.002)	(0.001)	(0.001)
Household head ever attended school (1/0)	0.238***	0.170***	0.147***
	(0.049)	(0.018)	(0.018)
No. of household members	-0.150***	-0.142***	-0.140***
	(0.005)	(0.004)	(0.004)
Land owned (ha) by household	0.012***	0.012***	0.012***
	(0.002)	(0.002)	(0.002)
Rural (1/0)	-0.486***	-0.472***	-0.436
	(0.116)	(0.060)	(0.345)
Constant	0.288	0.365***	0.344
	(0.155)	(0.061)	(0.294)
Observations	14573	14573	14573

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

- Contract farming on monthly household income

Table 14 Contract farming and monthly household income (log of monthly household income)

	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE

All countries (N=14,573)	0.144**	0.124***	0.104***
	(0.046)	(0.030)	(0.026)
Bangladesh (N=2,677)		-0.023	0.031
		(0.070)	(0.051)
Cote d Ivoire (N=2,686)		0.138**	0.091*
		(0.057)	(0.052)
Mozambique (N=1,443)		0.350*	0.265*
		(0.184)	(0.137)
Nigeria (N=2,604)		-0.010	-0.012
		(0.049)	(0.050)
Tanzania (N=2,621)		0.089	0.087*
		(0.055)	(0.051)
Uganda (N=2,542)		0.299***	0.267***
		(0.091)	(0.078)

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

- Contract farming on daily expenditure per capita, outliers included

Table 15 Contract farming and expenditure (log expenditure per capita and day), outliers included

Log of daily expenditure per capita	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
Contract household (1/0)	-0.052	0.013	0.007
	(0.029)	(0.024)	(0.023)
Female headed household (1/0)	0.028**	-0.005	-0.013
	(0.009)	(0.019)	(0.018)
Age of household head	0.003**	0.002***	0.002***
	(0.001)	(0.000)	(0.000)
Household head ever attended school (1/0)	0.088***	0.068***	0.065***
	(0.021)	(0.017)	(0.014)
No. of household members	-0.055***	-0.061***	-0.062***
	(0.008)	(0.004)	(0.003)
Land owned (ha)	0.002	0.001	0.002**

by household	(0.001)	(0.001)	(0.001)
Rural (1/0)	-0.136*	-0.132***	-0.305
	(0.057)	(0.040)	(0.290)
Log income per capita and day in US-Dollar	0.564***	0.520***	0.504***
	(0.047)	(0.017)	(0.014)
Constant	-0.299**	-0.267***	-0.115
	(0.090)	(0.046)	(0.248)
Observations	14349	14349	14349

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

- Contract farming on monthly household expenditure

Table 16 Contract farming and monthly household expenditure (log of monthly household expenditure)

Log of monthly household expenditure	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
All countries (N=14,573)	0.010	0.064**	0.048**
	(0.037)	(0.026)	(0.024)
Bangladesh (N=2,686)		0.001	0.019
		(0.057)	(0.047)
Cote d Ivoire (N=2,763)		-0.050	-0.066
		(0.054)	(0.051)
Mozambique (N=1,683)		0.289***	0.161
		(0.052)	(0.116)
Nigeria (N=2,641)		-0.011	-0.014
		(0.050)	(0.051)
Tanzania (N=2,681)		0.127***	0.136***
		(0.043)	(0.042)
Uganda (N=2,653)		0.156*	0.115
		(0.085)	(0.076)

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

- Contract farming on phones per capita, outliers excluded

Table 17 Contract farming and log of phones per capita, without outliers

Log phones per capita	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
All countries (N=12,577)	0.019 (0.013)	0.009 (0.015)	0.004 (0.014)
Bangladesh (N=2,514)		0.002 (0.039)	-0.016 (0.044)
Cote d Ivoire (N=2,610)		-0.020 (0.034)	-0.019 (0.033)
Mozambique (N=1,179)		0.003 (0.057)	-0.006 (0.066)
Nigeria (N=2,124)		0.059** (0.027)	0.052** (0.026)
Tanzania (N=2,165)		0.016 (0.030)	0.007 (0.027)
Uganda (N=1,985)		0.006 (0.036)	-0.002 (0.035)

