Accelerating Progress Towards Eradicating Child Labor (SDG8.7) with Quality Education
(SDG4): School Quality is Linked to Reduced Child Cocoa Labor in Côte d'Ivoire

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Abstract

Child labor disrupts education, but there is scant research on the reciprocal relationship: *education disrupting child labor*. We examined the link between school quality and child cocoa agricultural work in a sample of 2168 fifth-grade children from forty-one primary-schools in rural Côte d'Ivoire. Children attending a higher quality school were less likely to work on a cocoa plantation. Specifically, quality infrastructure and teaching materials were associated with reduced cocoa agricultural activities, but not with domestic and economic activities. Against the backdrop of a global focus on improving education quality, we suggest that investments in quality education may serve the dual purpose of reducing child labor alongside improving children's learning outcomes.

Keywords: Child Labor, Côte d'Ivoire, School Quality, SDG4, SDG8

Introduction

In September 2015 (UNDESA, 2015), a bold new agenda was unveiled at the Sustainable Development Summit held at the UN headquarters in New York City. Titled “Transforming Our World: The 2030 Agenda for Sustainable Development”, and adopted by 193 Member States of the United Nations, these 17 transformative Sustainable Development Goals (SDGs) call to end poverty, improve the lives of people, and protect the planet. Amongst these is SDG 8 (decent work and economic growth), with its indicator Target 8.7:

“Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms”.

In specifically measuring the progress of nations towards ending child labor by 2025, the world renewed its commitment to eradicate this global crisis which exposes an estimated 160 million children around the world (ILO, 2020) to physical/mental/moral hazard, sacrifices their future welfare for immediate benefit (e.g. Posso 2017). The increase in child labor worldwide as a result of the COVID-19 pandemic further reinforces the relevance of this commitment to protect and restore children’s childhood and future (e.g. ILO, 2020, ICI, 2020).

The measurement of child labor is internationally bounded by three United Nations conventions around two context-sensitive elements: age and the nature, duration and conditions of productive activities performed by the child (see note 1). Unlike children’s participation in economic activities that develop life-skills and knowledge (e.g. household chores, helping on the family farm, apprenticeships), child labor harms children and interferes with their right to education (see note 2) through *direct channels* such as education loss through decreased school

attendance and *indirect channels* such as negative effects on attitudes to learning and health (Putnick & Bornstein, 2015; Heady 2003; Emerson et al., 2017; Ibrahim et al., 2019). By impeding education, child labor is linked to a vicious downward spiral of persistent poverty: poor households send their children to work, lowering children's years of schooling, and reducing intergenerational school attainment; they become low productivity workers whose future earnings are low, contributing further to intergenerational poverty (e.g. Barro, 1991; Patrinos and Psacharopoulos, 1995; Sen 1999; Emerson and Souza, 2003; Psacharopoulos & Patrinos, 2004; Njong, 2010).

While child labor impedes education, the reverse may also hold true — education may pull children out of child labor. Education is one among the constellation of policy and legislative tools that governments have deployed to disrupt the equilibrium *horribilis* of child labor, low education over generations, and persistent poverty. These tools target expanding school *access* through a variety of channels such as increasing the number of schools (Vuri, 2008), lowering financial barriers with vouchers to reduce school-fees, or reducing socio-cultural barriers to access with girl-friendly schools (Leinberger-Jabari, Parker, and Oberg, 2005; Paruzzolo, 2009; see note 3 for other policy tools). These policies seek to reverse the positive feedback loop between child labor and poverty through a theory of change that improved schooling attainment in the current generation will increase intergenerational income and educational attainment, allowing sustained growth to take-off. However, these efforts have varied in effectiveness. Furthermore, the post-pandemic surge in child labor rates (ILO, 2020), the first in nearly two decades (UNDESA, 2020) illustrates how tenuous gains in child labor reduction have been.

The persistence of this problematic phenomenon suggests the need for novel approaches.

With less than 2 years to achieve Target 8.7, and 2021 (the International Year of Elimination of Child Labor) bringing renewed focus to this issue, we forward that nations need to accelerate legislative and practical actions to eradicate child labor worldwide, in order to reach Target 8.7. The International Labor Organization projects 121 million children will still be enmeshed in child labor by 2025 (ILO, 2017). Our research aims to inform this conversation by understanding how *school quality* (a component of education quality; SDG 4) could be applied as a lever against child labor (SDG 8.7).

If school quality indeed deters child labor, this would represent a value-added outcome to the growing global investments in education quality. While there is much research on how child labor interrupts school attendance and constrains learning outcomes, evidence on schools disrupting child labor is sparse. A recent report from the International Cocoa Initiative (2019) suggests school quality, as measured by a range of indicators (school infrastructure, school-related services, and school management), may reduce child labor. The strongest associations between education quality and child labor pertained to toilet facilities and school canteen programs. Abou (2021) suggests such a link, but acknowledges that research on the connection between education policy and child labor reduction is sparse.

Given that our understanding of the reciprocal relationship between child labor and education is nascent, our school-based study specifically investigates this emerging new lever of school quality in the context of rural cocoa-growing communities of Côte d'Ivoire; one of the fastest growing African economies, with an unsustainable confluence of high rates of youth and adult illiteracy, and high rates of child labor in its key economic sector (nearly a million Ivorian children work in cocoa agriculture), in a young nation (42% of the population 14 years and younger; UNDESA, 2019) in the lowest quintile of the Human Development Index (rank 162 out

of 189 countries and territories; Conceicao, 2020). We focus specifically on children who experience the dual demands of school and labor; a population that represents the majority of children active in the agricultural cocoa industry in Côte d'Ivoire. 38% of children in agricultural households are involved in cocoa production and 80% of children in agricultural households attend school (Sadhu et al., 2020). Understanding the relationship between school quality and child labor in this context will shed light on how to support the development of this population.

Child Cocoa Labor in Côte d'Ivoire

Côte d'Ivoire is the third largest economy of West Africa and has been the world's largest supplier of cocoa since 1977/1978 (AfDB, 2018). Cocoa forms the backbone of the Ivorian economy (Kanga, Moussa & Sanogo, 2019). Known as “brown gold”, this commodity is of extraordinary importance to the national economy (AfDB, 2018) and economic development (IFC, 2020). In 2019, cocoa represented approximately 35% of Côte d'Ivoire's total commodity exports (UNDESA, 2021) and accounted for 74% of total income for the average cocoa-growing household (Fairtrade International, 2018).

Most Ivorian cocoa production is done by approximately one million small household cocoa farmers concentrated in the South and South-West of the country (AfDB, 2018). Children often work on these small family cocoa farms as part of their household's normal economic activity (Nkamleu & Ndoeye, 2003). 78% of children in these agricultural households are economically active (Sadhu et al, 2020). Of the children in cocoa farming regions of Côte d'Ivoire, 80% are enrolled in school — the typical child working in cocoa agriculture manages labor activities alongside attending school. A subset of these children (38% or approximately 791,000 children between the ages of 5-17; Sadhu et al, 2020) are considered child laborers. These children are exposed to a variety of hazards at a critical time in their physical and mental

development (Sadhu et al, 2020) performing activities that fall under the seven categories of child cocoa labor. Some examples of these activities include lifting heavy weights, clearing land, making charcoal, using sharp tools to harvest and break pods, interacting with agricultural chemicals such as fertilizers and pesticides, and working long hours in the sun, or working during school hours. (Sadhu et al, 2020). Based on the total population of children in Côte d'Ivoire (UIS, 2018), this means approximately 1 in 10 children are engaged in child labor in the cocoa sector.

