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Contract Farming and Children's Education: Evidence From Maize Producers in Ghana

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ABSTRACT

The institution of contract farming (CF) has continued to proliferate in the small farm sector of developing countries. While its effects on smallholders across welfare outcomes such as income and food security have been well documented, there are growing concerns about its broader social implications especially on children. Yet, there is little empirical evidence about such social implications. In this paper, we address this gap by studying the role of CF on children's education, a critical component of human capital and sustainable development. Our study focuses in the Wa East District of Ghana. Employing different empirical approaches, our results show that CF is negatively associated with children's education measured by expenditure on education and days of school attended. Our results are robust to alternative estimation methods. The results underscore the need to look beyond the economic benefits of CF and focus on their broader social implications especially in the study area.

1 | Introduction

The small farm sector of developing countries has and continues to undergo considerable transformation (Davis et al. 2024; Reardon et al. 2009). A salient feature of this transformation has been the emergence and proliferation of contract farming (CF) arrangements. CF arrangements are broadly defined as pre-planting agreements between agro-processors and farmers, with the latter expected to deliver produce of certain quality while the former provides crucial resources such as improved seeds, fertilizers, machinery, technical know-how, or simply cash (Prowse 2012; Ton et al. 2018). As an institutional innovation, CF reduces market imperfections in both input and output markets and links farmers to value chains (Abman and Lundberg 2024; Arouna et al. 2021; Barrett et al. 2012). Accordingly, CF has been shown to have numerous effects on the livelihoods and welfare of smallholder farmers.

A growing body of literature has thus evaluated the effects of CF on various outcomes such as diets (Debela et al. 2021; Ndip and Sakurai 2024; Ochieng and Ogutu 2022; Ogutu et al. 2020), food security (Bellemare and Novak 2017; Mishra et al. 2018; Soullier and Moustier 2018), income (Andersson et al. 2015; Arouna et al. 2021; Rao and Qaim 2011), mostly reporting positive effects. Some studies have also reported negative effects on income; however (Wendimu et al. 2016). Beyond the household, some effects have also been reported at the community level (Gatto et al. 2017). Some of these effects have come at the expense of the environment by reducing the adoption of sustainable practices and promoting deforestation (Abman and Lundberg 2024; Dubbert et al. 2023).

While these economic and environmental effects have been studied, much less is known about the social implications despite growing concerns about the social implications of CF (Brandão and Schoneveld 2021; Oya 2012). For example, a growing social concern about CF is its effect on children, who constitute an important demography in developing countries. These concerns are related to the labor demands associated with CF, which may raise not just child labor issues but also have implications on

children's education. CF has been associated with changes in labor demands (Ruml and Qaim 2021a). It may increase a household's labor needs warranting children to work more on farms and consequently influence their time spent in school. In most developing countries, household labor is crucial and children are an important source of it (Becot 2022; Becot and Inwood 2024; Punch and Sugden 2013). Increased labor needs may thus reduce children's enrollment and days spent in school. In a case where CF rather decreases labor demands, probably through the adoption of labor-saving technologies, it may avail children the opportunity to spend more time in school. Alternatively, and on a more positive note, CF may lead to increased income. Increased income may imply that households can afford school fees and other school needs allowing children to enroll in school (Acemoglu 2001; Drajeaa and O'Sullivan 2014). This is important given that the lack of income could be a binding constraint on children's education. Income shocks may also cause households to withdraw their children from school to engage in other income generating activities (De Janvry et al. 2006; Duryea et al. 2007). While these links exist, they are at best anecdotal and warrant empirical analysis to explore them. Additionally, there is a lack of studies on how CF influences children's education. This study aims to address this gap.

In this study, we assess the implications of CF on children's education. Leveraging a unique survey dataset from the Wa district of Ghana, we employ different empirical approaches to evaluate the role of CF on different education outcome variables such as total expenditure on education and days of school attended.

Our study contributes to the literature in several ways. First, we provide novel empirical insights on the implications of CF on children's education. Education is an important human capital with transformative capabilities for children (United Nations 2015). Investments in human capital such as education have been shown to be important for sustainable development (Kruss et al. 2015; Osuntuyi and Lean 2023). This is further confirmed by international development agendas such as the United Nations Sustainable Development Goals (SDGs) which highlight education as an important goal in its own right (SDG 4) but also instrumental in the attainment of other goals. Understanding how CF influences education is therefore important not just for the institution of CF but also for broader sustainable development initiatives in developing countries. On a broader note, we add to the thin literature on the social implications of CF arrangements in developing countries. Understanding such social implications is important for the design and promotion of CF schemes in developing countries.

To better capture education, we look at the days of school attended and investments in children's education in terms of books, school, and examination fees. Previous studies on children's education have mostly focused on enrollment rates (Acemoglu 2001; Drajeaa and O'Sullivan 2014).[1] However, enrollment rates may not fully capture the educational status of a child. For example, these studies often use binary measures to assess if a child is enrolled in a school or not. Meanwhile, children may be enrolled but constantly miss school days, which may affect their learning. Therefore, it is important to look at other measures that go beyond enrollment and capture children's active participation in school. Additionally, a child can still be enrolled but with little investments in terms of books, school, and examination fees, which are also important for learning. Hence, we look at expenditure, which shows how much a household invests in children's education. A few other studies have looked at such measures (Tabe-Ojong and Molua 2024; Chrisendo et al. 2022), although they focus on oil palm production.

Second, we look at CF arrangements in staple crops. While there is a large body of extant literature on CF, it has mostly focused on high-value crops such as sugarcane (Wendimu et al. 2017), vegetables and fruits (Chege et al. 2015; Dedehouanou et al. 2013), and oil palm (Ruml et al. 2022). However, CF arrangements in such crops have been shown to promote inequality, as mostly wealthier farmers are able to access such contracts. Staple crops, on their part, may have broader impacts given that most farmers can access such contracts (Meemken and Bellemare 2020). Therefore, looking at CF arrangements in staple crops may have far-reaching implications for children, who may play an active role in the production of such crops through the provision of labor.

