IFPRI Discussion Paper 02080

December 2021

Agricultural Mechanisation and Child Labour in Developing Countries

Rob Vos

Hiroyuki Takeshima

Development Strategy and Governance Division
Markets, Trade and Institutions Division

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI), a CGIAR Research Center established in 1975, provides research-based policy solutions to sustainably reduce poverty and end hunger and malnutrition. IFPRI's strategic research aims to foster a climate-resilient and sustainable food supply; promote healthy diets and nutrition for all; build inclusive and efficient markets, trade systems, and food industries; transform agricultural and rural economies; and strengthen institutions and governance. Gender is integrated in all the Institute's work. Partnerships, communications, capacity strengthening, and data and knowledge management are essential components to translate IFPRI's research from action to impact. The Institute's regional and country programs play a critical role in responding to demand for food policy research and in delivering holistic support for country-led development. IFPRI collaborates with partners around the world.

AUTHORS

Rob Vos (R.Vos@cgiar.org**)** is the Director of the Markets, Trade, and Institutions Division of the International Food Policy Research Institute (IFPRI), Washington, DC.

Hiroyuki Takeshima (H.Takeshima@cgiar.org**)** is a Senior Research Fellow in IFPRI's Development Strategy and Governance Division, Washington, DC.

Contents

ABSTRACT

Child labour in agriculture remains a global concern. Agriculture is the sector where most child labour is found. Employment of children mostly relates to farm household poverty in developing countries. This raises the question of the extent to which the modernisation of agriculture prevents the use of child labour while also leading to higher productivity. One of the central questions in this context is whether agricultural mechanisation helps limit children's employment. Available studies have put forward opposing hypotheses, but rigorous empirical evidence is scant. The present study aims to fill some of this void by studying the evidence from comparable farm household survey data in seven developing countries, including three in Asia (India, Nepal, and Vietnam) and four in sub-Saharan Africa (Ethiopia, Ghana, Nigeria, and Tanzania).

Various key findings emerge. First, many children are found to engage in productive activities in studied countries. The prevalence is particularly high in African countries, such as in Ethiopia where more than one third of children aged 5-14 years engage in farm or off-farm work. Second, while the prevalence of child labour in agriculture (i.e., when productive engagement is detrimental to schooling and child growth) is much lower (at 10% or less in seven countries), they are still sizable in absolute terms; at least 6 million children in these countries partake in agricultural work at the expense of opportunities in adulthood. Third, agricultural mechanization, reflected in farm household's use of machinery such as tractors, significantly reduces the likelihood of use of children's labour and increases school attendance. Fourth, the measured impacts of mechanization are only modest, however, and likely indirect, that is, dependent on the extent to which mechanization helps improve household income and on local conditions (such as quality of rural infrastructure and accessibility of education and other social services).

Overall, promotion of agricultural mechanization can help prevent use of child labour. To be truly impactful, however, related support measures should be embedded in broader strategies to enable agricultural productivity growth and improve livelihoods of poor rural households.

Keywords: child labour, agricultural mechanisation, farm household data, Asia, Africa

ACKNOWLEDGMENTS

This study was funded by the Food and Agricultural Organization of the United Nations. Comments received from Ariane Genthon, Josef Kienzle, Mayling Flores Rojas, and Bernd Seifert of FAO are gratefully acknowledged. The authors are also grateful for editorial assistance provided by Swati Malhotra, Pamela Stedman-Edwards, and Emelyn Go. The research fits under the CGIAR Research Program on Policies, Institutions, and Markets (PIM), which is led by the International Food Policy Research Institute (IFPRI) and carried ou with support from the CGIAR Trust Fund. The opinions expressed in this paper and any remaining errors are the sole responsibility of the authors.

1. INTRODUCTION

The elimination of child labour is a shared global target. It is recognised as such through target 8.7 of the Sustainable Development Goals (SDGs). The United Nations has also declared 2021 as the International Year for the Elimination of Child Labour (FAO 2020). Child labour adversely affects human capital development (Sim, Suryadarma, Suryahadi 2017) and is detrimental to long-term health and nutrition (Sim, Suryadarma, Suryahadi 2017; Xia and Deininger 2019). Poor households, however, engage their children in farm work as it contributes to production and income generation. In low-income countries in Asia and Africa, their contribution has been found to be significant for poor households (see, for example, Alvi and Dendir 2011; Oryoie, Alwang, and Tideman 2017; André, Delesalle, and Dumas 2021). Access to social safety nets (including cash transfers) helps reduce use of child labour by poor farm households (Del Carpio, Loayza, and Wada 2016), but social transfers are less effective where children's labour is critical to resolving labour constraints and hence to farm production (André, Delesalle, and Dumas 2021). Generally, household decisions about child labour are influenced by a complex set of factors; these can include incomes, uncertainty, cost of hired labour, and the family's perception of the benefits of the child working versus the benefits of their receiving education (Dammert et al., 2018).