In addition to high rates of child labor, and despite a policy of compulsory education lasting 10 years from ages 6 to 15, Côte d'Ivoire maintains one of the highest levels of youth and adult illiteracy (Jasińska & Guei, 2022; Jasinska, Ball, & Guei, *in press*): an estimated 82% of 10-year-olds in Côte d'Ivoire cannot read and understand simple text by the end of primary school (Azevedo et al, 2021). As of 2014, 47% of 15-24 year olds in Côte d'Ivoire and 56% of adults aged 15+ are estimated to be illiterate, compared to SSA at 24% and 35% respectively (UIS, 2018). This is a problematic combination for sustainable economic development: participation in child labor hinders learning and educational attainment with substantive negative impacts ranging from lower reading and mathematics scores (Lee et al., 2021) to age-grade distortion (Patrinos and Psacharopoulos, 1997) and school dropout (Wortsman et al., *in preparation*).

School Quality Matters for Student Learning

School quality is one aspect of the multi-dimensional concept of education quality (e.g. Cheong Cheng & Min Tam, 1997). Aspects of school quality include the school's infrastructure, the school environment, quality of teaching materials, and human resources (i.e., teachers). Indeed SDG 4A recognizes the importance of adequate physical *infrastructure* (SDG 4A), with

indicators such as access to water, sanitation and hygiene (WASH) and electricity (UNESCO, 2016). There is a broad body of research on adequate physical infrastructure facilitating improvements in student outcomes, and reducing dropout rates, (e.g., Heyneman, 1980; Urwick and Janaidu, 1983; Varghese, 1995; Fuller, 1990; Cash, 1993; Cash 1994; Barrett et al, 2019; Chirgwin et al., 2021, Wortsman et al., *in preparation*). Elements of infrastructure which promote safe, secure, and supportive schools include WASH facilities, building maintenance, and library, furniture, and classrooms that have kept pace with expanding class sizes.

Studies investigating the *school environment* and students' performance in Côte d'Ivoire (characterized by the presence of certain basic services such as the availability of a canteen, the presence of a drinking water point, and class size) support the importance of the role of such elements of physical infrastructure in children's learning (e.g., Aturupane, et al., 2013; Bacolod & Ranjan, 2008; Abou, 2016; Spears, 2012; Spears & Lamba, 2016). The availability and adequacy of facilities including the building, classroom furniture, recreational equipment apparatus, and relevant *instructional materials* has been linked to higher academic achievement (e.g. Moscoviz & Bélanger, 2019). Alongside a school's infrastructure and learning environment, another input is the human resources of a capable and qualified *teaching force* in required numbers for lower pupil-to-teacher ratios. These quality indicators (e.g., teacher training and education) also meaningfully predict student learning outcomes (Slot et al., 2015).

Current Study

Our school-based research study explored whether improved quality of schools, a component of quality education (SDG 4), may be a potential lever to reduce child labor (SDG 8.7). While evidence of such a potential mechanism is starting to accumulate (e.g., Abou, 2021; ICI, 2019), it is not yet clear if school quality reduces all forms of child labor, if all aspects of

school quality matter, or what underlying mechanisms link school quality and child labor rates.

We contribute to the emerging evidence by examining the relation between school quality and child labor across different domains: domestic (i.e. chores), economic (i.e. non-agricultural), and cocoa agricultural activities (see note 4 on general domains of child labor). We further examine if distinct components of school quality relate to children's labor activities: school infrastructure (SDG 4A), school environment, teaching materials, and human resources (teachers). Specifically, we address the following research questions: (1) How does school quality relate to children's labor activities? (2) Does school quality similarly influence different forms of children's labor activities (domestic, economic, and agricultural activities)? (3) What aspects of school quality have the strongest relationship to children's labor activities? We test the hypothesis that higher school quality is associated with lower rates of labor activity, and that higher school quality may specifically predict lower child agricultural cocoa labor activity.

To directly examine the link between school quality and child labor, we focus our exploratory study on children who both work and attend school, rather than the entire child labor force, which includes children who are out of school. This allows us to directly examine the effect of school quality on child labor rates - in other words, if higher school quality is associated with reduced cocoa-farming related activities performed by the children, then we would expect to observe this direct link among children who attend school. We hope the insights from this research will inform practitioners' and policy-makers' ideation and implementation of novel interventions to reduce and ultimately eradicate child labor, while maximizing their investments in quality education, and arguing for increased funding for education systems.

Method

Participants

Children

2168 fifth grade students ($N_{\text{Female}}=1024$) ages 8-16 years ($M_{\text{age}}=11.02$, $SD=1.420$) participated in the study, as part of a larger research program aimed at understanding children's development in 41 public schools across rural cocoa-producing communities of South-Eastern, Central, and South-Western Côte d'Ivoire between 2016-2019 (note that no relevant regional differences in child labor rates were observed, see Supplementary Materials). Children with disabilities (developmental disorders, hearing, and vision impairments) were not eligible for the study. Our sample also excludes children who are out-of-school; this exploratory study specifically examines the relationship between school quality and child labor in a demographic which represents the experience of the majority of children in (80% of children in Cote d'Ivoire balance the dual demands of school and labor activities; Sadhu et al., 2020).

Teachers

Thirty-eight fifth grade teachers participated in this study ($M_{\text{age}}=43.19$; $SD=8.39$; range=30-58; $N_{\text{Female}}=10$, $N_{\text{Male}}=26$; 2 teachers did not report their gender on the questionnaire). 41 teachers from participating public schools were invited to participate, three however did not complete a questionnaire. Of the 38 teachers surveyed, all taught in French (35 teachers used French as the exclusive language of instruction (LOI); three teachers taught at schools which incorporated a local language as LOI in Grades 1-3). This study received ethics approval from Yale University, University of Delaware, University of Toronto, and authorization from the Ivorian Ministry of Education.

Measures

Demographic and Socioeconomic Characteristics

Children completed a questionnaire previously used as part of Tulane University's Survey Research on Child Labor in West African Cocoa Growing Areas (Tulane University, 2015) and USAID Early Grade Reading Assessment (EGRA) Child Questionnaire (RTI International, 2012). The questionnaire items elicited information about child characteristics (e.g. age) and labor activities in three categories (economic, domestic and agricultural; detailed below in *child labor*). Children's household SES was measured using a household inventory of specific items in their home (e.g. toys, books, radio, phone, electricity, indoor plumbing). This previously-validated and widely used measure is common for low- and middle-income countries such as those in sub-Saharan Africa (SSA; RTI International, 2012). The household SES measure yields a score between 0-15.

School Quality

Individual teachers completed a 30-item teacher questionnaire previously used as part of the Tulane University's Survey of Child Labor in West African Cocoa Growing Areas (Tulane University, 2015) and the Early Grade Reading Assessment (EGRA) used in West Africa (RTI International, 2012). The questionnaire elicited information about teachers' professional demographics (e.g. number of years of experience, professional degrees, educational rank in teaching), and several parameters related to their perception of classroom and school quality (e.g. presence of toilets and school canteens, child-appropriate pedagogical materials; see Supplementary Materials for full list of measures).

Child Labor Activities

This measure considered children's responses, in a "yes/no" format, to 42 items from Tulane University's Survey Research on Child Labor in West African Cocoa Growing Areas (2015). Items referred to children's participation in specific domestic, economic, agricultural activities within the previous 12 month period. Twenty-four items pertained to cocoa agriculture activities including land preparation (e.g. clearing fields, felling and chopping trees, burning, digging tree stumps, cutting stakes), planting (e.g. planting seedlings, aligning and planting stakes, preparing/ digging/ planting nurseries), farm maintenance activities (weeding, using agrochemicals, transporting water, maintaining and pruning cocoa trees), harvesting (e.g. plucking pods, gathering and heading pods, breaking cocoa pods), and post-harvest activities (e.g. fermenting and transporting cocoa beans, drying the cocoa beans). Nine items pertained to economic activities including commercial, artisanal, or agricultural work for payment or other remuneration (e.g. in-kind), unpaid commercial, artisanal, or agricultural work, paid domestic work, assisting parents in a family business, work in a family garden or plot, construction or repair work, fishing and/or hunting, and produce goods/property for use at home. Eight items pertained to domestic activities including laundry, cleaning, fetching water and firewood for household use, preparing food, and caring for other children or elderly family members, household repairs, and shopping.