The remainder of the paper is structured as follows. In section two, we provide a conceptual framework guiding the study. In section three, we present the study context while the materials and methods are presented in section four. We present and discuss the results in section five, while section six concludes and offers some policy perspectives.

2 | Conceptual Framework

Development is the broad goal of every society. Earlier conceptions of development focused narrowly on income, economic growth, and related indicators. Overtime, however, it has evolved to incorporate broader indicators such as education, health, and even the environment. This is reflected in broader development agendas such as the sustainable development goals (SDGs) where only one goal focuses exclusively on an income-related measure like poverty (SDG1). The other goals focus on aspects like education (SDG4), gender equality (SDG5), and good health and wellbeing (SDG3), which underline the social and human dimensions. Moreover, the SDGs also consider intergenerational justice through the integration of environmental indicators (e.g., SDGs 13, 14, and 15). Thus, development also involves meeting the needs of the present without compromising the future. As highlighted in the human capital development theory, education is paramount for equipping individuals with the training and skills necessary for ensuring more equitable development (Brewer et al. 2010). In this regard, investing in children's education is crucial not only for development but also social sustainability as education expands capabilities, reduces inequalities, and promotes long-term resilience. To reconcile these multiple objectives, broader sustainability frameworks such as the triple bottom line (TBL) approach also suggest that programs or institutional arrangements should be assessed across economic, environmental, and social dimensions (Nica et al. 2025; Burdon and Jiasui 2021).

How such development is achieved depends on several factors such as institutional arrangements, social, and economic structures. In agrarian societies, agriculture plays a pivotal

role in shaping livelihoods, income security, and well-being. Improving agriculture is thus central and could include reducing farmers' constraints and integrating them into markets where they do not just earn but also improve their income. One way of doing this is through CF arrangements, which have been shown to integrate farmers into modern value chains and reduce market risks (Barrett et al. 2012; Ton et al. 2018). However, to better understand the broader implications of CF for sustainable development, there is a need to view it from a sustainability framework. Among others, the TBL approach provides an interesting sustainability evaluation framework (Burdon and Jiasui 2021). Built on the work of John Elkington, this approach suggests that a program or policy has three dimensions: economic, social, and environmental. Though distinct, these dimensions can sometimes be interlinked (Svensson et al. 2018). While this framework has been widely employed in the corporate world, it could also be used in agriculture (Nica et al. 2025; Burdon and Jiasui 2021). Applying this framework in the case of CF, the economic dimensions would involve the income benefits to farmers and firms while the environmental dimensions would involve how it affects the adoption of sustainable farming practices, which have already been studied so far (Abman and Lundberg 2024; Dubbert et al. 2023). The social dimensions would include how CF arrangements affect labor allocation, inequality, and education of children. Here, we study children's education as a social dimension.

In this study where we aim to analyze the links between CF and children's education, we draw on the agricultural household model (AHM) of Singh et al. (1986). Studies by De Janvry and Sadoulet (2006) have shown that this model is appropriate for rural settings characterized by imperfect or completely absent credit, labor, and insurance markets. The model has equally been widely used to understand how household production decisions are linked to consumption decisions, especially among smallholder farming households in rural settings (Key et al. 2000; De Janvry and Sadoulet 2020). In settings like those in many African countries, Singh et al. (1986) have shown that household farm production and consumption decisions are nonseparable. Hence, children's education and farming decisions cannot be analyzed independently. Building on the AHM, we argue that participation in CF may alter household production decisions and thus influence children's educational outcomes through two potential pathways.

The first is through changes in household labor demands. CF arrangements may increase the household's labor demands. In Kenya, for example, Chege et al. (2015) showed that vegetable farmers under supermarket contracts had to clean and bundle the vegetables before supplying the supermarkets. This could increase labour needs as outside the contract schemes, such cleaning and bundling was not always necessary. The inclusion of such bundling and packaging activities could therefore increase labor demand for farmers under contract. With imperfect labor markets, household labor becomes crucial in most agricultural households. Given that children are an essential source of household labor, such labor demands may imply that children need to contribute more work hours to farm-related activities. Consequently, this may influence their school attendance by increasing the number of school days missed or reducing the number of days of school attended. Also, an increase in farm labor demands may imply an increase in the marginal productivity of labor, which may raise the opportunity cost of children's time spent in school. This may cause households to reallocate children's time from school to the farm.

On the other hand, CF may reduce household labor demands. Studying both production and marketing contracts in Ghana, Ruml and Qaim (2021a) show that both types of contracts reduced household labor demands through the adoption of labor-saving procedures and technologies. Specifically, both CF types reduced child labor needs. For instance, contracting households could directly sell palm bunches to contracting companies saving the labor needed for picking and processing the palm nuts. Given the role of household labor in many farming activities, such reduction may also permit children to have more time to attend school and may thus reduce the number of school days missed. However, Ruml and Qaim (2021a) further noted that some parts of the freed labor that ensued were reallocated to off-farm employment activities. To the extent that children engage in such off-farm employments, it may shape their education through the number of days of school missed. It should also be noted that they focus on CF arrangements in oil palm, which is a commercial crop and may require little child labor. Conversely, CF arrangements in staple crops such as maize, which is the crop studied here, may warrant considerable children's labor time on activities such as land preparation, planting, weeding, harvesting, manual threshing, and may thus have serious implications for children's educational outcomes like school days attended.

A second potential way through which CF may influence children's education is through income. Income has been shown to be a binding constraint on children's education (De Janvry et al. 2006). Lack of income by a household implies that such a household may not be able to enroll children in school due to lack of school or examination fees (Drajeaa and O'Sullivan 2014). Beyond such, lack of income or an income shock may cause a household to withdraw children from school to engage in income-generating activities. Hence, reducing such income constraints may play an important role in improving children's educational outcomes. In the absence of credit markets, participation in CF may increase income and relax such income constraints. A large body of literature has reported positive income effects of CF (Andersson et al. 2015; Arouna et al. 2021; Rao and Qaim 2011). With increased income, households can increasingly enroll their children in schools and adequately invest in their education by expending on school, examination, and registration fees.