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

- Contract farming on phones per capita, outliers included

Table 18 Contract farming and log of phones per capita, outliers included

Log of phones per capita	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
All countries (N=14,573)	0.029 (0.016)	0.017 (0.016)	0.013 (0.016)
Bangladesh (N=2,535)		-0.008 (0.040)	-0.021 (0.045)

Cote d Ivoire (N=2,709)	-0.000	-0.004
	(0.038)	(0.038)
Mozambique (N=1,179)	0.003	-0.006
	(0.057)	(0.066)
Nigeria (N=2,145)	0.058**	0.050*
	(0.027)	(0.026)
Tanzania (N=2,182)	0.010	0.003
	(0.034)	(0.032)
Uganda (N=2,009)	0.034	0.029
	(0.038)	(0.036)

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

- Contract farming on phones per household

Table 19 Contract farming and phones per household

No. of phones per household	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
All countries (N=14,573)	0.101* (0.048)	0.025 (0.072)	0.027 (0.071)
Bangladesh (N=2,689)		-0.034 (0.073)	-0.004 (0.085)
Cote d Ivoire (N=2,912)		0.026 (0.108)	0.009 (0.110)
Mozambique (N=2,331)		0.101 (0.082)	0.107 (0.107)
Nigeria (N=2,737)		0.045 (0.060)	0.041 (0.055)
Tanzania (N=2,706)		-0.042 (0.253)	-0.021 (0.242)
Uganda (N=2,765)		0.144* (0.078)	0.131* (0.068)

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

- Contract farming on multidimensional poverty index, without land owned as control variable

Table 20 Contract farming and multidimensional poverty index (without land owned as control variable)

Poverty index	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
Contracting household	0.333	0.252***	0.223***
	(0.176)	(0.066)	(0.060)
Female headed household (1/0)	-0.239*	-0.367***	-0.380***
	(0.113)	(0.055)	(0.051)
Age of household head	0.006	0.001	0.001
	(0.005)	(0.001)	(0.001)
Household head ever attended school (1/0)	0.811***	0.532***	0.479***
	(0.107)	(0.048)	(0.043)
No. of household members	-0.214***	-0.191***	-0.191***
	(0.013)	(0.008)	(0.008)
Rural (1/0)	-1.026***	-1.032***	-3.090**
	(0.199)	(0.131)	(1.501)
Constant	6.488***	6.805***	8.633***
	(0.349)	(0.133)	(1.284)
Observations	12678	12678	12678

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

- Formal contract farming on multidimensional poverty index

Table 21 Formal contract farming and multidimensional poverty index (without country outliers)

Formal contract	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
All	0.688**	0.559***	0.563***
(N=12,678)	(0.185)	(0.105)	(0.099)
Bangladesh		0.013	0.258
(N=2,433)		(0.294)	(0.248)
Côte d'Ivoire		0.307	0.468
(N=2,011)		(0.512)	(0.539)
Mozambique		1.058***	0.560
(N=1,173)		(0.241)	(0.366)
Nigeria		0.578***	0.556***
(N=2,261)		(0.200)	(0.198)
Tanzania		0.554***	0.596***
(N=2,451)		(0.133)	(0.144)
Uganda		1.279***	1.206***
(N=2,349)		(0.269)	(0.288)

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

Appendix E

Table 22 and log of daily expenditure per capita, outliers excluded

Log of expenditure per capita	(1) Country FE	(2) Admin. unit FE	(3) Cluster FE
All (N=13,954)	-0.004 (0.026)	0.023 (0.025)	0.006 (0.023)
Côte d'Ivoire (N=2,475)		-0.067 (0.048)	-0.079 (0.049)
Tanzania (N=2,394)		0.077* (0.043)	0.064 (0.042)
Nigeria (N=2,426)		-0.028 (0.049)	-0.031 (0.050)
Bangladesh (N=2,513)		-0.043 (0.052)	-0.008 (0.041)
Uganda (N=2,384)		0.128 (0.081)	0.114 (0.071)
Mozambique (N=1,542)		0.159 (0.114)	0.006 (0.060)

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