Procedure

During school hours, children participated in one-on-one interviews conducted by a trained researcher who, at a minimum, had an undergraduate degree in a relevant field (sociology, education, development). Testing took place outside the classroom. Children received small gifts (e.g. books) for their voluntary participation in the study. The teachers' questionnaires

were distributed by an experimenter from the research team at the beginning of a school day; teachers completed the questionnaires during school hours, at their respective schools, later the documents were collected at the end of the research team's visit to the school (i.e. at the end of the day or within a 1-2 days). Consent and data collection procedures were conducted by researchers who spoke Ivorian French and the local languages of the community. Consent was verbally obtained from village chiefs, elders, and community members following culturally appropriate procedures (see Jasińska et al., 2021 for details about informed consent procedures for low-literacy rural communities in Côte d'Ivoire).

Data Analysis

Separate generalized linear mixed models with random intercept by school were used to examine whether age, gender, household SES, and school quality significantly predicted child domestic, economic, and agricultural labor using the open-source statistical software R (R core Team, 2020). Regression models were fitted by maximum likelihood estimation for domestic and economic labor data. Zero-inflated poisson regression model was fitted with both a count model (poisson) and zero-inflation model (binomial) for agricultural labor data, given the over-representation of zero scores, i.e. children who did not work on a cocoa plantation and therefore did not complete any cocoa agricultural tasks; this analytic approach has previously been used to model child labor (e.g. Dendir, 2007). To examine how different aspects of education quality impacted child labor, we conducted follow-up regression models with distinct quality indicators, as stated above.

Please see Supplementary Materials for a detailed description of the coding of school quality and child labor indices, and specific R packages used.

Results

Descriptive Results

Table 1

Demographic, School Quality, and Labor Descriptive Statistics

Variable		N	Mean	SD	Min	Max	Median
Demographic	Age	2168	11.02	1.42	8	16	11
	Household inventory index	2168	6.41	2.59	0	15	6
School Quality	Teachers' age	26	43.19	8.4	30	58	43
	Teachers' years of experience	36	14.42	9.14	3	38	13.5
	Average class size	35	44.6	15.27	10	76	42
	School quality index (19-item average)	38	.06	.28	-.47	.68	.09
Child labor	Number of domestic activities	2158	4.67	1.27	0	7	5
	Number of economic activities	2160	3.86	1.95	0	9	4
	Number of agricultural cocoa activities reported (full sample)	2129	4.96	6.46	0	24	0
	Number of agricultural cocoa activities reported (sample of children who work on a plantation)	967	10.91	5.18	1	24	11

Additional descriptive results are presented in Supplementary Materials.

Child Domestic, Economic, and Agricultural Labor Activities

The proportion of children who reported each type of domestic, economic, and agricultural labor activity is shown in Figure 1A. In terms of patterns of labor activities across

and within each category, there was a moderate positive correlation between domestic and economic activities ($r(2156)=.422, p<.001$), between domestic activities and agricultural activities ($r(2123)=.227, p<.001$), and between economic activities and agricultural activities ($r(2125)=.344, p<.001$). Goodman-Kruskal τ results did not show any strong associations between domestic activities, and between economic activities. However, Goodman-Kruskal τ results for agricultural activities indicated that a number of tasks were moderately to strongly associated, see Figure 1B. For example, children who reported any harvest-related activities such as picking, moving, and fermenting pods, transporting fermented pods, drying beans, and transporting beans to storage were more likely to also report doing other harvest-related activities ($\tau=0.26-0.66$).

Figure 1. (A) Proportion of children who reported performing work activities within each labor category. (B) Goodman-Kruskal τ associations between each cocoa agriculture activity. (C) Relation between age, gender, and child labor across domestic, economic, and cocoa agriculture activities. (D) Probability of working on a cocoa plantation as a function of school quality.

School Quality and Child Labor

The effects of age, gender, household SES, and school quality on child labor activities were tested with separate linear mixed models with random intercept for school for domestic and economic activities, and with a zero-inflated poisson regression model with random intercept for school, for agricultural activities. The zero-inflated poisson regression model showed an improved model fit as compared to a linear mixed model for agricultural activities ($\chi^2(5)=4837.6$, $p<.001$). Older age was associated with more domestic, economic, and agricultural activities. Boys reported more economic and agricultural activities, whereas girls reported more domestic activities, see Figure 1C. Higher household SES was associated with increased domestic and economic activities, but not agricultural activities. Higher school quality was associated with a decreased likelihood of working on a cocoa plantation (zero-inflation logit model), see Figure 1D. School quality however was not associated with the number of agricultural activities reported by children who worked on cocoa plantations (poisson count model); see Table 2. School quality was not associated with domestic or economic work.

Table 2

Parameter Estimates of Age, Gender, Household SES, and School Quality Predicting Labor

Outcomes: Domestic and Economic Labor and Agricultural Labor (Count Model for Number of Cocoa Labor Activities and Logit Model for Probability of Working on a Cocoa Plantation)

Predictor	Domestic	Economic	Agricultural		
	β (SE)	β (SE)	Count Model β (SE)	Zero-Inflation Logit Model β (SE)	Exp(β)
Age	0.096(0.019)***	0.231(0.029)***	0.055(0.007)***	-0.117(0.034)***	0.889
Gender	-0.324(0.054)***	0.474(0.081)***	0.321(0.022)***	-0.804(0.095)***	0.447

(Male)					
Household SES	0.033(0.011)**	0.078(0.016)***	0.007(0.003) ⁺	-0.023(0.019)	0.977
School Quality	-0.204(0.136)	-0.014(0.95)	0.109(0.076)	1.292(0.407)**	3.163
R ²	0.05	0.11		0.175	
N	2158	2160		2129	

Note: ⁺p<.1, *p<.05, **p<.01, ***p<.001

A follow-up zero-inflated poisson regression model for agricultural activities examined specific components of school quality, namely school infrastructure, school environment, teachers, and teaching materials, on the number of cocoa agricultural activities reported and the probability of working on a cocoa plantation, see Table 3. Better school infrastructure and teaching materials were associated with a decreased likelihood of working on a cocoa plantation (zero-inflation logit model), however, no effects were observed for school environment (e.g. public health, school security, etc) and teachers (e.g. teacher qualifications, years of experience, etc.).

Table 3

Parameter Estimates of Specific School Quality Indicators Predicting Agricultural Cocoa Labor Outcomes: Count Model for Number of Cocoa Labor Activities and Logit Model for Probability of Working on a Cocoa Plantation

Predictor	Count Model	Zero-Inflation Logit Model	
	β(SE)	β(SE)	Exp(β)
Age	0.056(.007)***	-.115(.034)***	0.891
Gender (Male)	0.321(.022)***	-0.804(.095)***	0.447

Household SES	.007(.004)	-.022 (.019)	0.978
School Infrastructure	0.026(.052)	0.553 (.241)*	1.738
School Environment	0.031(.063)	0.142 (.296)	1.152
Teachers	-.046(.066)	-.421 (.305)	0.657
Teaching Materials	0.043(.041)	0.381 (.194)*	1.464
R ²		0.186	
N		2129	

Note: ⁺p<.1, *p<.05, **p<.01, ***p<.001

Discussion

This study examined the associations between school quality and children's domestic, economic, and cocoa agriculture activities in rural Côte d'Ivoire. Our results indicate that children who attend higher quality schools have a lower probability of working on a cocoa plantation relative to their peers who attend lower quality schools; these results support our hypothesized link between school quality and child labor. More specifically, better school infrastructure and teaching materials were significantly associated with a lower probability of working on a cocoa plantation. Furthermore, children's demographic and socioeconomic characteristics emerge as important predictors of rates of children's labor activities, but there are key differences across domestic, economic, and cocoa agriculture domains. Côte d'Ivoire currently invests approximately 3.3% of its GDP on education (World Bank, 2018). If investments in school quality reduces child labor rates, Côte d'Ivoire might more fully realize the gains from the education reforms implemented against the backdrop of a larger continental focus on the importance of quality education for Africa's future (African Economic Outlook report, 2020) and the shift in global discourse from education access to quality (e.g. Piper, Peterson & Kim, 2006, Britto, Yoshikawa & Boller, 2011; Mundy & Manion, 2021). It may also inform

conversations on increasing investments in education, to be at par with the world average education expenditure of 4.5% (World Bank, 2018). Together, our findings begin to reveal a complex system in which child-level characteristics (i.e. gender, age, household SES) and children's access to quality education impact child labor.