However, increased income through CF may not directly imply investments in education as it may depend on who within the household controls the income. For instance, it has been shown that women's income is more likely to be invested in children (Hoddinott and Haddad 1995; Quisumbing et al. 2023). This suggests that if women control the income from CF, it may lead to better investments in children's education. It also indicates that an increase in income may not generally translate to improved educational outcomes (Quisumbing et al. 2023). Moreover, it is possible that some CF arrangements do not increase a household's income (Ragasa et al. 2018). This is especially crucial

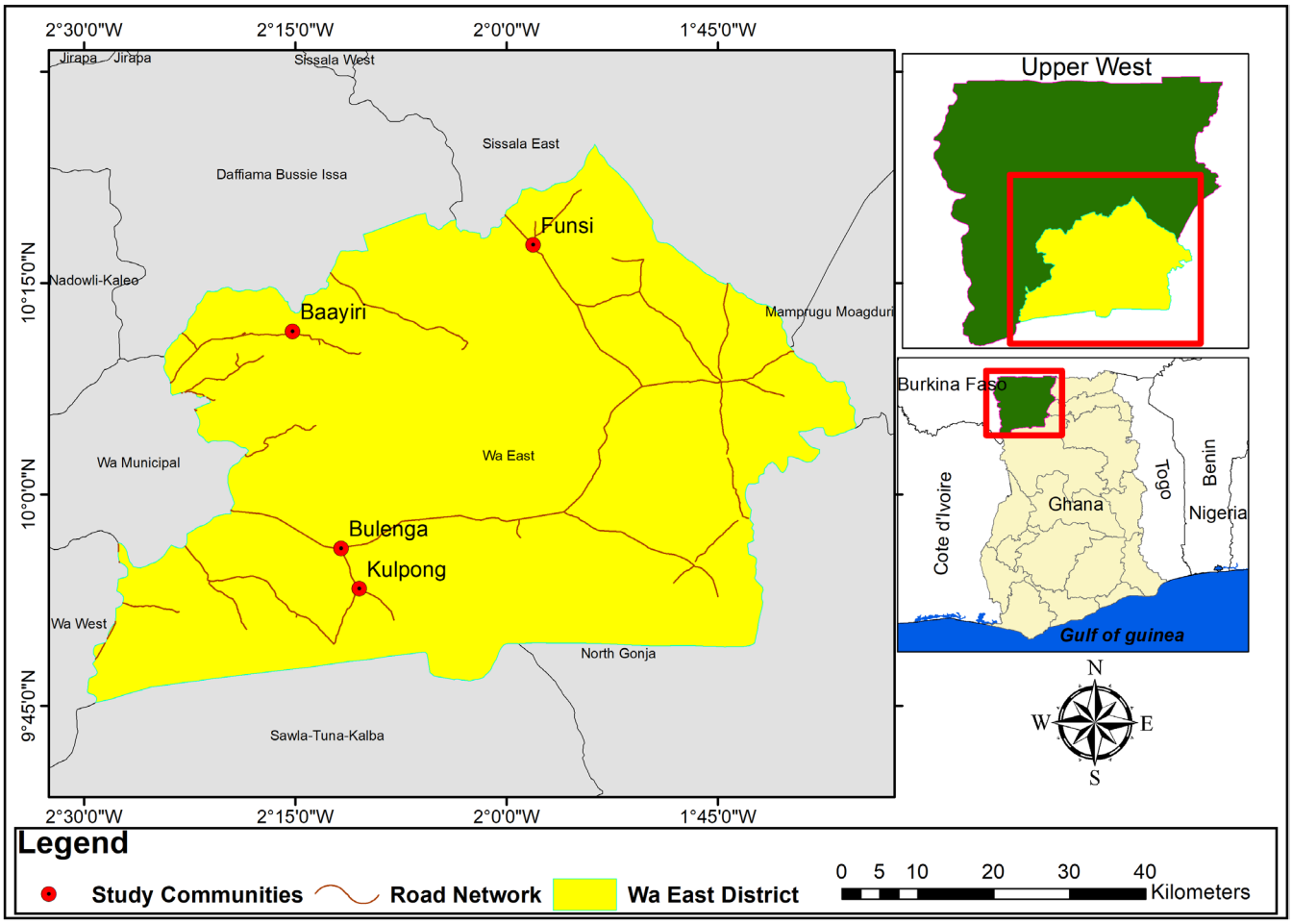

FIGURE 1 | Study area. *Source:* http://ghemms.cersgis.org/media/media/pdf/Wa_East.pdf.

in our case as we study staple crop contracts which in some cases have been shown to reduce household income and profits (Ragasa et al. 2018). In such situations, a reduction in income would imply that households have limited income to invest in children's education and may also force children to engage in other income-generating activities which may influence their school attendance.

The contrast in the literature implies that the theoretical relationship between CF and children's education is ambiguous a priori. The outcome depends on which of the potential mechanisms is likely to prevail as well as the interaction of the two mechanisms. For instance, if CF raises income while reducing labor demand, it may lead to positive educational outcomes. However, if it reduces income but raises labor demand, it may rather have negative educational outcomes. This theoretical ambiguity suggests that the relationship between CF and education may be context-specific and thus warrants an empirical investigation. Also, these mechanisms may play out differently depending on the type of contract (Ruml et al. 2022; Soullier and Moustier 2018). Due to data limitations, we cannot split the analysis by contract types.

Based on these insights from the AHM, we hypothesize that CF is associated with children's education proxied by days of school attended and school expenditure. We test these associations in this study. While we have presented potential income and labor channels, we do not test them empirically due to data limitations. Hence, they remain speculative.