Child Labor

Approximately 1 in 3 children (38%) self-reported working in cocoa agriculture, which is consistent with previous reports of child cocoa agricultural activities in Côte d'Ivoire (Sadhu et al, 2020). Furthermore, children who reported working on a cocoa plantation were likely to be engaged in multiple cocoa agricultural tasks. The most commonly reported tasks were related to the cocoa harvest (moving pods, fermenting pods) and farm maintenance (cleaning fields, weeding). The least commonly reported cocoa agricultural tasks in our sample were spreading fertilizer, insecticides and other chemicals, albeit as much as 9% of children self-reported being engaged in these hazardous tasks. In addition 35% of children reported breaking open and fermenting pods and 19% reported cutting trees, both of which require the use of a sharp tool, and are considered hazardous forms of labor for children. The majority of children also reported completing domestic and economic activities (e.g. >90% reported household chores such as cleaning and doing laundry, 86% reported fetching water). The strong positive correlations we found between all forms of labor activities (domestic, economic, agricultural) indicate that children who reported doing more tasks in one category were also likely to report doing more tasks in another.

Demographic and Socioeconomic Predictors of Child Labor

Our results indicate that older children worked more relative to their younger peers across all three domains of activities (domestic, economic, and cocoa agriculture), corroborating

existing literature. For example, Del Carpio and Macours' (2009) findings in Nicaragua: intrahousehold allocations of child labor prior to a social protection program is heterogeneous, with older children (boys in their context) more involved in child labor activities than their younger siblings. In addition, we found that gender is associated with labor, with girls participating in more domestic tasks, and boys in more economic and cocoa agriculture tasks. The engagement of girls and boys in different kinds of labor has been previously noted (e.g. Del Carpio and Macours, 2009; Fares and Raju, 2007; Pells, 2011). Across many contexts, girls are more likely than boys to work inside the home doing household chores, childcare, and elder care (e.g. Allais, 2009; Bonke, 2010).

Interestingly, we found small positive associations between household SES and domestic and economic activities, but not agricultural labor. This positive relationship between household SES, schooling and potentially hidden forms of child labor such as domestic activities (e.g. Boutin, 2012) may indicate the complexity of the micro-relationships underlying this phenomenon. One mechanism by which household SES specifically impacts child labor may be that children who engage in domestic and economic activities (non-agricultural income-generating work) indirectly contribute to household SES. For example, in replacing parental household work, they allow their parents to pursue more income-generating activities, which in turn may contribute to higher household SES. It may also be, as suggested by De Hoop et al. (2019) in the context of a cash transfer program in the Philippines aimed at increasing school attendance through a soft nudge, that working children help their households to fully cover the cost of education. This increase in hidden child labor would raise both participation in schooling and work.

School Quality

Our findings are situated within existing literature on school quality in Côte d'Ivoire and in SSA more generally. Primary schools in SSA face challenges in implementing high-quality primary education due to worn building infrastructure, a shortage of motivated and educated teachers, large class sizes, and insufficient teaching materials and classroom resources (Heneveld, 1994), and insufficient teaching and learning materials in local languages (e.g. Ball et al., 2022; Muthwii, 2004; Piper et al., 2018). The majority of teachers surveyed in this study reported facing multiple problems at their school including a lack of infrastructure (latrines, water) and large class sizes. They also reported lack of human resources and child appropriate materials.

In terms of school infrastructure, our results indicate that about a third of schools lacked drinking water, almost half did not have latrines, and about a third lacked electricity. These results corroborate the statistics of the Ivorian Ministry of National Education: in La Mé region (Adzope), 38.9% of schools do not have electricity, 43.5% do not have functional latrines, and 54.9% of schools do not have drinking water. Given the lack of latrines and water in many schools, it is perhaps not surprising that over half of teachers reported public health problems in their schools. Our results also showed some class sizes as high as 76 children, a number substantially higher than the Ivorian target class size of 40 students as per the Ivorian Ministry of Planning and Development's Strategic Education Plan for 2015-2025 (2021), and higher than the observed average student:teacher ratio of 43:1 in Côte d'Ivoire (Ivorian Ministry of Education, 2021). This average Ivorian student:teacher ratio is very high compared to, for example, international targets for pre-primary school of 20:1 (UNICEF, 2019). With respect to teachers' qualifications, most, but not all, teachers in our study reported completing a Pedagogical

Aptitude Certificate (the Ivorian requirement for teaching), suggesting that many under-qualified teachers are working in rural schools. It is important to consider that teachers who in fact did not have this certification may have been reluctant to report their accurate credentials, or lack thereof, in our questionnaire.

Theorized Mechanisms by which School Quality Impacts Child Labor

Our findings show that children who attend higher quality schools (with smaller class sizes, more qualified teachers, child appropriate materials, a sufficient canteen program, access to water and electricity and latrines) reported less involvement in all child labor activities (including domestic, economic, and agricultural activities) and were specifically significantly less likely to work on a cocoa plantation. Specifically, we found that the quality of school infrastructure and teaching materials related significantly to the probability of a child working on a cocoa plantation. In other words, the higher the school quality, the fewer the number of children who reported cocoa-agriculture activities. Interestingly, we did not observe any associations between school quality and domestic or economic activities, our results seem to uniquely relate school quality to cocoa agricultural activities. Child labor, children's education, and household economics connect through multiple and complex pathways, and the link between child labor and school quality may be explained by several mechanisms, see Figure 2. These results linking child labor and school quality should be considered in the context of children's participation in agricultural cocoa labor in Côte d'Ivoire being primarily a household-level decision.

Figure 2. Potential mechanisms by which school quality impacts child labor

One potential powerful mechanism linking school quality and child labor may be parents' (or caretakers, or other family members) opportunity-cost decision to send children to school, rather than to cocoa plantation, when school quality improves. In poor households faced with

severely limited options, parents may weigh the future benefit of sending children to school symmetrically with immediate economic survival of the household of their children working on a cocoa plantation (e.g. Basu and Van, 1998; Grootaert and Kanbur 1995; Ranjan 1999; Nkamleu and Kielland, 2006). The parents may prefer their children to go to school, but when faced with higher costs of schooling or low quality of schools, may prefer that their children either combine school and work or only work (e.g. Edmonds & Pavnick, 2005; Webbink et al 2013). These decision mechanisms may underpin our findings.

Consider that education in Côte d'Ivoire, while universal, has associated fees: government school fees are 6,000 FCFA (~10 USD); the cost of school uniforms and supplies (school textbooks are not provided by the school) range from 30,000 FCFA over 50,000 FCFA (~50-90 USD) according to the child's grade; and there are fees applied by COGES (School Management Committee consisting of parents of students, teachers and the principal, akin to a parent-teacher association) ranging from 5,000 over 20,000 FCFA (~9-35 USD), which is typically allocated for funding construction of new school buildings, latrines, etc., or other needs, depending on the school. Therefore, schooling costs for each child can range from 70 to 135 USD which, given the average annual cocoa farmer income of 3,000 USD (World Bank, 2019) and the average number of school-age children in these households being between 5 and 8, can represent over 35% of the average household income. This burden of the direct costs of schooling has been suggested by prior research (e.g. Abou, 2014).

The choice to send a child to school or have the child work on a family cocoa plantation is even more significant in the context of the cocoa crop cycle with respect to the start of the academic school year. There are two cocoa harvests each year, a main harvest typically in October, and a second smaller harvest in April. Cocoa farming households typically earn their

entire year's income after beans are harvested and sold. The start of the school year in September and October coincides with the main cocoa harvest--a time period when cocoa farming families typically have their lowest cash reserves and the highest need for children's work in an activity that generates much of their household income until the next harvest. The pressure for children to work on the cocoa plantation is greatest at precisely the moment when parents are faced with the decision to send their child to school. Indeed, our results show that children mostly engage in harvest and post-harvest activities, which start at the beginning of the school year. Therefore schooling and labor decisions may be intimately linked to the cocoa crop cycle and the financial constraints that households may face at the start of the school year. This may also be the reason that the economic and household labor, which are not a main source of farmer livelihood in cocoa-farming households, is not significantly linked to school quality.

In this context, for school quality to deter child labor, the opportunity-cost of a child attending school rather than working on a plantation must shift to favor schooling. From the perspective of the parent, some features of quality schooling may be more salient than others. For example, if a child's literacy and numeracy skills improve noticeably after attending school, parents can infer that schooling is effective and may be more inclined to support their child's continued attendance *if* they are engaged in their child's learning and actively monitoring their child's progress. For many farming families, it is common for parents to live on their plantation during the work week and return home on weekends while their child remains in the village, therefore parents may have limited engagement in their child's schooling. Similarly, updates to the curriculum and/or teacher training that increase education quality are unlikely to be perceived by disengaged parents. On the other hand, highly visible indicators of school quality such as the construction of new school buildings, latrines, or access to water and electricity may be more

salient to parents, having a more direct influence on parents' perception of school quality. Indeed, we found that, of the dimensions comprising school quality, better school infrastructure and teaching materials were associated with a decreased likelihood of working on a cocoa plantation. This would align with the existing evidence in research literature about quality infrastructure and parental perceptions (e.g., Abou, 2021). In addition, basic infrastructure such as access to water may directly benefit households (e.g. Hutton and Haller, 2004) by making the household chore of fetching water less time-consuming and thus lowering the demand for children's labor (e.g. Guarcello et al., 2004, Shafiq, 2007).

School quality may also influence child labor through teachers, specifically teacher absenteeism as a result of inadequate school facilities and infrastructure or classroom structure (e.g. Chaudhury et al., 2006; Lee et al., 2015). If the school lacks a latrine, water, and/or electricity, a teacher may be less inclined to come to work and stay for the entire duration of the school day. Similarly, if teachers face overwhelmingly large class sizes, or if there are insufficient learning and teaching materials available and limited school supplies, then teachers may feel ill prepared to teach to a classroom which frequently has children of different ages and skill levels. This would diminish teachers' motivation and contribute to lower education quality in the classroom and increased teacher absenteeism. An absent teacher may result in canceled classes, and children may return to their homes or to work in the fields with their parents. In turn, this schooling disruption may shift household perceptions of the opportunity-cost of sending children to school in favor of keeping them working at home for the household's immediate benefit. The impact of poor school facilities and unavailability of teachers as a reason for student attrition has been suggested by research (e.g. Momo et al., 2018).

The child may also be agentic in the relationship between school quality and child labor through either the *direct* channel of their own decision to choose among going to school, combining school and work, or working, or the *indirect* channel of influencing the household's decision. When school quality is high, the child's interest in education may be correspondingly higher, and this may limit the propensity that (s)he engages in child labor. For example, if a school is able to offer a functioning canteen program, attending school may be more attractive to both parents and children. A child who is engaged in their schooling may be able to convince their parents to allow him or her to continue to go to school on a regular basis and to better engage with schooling. It should be noted that school quality is an endogenous indicator, meaning it includes the possibility of a reverse relationship, with child labor leading to low school quality. There are well established links between child labor and poor educational outcomes. For example, in a sample of nine Latin American countries, Gunnarsson et al. (2006) found that child labor was a significant predictor of poor learning outcomes. In particular, children who work one standard deviation above the mean show a 16% decrease in their mathematics test scores and an 11% decrease in their language test scores. Therefore child labor might reduce school quality by introducing higher heterogeneity in the classroom, and in turn, a lower quality education context for all students. In addition, children's absenteeism from school as a result of child labor may in turn contribute to higher heterogeneity in the classroom teaching-learning environment, as they struggle to catch up with missed materials and socialization, impacting teacher's perceptions of their capabilities and their motivation to teach.

Implications for Policy and Practice

Our findings, that higher school quality is associated with lower rates of child labor, has implications for both education and child labor policy formulation and implementation.

First, school quality can be a nuanced policy tool to reduce child labor which nudges the largely household decision about children working on family farms. This novel approach can augment existing mandates such as child labor bans or compulsory attendance, which may be blunter instruments against the breadth of reasons why individual families may be noncompliant (e.g. Basu and Tzannatos, 2003; Brown, 2001; Krueger, 1996). Bans, assuming adequate resources to enforce them, can have dire consequences for poor households (and their children) who resort to child labor out of desperation to make household ends meet. Similarly, trade policies and consumer boycotts, while spotlighting child labor, are unlikely to alter the household decision of a typical child cocoa laborer helping their parents on the family farm. We forward that child labor policies can be strengthened by including and measuring school quality, with consideration given to quality infrastructure that provides access to basic services alongside materials and human resources.

Second, our findings highlight the importance of strengthening, expanding and evaluating high quality infrastructure. Indeed the Ivorian government's National and Education Sector Plans under the Global Partnership for Education (2017) aims to improve the quality of education and calls for quality school infrastructure and improved school safety, hygiene, and health in rural areas by constructing more latrines, hand washing systems, and drinking water points at schools. The government also plans to reduce class sizes and improve student-teacher ratios by constructing 3,000 additional classrooms per year and rehabilitating 5% of existing classrooms. We forward that aligning new high quality school infrastructure, and updates to infrastructure, around *community-identified* basic services of importance (e.g. reliable water and latrines, reliable functioning canteens) may shift household perceptions about the value of schools and

schooling in their communities, and nudge household decisions around the opportunity-cost of sending children to school.

Third, in alignment with the myriad mechanisms through which school quality likely acts on parents and children (see Figure 2) to influence the household decision around child cocoa labor, multiple entry points are needed to nudge households along the continuum of children-only-working to children-only-going-to-school. From the pivot to remote learning as a result of the Covid-19 pandemic, we have learned that learning at scale can occur outside a restricted number of hours of the day at a physical school plant. We forward that the Ivorian plan to implement and expand high quality infrastructure can be an opportunity to strengthen life-wide learning through a high quality out-of-school education ecosystem, which includes infrastructure, materials and human resources.

Fourth, the effect of material resources on child cocoa labor supports the importance of high quality human resources and teaching-learning materials, which make learning relevant. The National Development Plan (Ivorian Ministry of Planning and Development (2021) recognizes teachers as important to school and education quality: many teachers are under-trained, lack professional support, and have access to limited teaching material for teaching students. The Ivorian government plans to increase teacher training from 2 to 3 years, conduct regular pedagogical monitoring of teachers, and improve teaching and learning materials. We forward that attention should be given to the materials resources to align with the needs of the community so that households perceive the learning in schools as relevant. Though our study did not examine whether teaching materials were relevant in the community, teaching materials aligning with the language of instruction have been found to impact learning outcomes (Ball et al., 2022); therefore we posit that relevant teaching materials may increase school quality

and thereby decrease child labor. It may be that if parents (and children) see their learning as immediately relevant to their lives and understand the material, it may motivate them to engage more with school and sacrifice immediate household benefit. At the very minimum then, investing in school quality as a lever against child labor represents value added to this government investment. A quality education will develop human capability irrespective of whether the long-term outcome for this education is coupled with the labor market. Among the public goods of high quality education are higher levels of literacy and numeracy, and improved health outcomes from access to reliable sanitation, clean water and sanitation at schools, and lack of exposure to physical, chemical and social hazards while engaged in child labor, and chemical hazards. Coupled with an economic environment that facilitates and encourages private sector development in these areas, such as through successful microentrepreneurship, or the establishment of fair-trade co-ops which engage in better farming practices, investments in high quality education that draw children out of child labor has the potential to break the cycle of persistent intergenerational poverty and unleash the human capital and sustainable development of a very young nation.