3 | Study Context

Our study area is the Wa East district, located in the Upper West Region of Ghana. Wa East District is situated in the Northeastern part of the Upper West Region. It shares boundaries with several administrative units: Nadowli-Kaleo District to the North, Wa Metropolis and Wa West to the South, Sissala East and West to the East, and an international border with Burkina Faso to the West. The district capital, Funsi, functions as the administrative and economic hub, with other notable settlements including Bulenga, Kundugu, Loggu, Yala, Guli, and Zowayeli. Figure 1 shows the map of the study area.

Educational development in the Wa East District faces numerous challenges. In many communities, school dropout rates are high due to a combination of economic hardship, cultural factors, and inadequate educational infrastructure (Ghana Statistical Service 2021; Ghana Education Service 2020). One significant barrier to sustained school attendance is the reliance on child labor in agriculture. During peak farming seasons, children are often pulled from school to assist in planting, weeding, and harvesting. Additionally, seasonal migration, which is common in rural Northern Ghana, further disrupts children's education

as families move in search of better livelihood opportunities (Whitehead et al. 2007).

The area provides a compelling setting for analyzing rural agricultural dynamics and their broader socio-economic implications. Predominantly rural, the district relies heavily on agriculture as the principal livelihood activity for the majority of households (Ghana Statistical Service 2021). Among the various agricultural commodities cultivated in the area, maize stands out as the primary crop, contributing significantly to both household food security and income generation (Ministry of Food and Agriculture 2020).

In recent years, CF has gained traction in Wa East as a means of integrating smallholder farmers into formal agribusiness value chains. These arrangements typically allow farmers to receive production inputs such as improved seeds and fertilizers from agribusiness firms or larger aggregators in return for committing to sell their harvests at prenegotiated prices or simply supply agricultural produce equivalent to the value of the inputs received. Depending on the specific type of arrangements, farmers are either obliged to sell all their produce to the contracting firm or choose to sell only a portion (Ragasa et al. 2018). According to Ragasa et al. (2018), contracting firms are the only means through which farmers can access modern inputs and CF firms use it as a means to sell their input brands. Farmers can easily engage in such schemes so long as they are into maize farming. Some aggregators also allow farmers to repay using other farm produce. Hence, the schemes are more inclusive compared to schemes in high-value crops.

4 | Materials and Methods

4.1 | Farm Household Survey

The data used in this study are obtained from a household survey conducted in the Wa East District between July and September 2024. The study employed a multi-stage sampling strategy. In the first stage, the Wa East district was purposively selected due to the existence of CF arrangements in the area. In the second stage, villages were randomly selected on a probability proportional to size basis. In the final stage, households were also randomly selected on a probability proportional to size basis. This sampling strategy resulted in 445 sampled households. The main instrument was the questionnaire, which was administered by trained enumerators who could speak English and the local language. The questionnaire comprised of several modules such as household demographics, food consumption, agricultural production, engagement in CF schemes, and educational outcomes for children of school-going age.

To be as inclusive as possible, we set out to collect information largely on children of basic and secondary school-going age by considering children from 2 to 17 years. However, most of the children who were enrolled in school were from 5 to 17 years of age, mostly primary and junior high school level. Hence, our analysis focuses only on 341 households who had children who were actually enrolled in school and were between 5 and 17 years of age. We focus on this age range because it mostly consists of primary and junior high school children who have a fixed 5-day schooling week. This allows for direct comparison of schooling days between the children. Children of higher ages are mostly enrolled in tertiary schools like universities which are found in the urban areas, hence, they were not considered as part of the sample. Since we had complete educational information of at least one child per household, we only keep one child per household for the empirical analysis.

4.2 | Measurement of Key Variables

4.2.1 | CF Participation

Our main variable of interest is CF participation, which is measured at the household level. We measured CF as a dummy variable which takes a value of 1 if any household member was involved in any CF arrangement over the last 1 year and zero otherwise. This is in line with other studies (Ndip and Sakurai 2024, 2025). In most cases, only one person, the household head, was involved in CF. As highlighted in the conceptual framework, we could not capture the particular type of CF arrangement (whether it was a production or marketing contract). This was partly because it was difficult to make a clear distinction since some of the features of both types of contracts overlap. Most CF arrangements in the area provided both input and cash to farmers.

4.2.2 | Educational Outcomes

The main outcome variable is children's education. We use two variables to capture children's education. The first is the number of days of school attended, which is the count of the number of days the child was present in school during the third term, which ranges from April to July. We focus on this term because it coincides with the main farming period, allowing us to capture the days of school missed that may have resulted from farming activities. The number of school days attended is a proxy for educational commitment and is positively associated with academic achievement (Morrissey et al. 2014). This measure allows us to gauge how frequently a child is in school, which may influence their learning outcomes. An increase in the days of school attended may point to better educational status. Previous studies have also used such measures (Chrisendo et al. 2022; Tabe-Ojong and Molua 2024). Second, we look at total school expenditure, which is the amount of money spent on books, examinations, school fees, and feeding fees. This allows us to gauge to what extent households are investing in children's education. Such investments are crucial for children's learning and future outcomes. It should be noted that we collected the data just at the end of the academic year, hence households may not provide very accurate information on days of school attended. However, this would be the same for both contract and non-contract households and thus evens out.

4.3 | Empirical Approach

We are interested in estimating the relationship between CF and children's education. To do this, we estimate models of the form:

$$\boldsymbol{E}_{ci} = \beta_0 + \beta_1 C_i + \alpha_i \boldsymbol{X}_i + \varepsilon_i \quad (1)$$

where c indexes a child and i indexes a household. $\boldsymbol{E}$ is the vector of educational outcomes, which includes days of school attended and total school expenditure. C is the CF status of a household, $\boldsymbol{X}$ is a vector of household factors that may also influence educational outcomes such as the age, educational level, marital status of the household head, access to road and nearness to an urban center. β_0, β_1, and α_i are the parameters to be estimated with β_1 being the parameter of interest as it gives the association between CF and educational outcomes. ϵ_i is the error term. We estimate Equation (1) with the ordinary least squares (OLS) estimator with standard errors clustered at the village level to cater to inter-household correlations. We interpret all our estimates as associations since the OLS estimates from Equation (1) are likely biased and cannot pass as causal effects owing to the endogeneity of participation in CF (Barrett et al. 2012; Bellemare 2012; Ndip and Sakurai 2024, 2025).