Limitations and Future Directions

Our findings reveal important links between school quality and child agricultural cocoa labor and suggest potential mechanisms by which improved school quality may reduce child labor. However, it should be noted that our findings reveal *correlations* between school quality and child labor, rather than *causality*. While our data do not conclusively narrow down one or more mechanisms that link increased school quality to a reduction of child labor, our findings call for causal studies of school quality and child labor given the global investments in school quality and the recognition of the importance of eradicating child labor. It is important that the

potential pathways between school quality and child labor are fully tested in future research. Indeed, in a parallel research study (ongoing randomized evaluation in Côte d'Ivoire, see Jasińska, & Guei, 2018), we specifically measure if improving school quality causes a reduction of child agricultural cocoa labor in Côte d'Ivoire. Future studies can also narrow down the specific aspects of school quality that pull children into school and away from labor — for example, pinpointing the specific aspects of school infrastructure (e.g., WASH facilities) that have the greatest impact on child labor reduction may allow for more targeted and impactful educational investments within LMICs.

Another limitation of our study is that our child labor data was reported by children. Since the effect of the type of respondent (parent, child) on child labor statistics is not clear *a priori* (e.g. Dammert & Galdo, 2013), we must interpret these findings with caution. However, child-reported information may be more accurate than proxy responses (e.g. parent) if the child knows best what labor activities(s) he participates in (Lichand & Wolf, 2022). While we did not use proxy respondents, a proxy respondent may be familiar with the children's activities and the frequency and continuity of work activities. The broader measurement error literature highlights relevant factors such as the salience of work activities, and recall decay bias (e.g., Bound et al., 2001). This literature, however, also suggests that our reports of child labor might be downward biased, providing a lower bound for the effect of school quality and other predictors. In fact, given the already high prevalence of child labor in our study area (>30% according to recent estimates), the recall bias will likely only reduce the propensity that the child reports being engaged in child labor. Furthermore, proxy respondents (i.e. parents) may be also inaccurate; for example, social desirability biases may lead parents to under-report their child's labor. Further,

there is no reason to expect that biases in child labor reports would differ from high to low quality schools.

We emphasize that this study focuses on the type of child agricultural cocoa labor that is common in rural cocoa-growing communities of Côte d'Ivoire: a majority of these children who are enrolled in school are faced with managing the dual demands of attending school and child labor activities, whether domestic, economic or agricultural. Our exploration stops at the border of school quality being a push-pull factor for those children who are enrolled in school while engaged in labor activities. Since our sample excludes those children who are not enrolled in school, we do not know if poor school quality can push children out of schools entirely. Yet our study may impact out-of-school children; if school quality is high, parents' and students' incentives to attend school may increase (i.e., if WASH facilities and canteens are adequate and learning outcomes afford children more opportunities, parents may deem a school as safer and more valuable) — high quality schools may *pull in* these out-of-school children. Given the prevalence of domestic, economic, and agricultural activities in these communities, more research is needed to understand the factors that push or pull children away from school completely, so that we may better inform child labor interventions and policies to increase educational attainment.

Lastly, our work focused on a narrow set of education quality indicators; largely school infrastructure and teacher's self-report of the quality of pedagogical materials and the school environment as a measure of school quality. A combination of teacher-reported data, classroom observations, government indicators, and children's learning outcomes would provide more informed insights into education quality (including school quality). Given the important links we

have observed, an important next step in this research agenda is the inclusion of a broader range of school and education quality measures.

Conclusion

A large body of literature has explored how children's school participation and learning outcomes are impacted by child labor (e.g., Adonteng-Kissi, 2023; Guarcello et al, 2015; ICI, 2019). Indeed one criteria of 'child labor' is that the work a child does interferes with their schooling. While there is extensive research showing *child labor disrupts education*, there is scant research about the reciprocal relationship: *education disrupts child labor*. Our research on the relation between school quality and child labor rates found that higher school quality was associated with a lower probability of working on a cocoa plantation. This suggests the potential for leveraging investments in education quality as an intervention against child labor, within the context of cocoa labor in Côte d'Ivoire. Our results represent an intriguing finding given the high levels of global investment in quality schooling and the post-COVID recognition of the importance of high quality basic school infrastructure. Our findings suggest the value of further investigation into the parent-level, teacher-level and child-level mechanisms by which education quality influences the household decision of child labor. We believe that this study opens an exciting new pathway for addressing this problematic global phenomenon.

Notes

1. The definition of child labor is bounded by International Labour Organization (ILO) Convention No. 138 on minimum age for admission to employment, ILO Recommendation No. 146 (1973), ILO Convention No. 182 on prohibition and immediate action for eliminating the worst forms of child labor, ILO Recommendation No. 190 (1999), and the United Nations Convention on the Rights of the Child. While context sensitive, this encompasses i) any economically active child under the age of 12; ii) children 12-14, engaged in productive activities outside permissible light work; iii) children aged 17 and younger engaged in "hazardous" activities (those affecting the child's safety, physical and mental development) or the "worst forms of child labor" (e.g. commercial sexual exploitation, armed conflict). It should be noted that not all work done by children is considered child labor. Many children around the world participate in the workforce, engaging in economic activity at a young age for varying reasons e.g. domestic chores vs. apprenticeships; working for pocket money vs. income for survival; working a few hours vs. working all day during peak harvest season.
2. Broad research indicates that child labor interferes with educational attainment. For example, children's reading competence (as assessed by parents) decreases with child labor hours in Tanzania (Akabayashi and Psacharopoulos 1999). Heady (2003) found a negative relationship between child labor and educational attainment, using direct measures of reading and mathematics ability, in Ghana. Lee et al. (2021) found child labor lowers reading and mathematics scores for both genders and regardless of age (children under 12 and over 13 years) in francophone West and Central Africa. Child work is a significant predictor of age-grade distortion in Peru (Patrinos and Psacharopoulos, 1997). Child labor hinders learning performance by taking time away from study, play and sleep, injuries that damage physical and mental health,

interfering with children's school attendance and opportunity to learn (Patrinos and Psacharopoulos, 1995), and has negative effects on attitudes toward studying (e.g. Dumas, 2012; Emerson et al., 2017).

3. Child labor is a complex phenomenon and many factors promote or maintain this phenomenon including the unavailability or prohibitive cost of schooling, gender-based cultural norms, and individual family needs. Dammert et al. (2018) typologize five common policy and legislative approaches to combat this are: 1) increasing labor market access through labor-oriented programs (eg. micro-entrepreneurial activity, public works); 2) increasing household income for the unbanked or under-banked through microfinance programs (e.g. business loans); 3) cash transfers programs (cash, in-kind non-fungible goods and services such as food for education) to households either with no-strings-attached, or conditional upon compliance with schooling and health requirements (e.g. school enrollment, health visits); 4) targeted child labor programs (e.g. information campaigns to parents, employers, children, and policy makers about the negative consequences of child labor, integrated interventions to reduce risk of working such as incentivizing school attendance through take-home rations alongside raising parental awareness); and 5) schooling incentives (e.g. reducing cost of education, expanding pre-schools). They also point out that these have met with varying success and in some cases increased child labor rates, pointing to the complex set of factors that influence this phenomenon.