Such endogeneity may arise from three main sources: omitted variables, measurement error, and simultaneity (Wooldridge 2010). However, measurement error may not be a main source of endogeneity in this case as farmers are less likely to misreport their involvement in CF, talk less of such misreporting being systematic. Omitted variables may be a potential source of endogeneity. It is possible that unobserved factors such as farmers' motivation, entrepreneurial nature, care, and forward-looking nature simultaneously affect farmers' decision to participate in CF and children's education. For example, highly motivated and entrepreneurial farmers may be willing to invest more in their children's education owing to the benefits associated with such education. At the same time, such farmers are more likely to engage in CF to boost their incomes. However, both motivation and the forward-looking nature of farmers are difficult to measure and more practically, we fail to capture them in our dataset. Failure to control for them may lead to omitted variable bias issues. Simultaneity may also constitute a source of endogeneity. That is, more educated children may encourage their parents to engage in CF owing to their benefits and at the same time households that engage in CF are likely to have more educated children. Since we do not address such endogeneity issues, the OLS estimates are biased and thus we interpret all our estimates as associations instead of causal effects.

4.4 | Robustness Checks

We employ several approaches to assess the robustness of our findings. First, we employ the instrumental variable two stage least squares (IV-2SLS) regression (Bellemare 2012; Wooldridge 2010) in an attempt to address potential endogeneity issues. To estimate an IV-2SLS regression, there is a need for an instrument. A valid instrument must be relevant and exogenous (Wooldridge 2010). Relevance implies that it is strongly partially correlated with the endogenous variable, in this case CF participation. Exogeneity implies that it affects the outcome only through CF participation. This is also known as the exclusion restriction assumption.

We use the proportion of CF participants at the village level, excluding the household of interest, as our instrument. A farmer may decide to participate in a CF scheme if there are other participating farmers around him. This is informed by the social networks literature, which shows that farmers adopt technologies based on their peers' adoption (Magnan et al. 2015). Several studies have employed such instruments (Aihounton and Christiaensen 2024; Tabe-Ojong et al. 2022). Besides this theoretical insight on the choice of instrument, we also perform other tests to confirm the relevance of our instrument. First, our instrument is relevant as it is highly correlated with the endogenous variable in the first stage regression (Table A1 in the appendix). Additionally, the F-statistic is greater than 10. An F-statistic above 10 is usually regarded as a test for the relevance of an instrument. We also perform a falsification test based on Di Falco et al. (2011), where we regress the outcomes on the instrument and other control variables on the sub-sample of non-contract farmers. As expected, the coefficient of the instrument is not statistically significant, suggesting that the instrument is plausibly exogenous (Table A2). This suggests that the instrument indeed operates only through CF participation. However, we acknowledge that the instrument may be highly correlated with other village-level characteristics such as access to roads, which may also jointly affect education and participation in CF. Barrett et al. (2012) show that CF schemes are usually located in areas with access to road and such areas are likely to have better schools and may thus affect children's educational outcomes. While we control for a household's access to roads and nearness to urban centers in the regressions, there are other important infrastructural and institutional characteristics that may influence both CF and children's education but are not captured by the instrument. Hence, we do not fully address all potential endogeneity issues with the IV-2SLS strategy. To this end, we strictly interpret all the estimates as associations and not causal, and we use the IV-2SLS strategy to confirm the OLS estimates and test the stability of the relationship between CF and education. Second, we employ the heteroskedasticity-based estimator by Lewbel (Lewbel 2012). This estimator uses internally generated instruments to control for potential endogeneity (Lewbel 2012). Last, we employ methods by Oster (2019) and Diegert et al. (2023) to estimate a bias-adjusted estimate and test for the extent to which unobserved factors may drive our results, respectively.

5 | Results

5.1 | Description of Sample

The sample characteristics are presented in Table 1. Starting with the outcome variable, on average households expend 439 cedis on children's education per school year. To put this into perspective, this is less than average expenditure on education in Ghana (Addai 2022). Children spend over 68 days in school during the third term. For the treatment variable, over 44% of the sampled households engage in CF. As expected, over 60% of the household heads are males who are on average 40 years old. Despite being young, they have an extremely low educational level of about two years. This implies that most of the farmers may not be literate. As expected, over 95% of the farmers are married. The household sizes are also relatively large with an average of over six people. Such household sizes are important sources of farm labor. Over 50% of the sampled households also

TABLE 1 | Sample characteristics.

Variables	*N*	Mean	SD
Outcomes			
Total school expenditure (cedis)	341	439.352	588.617
Days of school attended (number)	341	68.613	18.628
Variable of interest			
Contract farming (1/0)	341	0.443	0.497
Controls			
Gender HH (male = 1)	341	0.595	0.492
Age HH (years)	341	40.78	10.481
Marital status (1/0)	341	0.95	0.218
Educational level (years)	341	2.279	3.823
Household size	341	6.018	2.73
Extension access (1/0)	341	0.493	0.501
Off-farm employment (1/0)	341	0.683	0.466
Asset value (0000 cedis)	341	1345.62	13,953.64
Road access (1/0)	341	0.795	0.404
Distance to urban center (km)	341	9.085	1.771
Proportion of CF in a village (IV)	341	0.443	0.455

Abbreviation: HH, household head.

TABLE 2 | Mean comparisons.