4. Child labor is often divided into three major categories: paid or unpaid activities outside the home (e.g. agriculture, which accounts for 69% of economically active children), family work, and housework (Hagemann, Diallo, Etienne, & Mehran, 2006). Family work consists of any (usually unpaid) activities that children do for the family, which is often agricultural, but also

includes work for any other type of family-owned business (e.g. Webbink, Smits, & de Jong, 2012). Finally, housework, or household chores, includes childcare, cleaning, cooking, laundry, shopping, fetching water and wood, and home maintenance. Housework is considered to be a hidden form of child labor because it is unpaid and often goes unreported (e.g. Gibbons, Huebler, & Loaiza, 2005; Webbink Smits, & de Jong, 2012).

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Supplementary Materials

Regional Differences in Child Labor

Participants were recruited from cocoa growing regions of Adzope, Sikensi, Soubre, and Thierbissou. We found no difference in the number of cocoa agricultural activities that children reported between regions ($F(3,2125)=1.801$, $p=.145$).

Data Analysis

School Quality

A school quality index was constructed following the protocol applied by the International Cocoa Initiative (International Cocoa Initiative, 2019) using 19 variables related to school infrastructure (electricity, water, latrine, classroom furniture, physical classroom condition, student supplies), teaching and learning materials (availability of French pedagogical materials, teacher-reported problems with child-appropriate materials, pedagogical materials, and materials in the local language of instruction), school environment (class size, lack of teachers, school security, public health, availability of functioning canteen), and human resources (teacher education, teacher experience, teacher satisfaction). This index was computed as an average of these 19 individual scaled indicators. For each indicator, a positive value indicated higher quality, with indicators where a positive value indicated poorer quality, such as class size, being reversed.

Child Labor

Child labor was disaggregated into domestic, economic and agricultural labor. Each type of labor was defined as the total number of different activities in that category, that children reported, in the preceding 12-month period. Regression models were fitted by maximum likelihood estimation using the lmer function from R lme4 (Bates, Mächler, Bolker & Walker, 2015) and lmerTest (Kuznetsova, Brockhoff & Christensen, 2017) packages for domestic and economic

labor data. Zero-inflated poisson regression model was fitted with both a count model (poisson) and zero-inflation model (binomial) using glmmTMB function in R (Brooks et al., 2017). Model R^2 values were computed using the r2 function from the performance package in R (Lüdtke et al., 2021). Goodman-Kruskal tau (Pearson, 2020) and Pearson correlations were used to examine statistical associations between school quality and child labor, for categorical and continuous variables, respectively. Data were visualized using the ggplot2 function in R (Wickham, 2016).

Supplementary Descriptive Results

Child Demographic and Socioeconomic Characteristics

Age and Gender. The distribution of boys and girls in the sample was unequal ($\chi^2(1,2168)=6.642, p<.001$), there were more boys than girls (53% male vs. 47% female). The mandatory age of school start in Côte d'Ivoire is age 6, therefore children in grade 5 are expected to be between 10 and 11 years, as reflected in the age distribution (51.6% of students were in the 10-11 year range, median age 11). However, we observed some variability in age (range 8-16 years, $SD=1.420$), which may indicate differences in the age of school-start outside the mandated age and/or grade repetition. Age and gender were significantly related ($\beta=.30, SE=.006, 95\% CI [0.18, 0.42], t(2133)=4.87, p<.001$), boys were older compared to girls.

Socioeconomic status. The proportion of children reporting each item that their family owns is shown in Supplementary Figure 1. Household SES was also significantly associated with children's age ($\beta=-.04, SE=.012, 95\% CI [-0.06, -0.02], t(2129)=-3.40, p<.001$), with older children being from lower SES households. No significant associations between gender and household SES were observed ($\beta=-.11, SE=.11, 95\% CI [-0.33, 0.10], t(2190)=-1.03, p=0.303$). Household SES significantly differed by school ($F(40, 2123)=29.417, p<.001$). Tukey HSD results revealed that the schools with the highest average household SES (School 1: $M=7.4$,

SD=2.15; School 2: M=6.42, SD=2.88; School 3: M=6.27, SD=2.65) significantly differed from the schools with the lowest average household SES (School 41: M=4.04, SD=2.42; School 40: M=5.1, SD=2.57).

School Quality

Teacher demographics. Teachers had an average of 14.42 years of teaching experience (SD=9.13; range=3-38). 76.31% of teachers were employed in certified positions (akin to an elementary school teacher in USA/Canada), 15.76% were employed in non-certified positions, and 2.63% were volunteers (see Supplementary Materials for details on teacher qualifications and positions in Côte d'Ivoire). The distribution of teachers' gender was unequal with only 26.31% female compared to 68.42% male teachers in the sample. 32% of teachers reported that they were not speakers of the local language. Teachers' educational qualifications were converted to a rating; BEPC (Brevet d'étude du Premier Cycle) and CAEP (Elementary Certificate of Pedagogical Aptitude) degree holders scored 1 (lowest qualification), CAP (Pedagogical Aptitude Certificate) and BAC (Baccalauréat) degree holders scored 2, and anyone with a higher degree scored 3 (highest qualification). 20% of teachers had the lowest educational qualifications (BEPC or CAEP), 67% of teachers had CAP or BAC degrees, and 13% of teachers had a higher degree. Supplementary Table 1 provides the descriptions of teachers' educational degrees.

School quality indicators. The majority of teachers surveyed in this study reported facing multiple problems at their school, see Supplementary Figure 2. Teachers reported problems with teacher shortage/lack of teaching human resources, child appropriate materials, and the language of instruction. With respect to infrastructure, 68% of schools had electricity, 55% had a latrine, and 32% had access to water. 55% of teachers who reported public health problems. While 58% of teachers reported a canteen program at their school, only 38% stated

that the canteen program was sufficient (i.e. was operational every day, offered to all children, and provided adequate portions/nutrition). Class sizes were generally large ($M=44.6$), with some as large as 76 students. We further examined the associations between school quality indicators (see Supplementary Table 2 and Figure 3). Goodman-Kruskal τ , Pearson's correlations, and regression were used to examine association among categorical and continuous school quality variables. Goodman-Kruskal τ results showed that schools that had drinking water were more likely to also have electricity ($\tau=.12$), and teachers who reported no problems with pedagogical materials also indicated sufficient school supplies ($\tau=.17$). Likewise, teachers in schools with electricity reported less problems with classroom conditions ($\tau=.17$) and lack of teaching human resources ($\tau=.13$), see Supplementary Figure 3. Pearson's correlations suggest that teachers with more years of teaching experience teach larger class sizes ($r(31)=0.351$, $p=.045$), albeit this likely reflects different teacher training qualifications among older generations of teachers. We fitted linear models to predict the continuous variables with categorical variables (see Supplementary Materials for detailed results). Overall, the models explained statistically non-significant and very weak proportions of variances in the outcome variables. There was only a marginal significant relation between class size and student supplies ($\beta=-10.297$, $SE=5.129$, $p=.057$) and public health ($\beta=-8.796$, $SE=5.030$, $p=.090$).

We did not find significant associations between school quality and child's age ($\beta=-.15$, $SE=.16$, 95% CI $[-0.49, 0.19]$, $t(36)=-0.92$, $p=0.365$), and between school quality and child's household SES ($\beta=.05$, $SE=.006$, 95% CI $[-0.66, 0.75]$, $t(36)=0.13$, $p=0.896$). Correlations between variables are presented in Supplementary Table 3.

Supplementary Figure 1. Proportion of children who reported whether their household owned each item on the SES Household Inventory.