Variables	Contract (151)	Noncontract (190)	*p*
Total school expenditure	386.42 (591.36)	481.42 (584.56)	0.14
Days of school attended	66.59 (17.80)	70.22 (19.16)	0.074
Gender HH	92 (60.9%)	111 (58.4%)	0.64
Age HH	40.55 (10.40)	40.96 (10.57)	0.72
Marital status	144 (95.4%)	180 (94.7%)	0.79
Educational level	2.49 (3.93)	2.11 (3.74)	0.36
Household size	6.61 (2.74)	5.55 (2.63)	< 0.001
Extension access	81 (53.6%)	87 (45.8%)	0.15
Off-farm employment	102 (67.5%)	131 (68.9%)	0.78
Asset value	1967.69 (20211.53)	851.24 (5049.31)	0.46
Road access	147 (97.4%)	124 (65.3%)	< 0.001
Distance to urban center	7.82 (1.99)	10.09 (0.47)	< 0.001

have access to agricultural extension services. Besides farming, households also engage in off-farm activities as over 68% of the sampled households report engaging in off-farm activities. Engaging in both on-farm and off-farm activities may have helped households accumulate assets as the average asset holding is over 13 million cedis. The majority of the households, over 79%, also report that they have access to the main road. Access to the main road may suggest that some of the communities are quite developed and this may be important for access to education. Additionally, it has been shown that contracting firms strategically locate themselves around areas with good road access. Accordingly, the average distance from the communities to an urban area is only 9 km, which implies that they are very close to urban areas. Closeness to urban areas may also be important for children's access to education. At the village level, over 44% of households are engaged in CF.

5.2 | Mean Comparisons

In Table 2, we compare the means of the variables for contract and non-contract farmers. Starting with school expenditure, non-contract farmers tend to spend more on children's education compared to contract farmers. However, the difference is not statistically significant as indicated by the *p*-value in the last column. Children in non-CF households spend more time in school compared to those in CF households. These results provide suggestive evidence that CF may not lead to improvements in children's education. However, such conclusions may be misleading given that both observed and unobserved factors may influence such outcomes. It is, therefore, important to control for such factors in a regression set-up, which we do in the next section.

5.3 | Econometric Results

Table 3 shows the OLS estimates of CF on children's education. It is worth re-iterating that these estimates are conditional associations and not causal effects. The results suggest that CF is negatively associated with children's education. Starting with total school expenditure, the results suggest that participation in CF is associated with 245 cedis less expenditure on schooling. This represents a 56% less expenditure relative to the mean value. That is, households that participate in CF tend to spend less on children's education. It is important re-emphasizing that expenditure involves aspects such as books, unifrom, examination fee, feeding, and registration fee. It is possible that households do not invest very much in children's education. The household may simply enroll children in school with little attention on their learning materials, examination, feeding, and registration fees. Given that such expenditures may be regarded as a luxury that warrants additional income from households, we turn to another indicator of education, which may not require income.

TABLE 3 | OLS estimates of contract farming on children's education.

Variables	(1) Total school expenditure	(2) Days of school attended
Contract farming (1/0)	−245.419**	−11.738***
	(108.700)	(2.393)
Male head (1/0)	−110.164*	1.03
	(60.639)	(1.763)
Age (years)	1.119	−0.072
	(3.395)	(0.095)
Educational level (years)	219.855***	−0.967
	(84.602)	(4.083)
Marital status (1/0)	13.098	−0.126
	(8.260)	(0.285)
Household size	24.449	0.593
	(22.482)	(0.420)
Extension access (1/0)	−55.43	−9.041***
	(80.899)	(2.411)
Off farm employment (1/0)	190.201**	5.752***
	(73.440)	(2.081)
Asset value (0000 cedis)	0	0
	(0.001)	0.000
Road access (1/0)	89.586	10.155***
	(105.499)	(3.127)
Distance to urban center (km)	−33.769	−1.613**
	(20.998)	(0.628)
Constant	361.563	83.736***
	(312.457)	(9.628)
Observations	341	341

Note: Robust standard errors in parentheses clustered at village level.
*$p < 0.1$.
**$p < 0.05$.
***$p < 0.01$.

Turning to the days of school attended as another indicator of education, the results show that participation in CF is negatively associated with days of school attended. Specifically, it is associated with 11 less days of school attended, 17% less days relative to the mean value. As explained in the conceptual framework, CF may have plausibly increased a household's labor demands necessitating children to contribute to on-farm work, hence reducing the days spent in school. Taken together, the results show that CF is conditionally negatively associated with investment in children's education.

5.4 | Discussion

We have assessed the implications of CF on children's education where we find consistent conditional negative associations between CF and education; expenditure on schooling and days of school attended. This study provides the first evidence on the links between CF and education. These findings contribute broadly to a growing but a mixed empirical literature on the implications of CF. While some studies report welfare gains especially in terms of income, others reported no effects or negative effects, depending on the crop-type or context. For instance, Wendimu et al. (2016) showed that sugarcane contract schemes reduced farmers income while Soullier and Moustier (2018) also show that rice marketing contracts had no income effects. Our findings align with this strand of literature, suggesting that CF does not always have positive effects. This finding also supports Burdon and Jiasui (2021)'s work on the need for more integrated evaluations such as the TBL in assessing the implications of policies or programs.

Based on the AHM of Singh et al. (1986) which emphasizes non-separability, we interpret these findings through the joint determination of farming and schooling decisions due to credit and labor market imperfections, which are rife in rural settings. The AHM emphasizes that in the presence of market imperfections, children's education is shaped by income and labor changes. These two conditions are simultaneously influenced by a household's participation in CF arrangements.

Although CF may increase income, it is not always the case. In contexts where CF does not increase income, as shown in cross-country evidence where welfare impacts are mixed (Meemken and Bellemare 2020; Narayanan 2025), households may face tighter liquidity constraints. Strands in labor economic theories suggest that income shortfalls and binding credit constraints push children into work and reduce schooling (Bhalotra and Heady 2003; Edmonds and Theoharides 2021). In such cases, children may reallocate their labor toward income-generating activities, reducing their school attendance. Our finding of reduced educational expenditure among participating households is consistent with this potential mechanism. Although we cannot directly test this mechanism owing to data limitations, existing evidence suggests that CF, especially in a staple crop like the one we study here, can indeed reduce income and net-farm returns (Ragasa et al. 2018), making this pathway plausible.

CF may also influence children's education through labor changes either by increasing or reducing household labor needs. With imperfect labor markets and given that children constitute an important source of household labor, an increase in labor needs owing to CF may increase children's labor demands, increasing their farmwork time, and thus keeping them away from school. Our finding of reduced days of school attended is also consistent with this potential mechanism, although we cannot test it empirically due to data limitations.

Importantly, these findings highlight that the income and labor channels interact and are not mutually exclusive, consistent with the non-separability emphasized in the AHM. Negative educational implications may arise not only when labor demand increases but also when income declines, even if farm labor requirements fall. Evidence shows that when

households experience income shortfalls or face liquidity constraints, they often reallocate children's time toward income-generating activities including off-farm work to stabilize consumption (Edmonds and Theoharides 2021; Bhalotra and Heady 2003). Similarly, reductions in farm labor demand under CF may free labor that households subsequently shift to off-farm employment (Ruml and Qaim 2021a). Thus, reduced school attendance does not necessarily stem from labor demands alone; it can also reflect broader income pressures, particularly when CF does not deliver income gains. This underscores the joint influence of income and labor pathways on children's schooling outcomes.

Our study adds nuance to the literature by showing that CF can lead to reduced human capital investment even when promoted as a pathway to rural development. Previous studies have mostly focused on income and productivity effects, neglecting such human capital implications. By explicitly linking CF to children's education within a non-separability framework, we provide insights on a neglected dimension and potential trade-offs that may exist between institutional arrangements aimed at making agriculture more commercial and human capital formation.

The results also suggest that it is important to look at institutional arrangements such as CF from a sustainability lens, considering their economic, environmental, and social benefits. While they may be beneficial in an economic and environmental sense, they may have unintended social consequences. For instance, based on the TBL, these findings suggest that CF in our context is not socially sustainable as it is negatively associated with children's education and thus does not contribute to human capital development. These negative associations with education could also imply that children may become worse-off in the future, given that the human capital theory suggests that investments in children in the form of education could improve their future outcomes. In this regard, CF does not improve human capital investments in children in our context and could thus hurt sustainable development, which has education as one of its pillars.

Overall, our findings underscore that CF is not always welfare enhancing. Its implications, especially on children's education, depend on how it shapes income and labor under imperfect market conditions where household decisions are non-separable. By analyzing the institution through the AHM, the study shows how CF as an institutional arrangement may reduce rather than promote human capital formation.

5.5 | Robustness Check Results

We employed several empirical techniques to assert the robustness of our results. The first is the IV-2SLS. The results, which are presented in Table 4 also show a negative association between CF and children's education, similar to what we find with the OLS estimator. The second robustness check is based on the heteroscedasticity-based estimator of Lewbel (2012). The results of the Lewbel estimator are presented in Table 5. The results confirm that CF is negatively associated with expenditure on education and the number of school days attended, also similar to the OLS results. These provide suggestive evidence that our results are robust.

TABLE 4 | IV-2SLS estimates of contract farming on children's education.

	(1)	(2)
Variables	**Total school expenditure**	**Days of school attended**
Contract farming (1/0)	−190.888**	−9.415***
	(95.316)	(2.778)
Male head (1/0)	−108.118*	1.117
	(59.276)	(1.725)
Age (years)	1.259	−0.066
	(3.318)	(0.093)
Educational level (years)	223.294***	−0.821
	(83.362)	(4.023)
Marital status (1/0)	12.771	−0.139
	(8.200)	(0.280)
Household size	22.699	0.518
	(20.816)	(0.426)
Extension access (1/0)	−56.002	−9.065***
	(79.543)	(2.382)
Off farm employment (1/0)	189.876***	5.738***
	(72.404)	(2.039)
Asset value (0000 cedis)	0	0
	(0.001)	0.000
Road access (1/0)	68.493	9.256***
	(102.123)	(3.100)
Distance to urban center (km)	−25.302	−1.252**
	(19.657)	(0.635)
Constant	279.203	80.226***
	(311.420)	(9.454)
IV diagnostics		
Kleibergen–Paap LM statistic	168.868***	168.868***
Cragg–Donald stat	918.294	918.294
F-stat	300.92***	300.92***
Observations	341	341

Note: Robust standard errors in parentheses clustered at village level.
*$p < 0.1$.
**$p < 0.05$.
***$p < 0.01$.

As further robustness checks, we employ the techniques by Oster (2019) to estimate a bias-adjusted coefficient (beta) under equal selection. That is, assuming that observed and unobserved factors have an equal effect on selection into CF. To test the

extent to which unobserved factors drive our results, we employ the technique by Diegert et al. (2023). This allows for the calculation of a breakdown point, the point at which unobserved factors may overturn a baseline result. The higher the breakdown point, the lower the likelihood that the results are driven by unobserved factors. All these results are presented in Table 6. The bias-adjusted estimate, although very large, suggests that even after correcting for bias, CF is still negatively associated with expenditure on education and number of school days attended. The breakdown points are also relatively high, suggesting that our results are less likely to be driven by unobserved factors. These further suggest that our results are robust.

TABLE 5 | Lewbel estimates of contract framing on children's education.

	(1)	(2)
Variables	**Total school expenditure**	**Days of school attended**
Contract farming	−281.391*	−17.077***
	(160.947)	(3.507)
Gender HH	−111.513*	0.830
	(61.272)	(1.793)
Age HH	1.026	−0.086
	(3.479)	(0.095)
Marital status	217.586**	−1.304
	(86.599)	(4.092)
Educational level	13.314	−0.094
	(8.202)	(0.288)
Household size	25.603	0.764**
	(24.227)	(0.380)
Offfarm employment	−55.053	−8.985***
	(81.302)	(2.398)
Extension access	190.416***	5.784***
	(73.395)	(2.104)
Asset value	0.000	0.000
	(0.001)	(0.000)
Road access	103.501	12.220***
	(128.033)	(3.441)
Distance to urban area	−39.354	−2.442***
	(25.855)	(0.866)
Constant	563.956***	76.175***
	(80.009)	(1.684)
Observations	341	341
R^2	0.068	0.124

Note: Robust standard errors in parentheses. We combine internally generated and external instrument as they produce more consistent estimates.
*$p < 0.1$.
**$p < 0.05$.
***$p < 0.01$.