Teacher Qualifications in Côte d'Ivoire

Certified teachers are permitted to teach based on their prior degree (BAC or above, see Supplementary Table 1) and have obtained teaching credentials (Pedagogical Aptitude Certificate, or CAP; see Supplementary Table 1), but are not yet tenured in the Ivorian education system. Tenure is obtained after 2 years as a “certified teacher” in a school. Teachers in non-certified positions are teachers that have less than the BAC degree and have obtained a CAEP degree (Elementary Certificate of Pedagogical Aptitude, see Supplementary Table 1). Non-certified teachers should have at least a BAC level in order to get tenure, otherwise they remain in their position.

Supplementary Table 1

Descriptions of teacher's educational degrees

Degree	Education Ranking	Description
BEPC	1	Brevet d'étude du Premier Cycle or BEPC certification refers to the completion of lower secondary study.
CAEP	1	Since 2017, Côte d'Ivoire has been providing Elementary Certificate of Pedagogical Aptitude (CEAP) training to BEPC graduates who later become assistant teachers with a reduced salary.
CAP	2	Normally, holders of the Baccalauréat enter primary school teacher training and receive the Pedagogical Aptitude Certificate (CAP).
BAC	2	Baccalauréat indicates the completion of one or two years of study in a University level program.
DEUG 1	3	Diplôme Universitaire d'Etudes Générales 1 or DEUG 1 certification was achieved after studying in a University level program for one year.
DEUG 2	3	Diplôme Universitaire d'Etudes Générales 2 or DEUG 2 certification was achieved after studying in a University level program for two years.
BTS	3	Brevet de Technicien Supérieur or BTS is a professional diploma. Training courses are provided in vocational and technical training establishments to students with a Baccalauréat degree.
Licence	3	Refers to obtaining a bachelor's degree or undergraduate degree (following a three-year program).
Master 1	3	Refers to the completion of a professional master's degree program (following a four-year program).
Master 2	3	Refers to obtaining a research master's degree (after four years); suitable program for a third university cycle.
Doctorate	3	Third Cycle Specialty Doctorate is the diploma awarded after the thesis defense (after 7 years).

Supplementary Figure 2. *School Quality Index. Proportion of teachers who responded 'yes' to each indicator.*

	Teacher Satisfaction	Appropriate French Pedagogical Materials	Adequate Student Supplies	Electricity	Water	Latrine	Canteen	Functioning Canteen	Tables and Benches	Problems with Peda. Materials	Problems with Public Health	Problems with Classroom Condition	Lack of Teachers	Problems with School Security	Problems with Child Appropriate Materials	Problems with LOI
Teacher Satisfaction	K = 2	0.03	0	0.09	0.2	0.09	0	0.14	0.04	0.07	0.01	0	0.1	0.03	0.06	0.02
Appropriate French Pedagogical Materials	0.03	K = 2	0	0.12	0.02	0.02	0	0.01	0.04	0	0	0.09	0.09	0.07	0.06	0.32
Adequate Student Supplies	0	0	K = 2	0.11	0.01	0	0.03	0.07	0	0	0.17	0.03	0	0.03	0.01	0.01
Electricity	0.09	0.12	0.11	K = 2	0.02	0.01	0.04	0	0	0.02	0.16	0.01	0.02	0.04	0	0.02
Water	0.2	0.02	0.01	0.02	K = 2	0.12	0.04	0.06	0.1	0	0.1	0.02	0.17	0	0.13	0
Latrine	0.09	0.02	0	0.01	0.12	K = 2	0	0.01	0	0.02	0	0.04	0	0.07	0.02	0
Canteen	0	0	0.03	0.04	0.04	0	K = 2	0.04	0	0	0.01	0	0	0.06	0	0.01
Functioning Canteen	0.14	0.01	0.07	0	0.06	0.01	0.04	K = 2	?	0.04	0	0	0.01	0.09	0	0
Tables and Benches	0.04	0.04	0	0	0.1	0	0	?	K = 2	0.04	0	0	0.03	0.02	0.02	0
Problems with Peda. Materials	0.07	0	0	0.02	0	0.02	0	0.04	0.04	K = 2	0.02	0	0.03	0	0	0.06
Problems with Public Health	0.01	0	0.17	0.16	0.1	0	0.01	0	0	0.02	K = 2	0.01	0.01	0.06	0	0.02
Problems with Classroom Condition	0	0.09	0.03	0.01	0.02	0.04	0	0	0	0	0.01	K = 2	0.02	0.08	0	0.13
Problems with School Security	0.1	0.09	0	0.02	0.17	0	0	0.01	0.03	0.03	0.01	0.02	K = 2	0.03	0.09	0.06
Lack of Teachers	0.03	0.07	0.03	0.04	0	0.07	0.06	0.09	0.02	0	0.06	0.08	0.03	K = 2	0	0.05
Problems with Child Appropriate Materials	0.06	0.06	0.01	0	0.13	0.02	0	0	0.02	0	0	0	0.09	0	K = 2	0.08
Problems with LOI	0.02	0.32	0.01	0.02	0	0	0.01	0	0	0.06	0.02	0.13	0.06	0.05	0.08	K = 2

Supplementary Figure 3. Goodman-Kruskal tau results indicating associations between each school quality indicator.

Supplementary Table 2

Parameter estimates of categorical school quality variables predicting continuous school quality variables

Predictor	Class Size b(SE)	Years of Teaching b(SE)	Teacher's Education b(SE)
Teacher Satisfaction	4.671(5.332)	-2.676(3.853)	-.313(.268)
Adequate French Pedagogical Materials	-.359(5.993)	-.162(3.449)	-.222(.227)
Adequate School Supplies	-10.297(5.219) ⁺	1.495(3.344)	.095(.223)
Electricity	4.620(5.742)	-0.001(.000)	-.087(.239)
Water	2.004(5.507)	1.364(3.345)	-.348(.215)
Latrine	3.111(5.213)	2.775(3.072)	.031(.215)
Canteen	3.984(5.212)	-3.514(3.075)	.013(.211)
Functioning Canteen	-10.805(7.385)	-1.583(3.837)	-.143(.280)
Tables and Benches	-7.114(5.092)	-.232(3.094)	-.021(.212)
Problems with Pedagogical Materials	3.235(5.614)	3.023(3.410)	.095(.223)
Problems with Public Health	-8.796(5.030) ⁺	-2.963(3.067)	-.143(.209)
Problems with Classroom Condition	7.000(5.151)	-2.257(3.109)	-.118(.209)
Problems with School Security	-1.624(5.233)	1.105(3.088)	.111(.211)
Lack of teachers	-5.026(5.929)	-4.408(3.365)	-.248(.226)
Problems with Child Appropriate Materials	4.098(5.950)	1.255(3.347)	-.382(.207) ⁺
Problems with the Language of Instruction	-2.240(5.785)	-1.223(3.442)	-.523(.196)*

Note: ⁺p<.1, *p<.05, **p<.01, ***p<.001

Supplementary Table 3

Correlations Between Child Demographic Characteristics, School Quality, and Child Labor

	Child age	Household SES index	Teacher age	Teachers' years of exp.	Class size	School quality index	# of dom. activities	# of eco. activities	# of agr. activities
Child's age	1	-.073 ***	n.a	n.a	n.a	-.022	.089***	.172***	.149***
Household SES index		1	.082***	.110***	.081***	-.021	.062**	.079**	.029
Teachers' age			1	0.774***	.482*	-.175	n.a	n.a	n.a
Teachers' years of exp.				1	.351*	.004	.014	.012	.015
Class size					1	-.221	.042	-.023	.032
School quality index						1	-.043*	-.021	-.074***
# of dom. activities							1	0.422***	0.227***
# of eco. activities								1	0.344***
# of agr. activities									1

Note. ⁺p<.1, *p<.05, **p<.01, ***p<.001; n.a in the table stands for *not applicable* and designates all correlations that are not meaningful.

Highlights

- In rural Côte d'Ivoire, participation in cocoa labor pulls children away from school.
- High quality schools were associated with reduced cocoa agricultural activities.
- Quality schooling may both reduce child labor and improve learning outcomes.