6 | Conclusion and Policy Implications

Education is a human capital investment with profound developmental implications. Additionally, it has transformative potential on children's future outcomes. Its importance cannot be overstated, especially in a developing country's context. Cognizant of this, we study the role of CF on children's education in this paper. While the institution of CF has proliferated in developing countries, evidence of its impacts on children's education is lacking. We employ cross-sectional data from maize producing households in the Wa district of Ghana. We employ different empirical approaches such as the OLS and the IV-2SLS in an attempt to address potential endogeneity issues. Our results suggest that participation in CF is negatively associated with children's education—expenditure on children's education, and the number of school days attended in the area studied.

Our results hold a few policy implications for development policy. First, the broader social implications of CF arrangements should be considered. As we have shown in the context of this study, CF is negatively associated with education. Given the important role of education in reducing poverty and spurring development, reduction in educational investments may perpetuate poverty traps, exacerbating rural poverty, and stifle broader rural development. Understanding the broader social implications of CF also aligns with other studies that have criticized the institution of CF as a tool for exploiting rural labor and land-grabbing in developing countries (Little and Watts 1994; Oya 2012). In some cases, farmers are forced to participate in such schemes with exploitative contract terms (Wendimu et al. 2016). In Ghana, Ruml and Qaim (2021b) also document farmers' dissatisfaction with contract terms. These studies highlight that the broader social implications of CF should be considered to better understand the institution. Also, if these associations reflect the underlying hypothesized mechanisms, then we recommend better contract designs to address some of these issues. For example, contracts that forbid the use of children's labor or ensure that households invest in children's education could be instrumental. Contracting firms could provide premiums to households that do not use child labor or have their children in school. However, the negative associations observed in this study may be context-specific and peculiar for staple crop CF

TABLE 6 | Coefficient stability and unobserved selection.

Outcome	Uncontrolled	R^2	Controlled	R^2	Bias-adjusted estimate	Breakdown point
Total school expenditure	−95.003	0.006	−244.419	0.069	−9114.01	14.1%
Days of school attended	−3.632	0.009	−11.738	0.134	−159.69	21.5%

Note: bias-adjusted estimates are compared to OLS estimates based on the methodology by Oster (2019).

arrangements. Perhaps CF arrangements that boost income may also lead to better educational outcomes. Unfortunately, we do not have other case studies where CF has increased income and what the implications are for education.

Our study also has some limitations. First, we fail to do a gender-disaggregated analysis. It is possible that CF may have different educational implications for boys and girls. Gender discrimination is common in developing countries (Quisumbing et al. 2022). It is also well-known that there are gender differences in education. Thus, it would have been interesting to see such implications. However, our data limits us from doing such analysis. Future studies could shed further light on the education implications of CF by doing a gender-disaggregated analysis. Second, is internal validity issues due to the use of cross-sectional data. Cross-sectional data does not allow us to credibly estimate the causal effects of CF. Hence, we interpret our estimates as conditional associations. Ideally, randomized control trials (RCTs) would produce estimates that are more credible. Future studies can therefore implement RCTs to credibly test the effects of CF on education. While this may be a daunting task due to institutional issues especially from contracting firms, it is not impossible. Arouna et al. (2021) employ an RCT to test the effects of CF on various farm outcomes, suggesting that it is possible. Alternatively, future studies can also leverage panel data to improve causal identification. Third, we fail to empirically explore all hypothesized mechanisms. Future studies can therefore shed light on other mechanisms through which CF may affect education. Finally, we are concerned about the external validity of our findings since we focus only on staple crop contracts in a small area in Ghana. It is not clear if such findings would be obtained in other areas. The results may only be applicable in the given context. Moreover, it has been shown that CF arrangements in staple and nonstaple crops may provide different results. Studies that consider broader areas may be instructive for more nuanced conclusions. Additionally, it is not clear if the effects remain the same over time. Other studies with panel data may provide more insights on the effects of CF on education over a longer time horizon. These limitations notwithstanding, our study has provided some evidence of how CF influences education, highlighting negative associations in the context of the study.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

These data are available upon request.

Endnotes

[1] Other relevant indicators for education are test scores and long-term earnings. However, it is difficult to get these indicators in household surveys especially in a rural context. Hence, the use of days of school attended and school expenditure is justified in a rural context.

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Appendix A

TABLE A1 | First stage instrumental variable results.

Variables	Contract farming
Proportion of contract farmers in the village (IV)	0.854***
	(0.049)
F-stat	300.92***
Controls	Yes
Observations	341

Note: Robust standard errors in parentheses clustered at village level. Controls include: gender, age, marital status, educational level of household head, engagement in off-farm employment, household size, asset value, road access, distance to urban center.
***$p < 0.01$.

TABLE A2 | Falsification test.

	(1)	(2)
Variables	**Total school expenditure**	**Days of school attended**
Proportion of CF in the village (instrument)	699.516	7.582
	(487.110)	(4.855)
Gender HH	−102.024	2.592
	(91.536)	(2.153)
Age HH	−0.138	0.056
	(4.293)	(0.123)
Marital status	287.864***	−3.404
	(85.103)	(4.173)
Educational level	17.172	−0.325
	(10.704)	(0.430)
Household size	16.541	0.298
	(23.828)	(0.807)
Off farm employment	−25.787	−14.758***
	(90.702)	(3.243)
Extension access	334.926***	3.933
	(99.073)	(3.267)
Asset value	−0.001	−0.000
	(0.003)	(0.000)
Road access	173.480	9.256***
	(131.187)	(2.847)
Distance to urban center	−494.372**	0.403
	(228.011)	(2.198)
Constant	4834.919**	66.595***
	(2269.434)	(24.836)
Observations	190	190
R^2	0.218	0.212

Note: Robust standard errors in parentheses clustered at village level.
**$p < 0.05$.
***$p < 0.01$.