Introduction of mechanisation technologies has generally boosted agricultural productivity and farm income. Mechanisation in agriculture generally reduces the need for labour inputs and hence could also help reduce the need for child labour by farm households. Historically, governments have promoted mechanisation by giving financial support to mechanisation service providers, engineering research on machines, or intermediate animal traction technologies. Government support through extension services, for example training programmes on the use of agricultural equipment machines and draught animals, has also been critical to the adoption of mechanisation in agriculture (Pingali 2007; FAO and AUC 2018; Diao, Takeshima, and Zhang 2020).

Farm mechanisation is a sequential process. Typically, the more arduous human-powered tasks are the first to be replaced with mechanical or animal draught power. As a result, operations such as land

preparation tend to be mechanised first, followed (often with a substantial time lag) by the mechanisation of other operations ranging from harvesting, planting, and weeding, to pest control. In the initial stages, government support may be required to promote adoption of technologies for mechanised land preparation, while support for mechanisation of other farming activities is helpful for later stages.

The sequential introduction of different mechanisation processes complicates assessment of the relationship between mechanisation and the use of child labour. If tillage by tractors, for example, allows more thorough breaking up of soils—and thus the destruction of the roots of weeds or the killing of pests—it will likely reduce the need for farm (including child) labour. This is not necessarily always the case, however; more labour may be needed for other operations or if mechanisation of land preparation leads to a larger cultivated area or higher levels of production. In such cases, the demand for child labour could also increase, for example for planting or weeding or for post-harvest activities. Introducing machines (such as threshing machines) that reduce the physical strength required, can also inadvertently lead to an increase in child labour for such tasks (see, for example, Pingali 2007). There is scant evidence on the relationship between farm mechanisation and child labour or children's employment in general, and it is limited to case studies (Pingali 2007; Self and Grabowski 2009).

The present report aims to provide more systematic evidence regarding the relationship between mechanisation, child labour, and school attendance.

1.1 Data and definitions

While agricultural mechanisation takes a variety of forms, this study focused on the adoption of tractors, which are one of the most versatile farm mechanisation tools. Historically, their adoption has been considered to be one of the key elements of overall agricultural mechanisation processes. The study provides a comparative analysis of seven countries in Asia and Africa: India,[1] Nepal, Vietnam, Ethiopia, Ghana, Nigeria, and Tanzania. For all seven countries, comparable farm household survey data was

[1] Data for India covers households in semi-arid areas only.

available from Living Standards Measurement Study—Integrated Surveys on Agriculture (LSMS-ISA) or from other living standards surveys, as well as from the Village Dynamics Studies in South Asia (VDSA).

As further detailed below, in some cases survey data shows considerable variation between survey rounds over a relatively short time span. In most cases, we consider the estimates of changes in key indicator values as being sufficiently reliable estimates of actual change on the ground, though part of the variation may be attributable to variation in data collection methods. In each of the country cases, to estimate the impacts of mechanisation on child labour we focus primarily on differences between farm households that use capital equipment and those that do not; we focus less on changes over time. In much of the analysis, this study thus takes averages of key indicators across survey rounds.

The use and availability of tractors and draught animals for farming varies considerably across the seven countries. Table A1 distinguishes three types of farm households: (1) those using human power only; (2) those using draught animals but not tractors; and (3) those using tractors. Among the four African countries, the share of tractor-using farm households has been rising faster in Ghana and Tanzania (reaching 15 percent or more) than it has in Nigeria and Ethiopia, where between 3 and 5 percent of households use tractors. In Ethiopia, the use of draught-animal power is more widespread than in Nigeria or Tanzania. In Asia, use of tractors is more common, with more than 50 percent of households in Vietnam and in semi-arid areas of India using tractors. Tractor use is less common in Nepal, though increasing, with the share of usage reaching 25 percent of farm households in 2010, up from 5 percent in 1995. About 10 to 12 percent of farms in the semi-arid areas of India also use combine harvesters. No information is available for such usage in the other study countries.

International conventions define child labour as "work that is inappropriate for a child's age, affects children's education, or is likely to harm their health, safety or morals" (FAO 2020; Box A). Child labour is thus not about children's employment per se; rather, it concerns situations where children below the minimum age for employment are engaged in labour, where it interferes with compulsory schooling, and where hazardous and/or mentally, physically, socially or morally dangerous conditions prevail. It refers, in short, to situations in which work undermines children's well-being or hinders their education

and development, thus eroding their future opportunities in life. Child labour studies mostly concentrate on children 5 to 14 years old, as, in many countries, this age range coincides with that of compulsory education and with age requirements for employment. We checked the robustness of our results by adding adolescent youth in the age of 15 to 17 years old, as their employment sometimes faces legal barriers similar to those of children under 14 years of age (ILO 2018). We found that the key messages of this study generally hold across proxies for these definitions.

"Children's employment", as it is referred to in this study, includes all activities carried out by children either in actual employment or in unpaid household chores. No qualification related to the definition of child labour is imposed in terms of the nature of the work or whether it is detrimental to children's development. The survey data does not always allow strict adherence to such concepts, but in the statistical analysis of this study (as indicated in Box A) we have tried to adhere as much as possible to international standards and definitions.

1.2 Outline

The remainder of this report is organised as follows. Section 2 provides a descriptive analysis of the extent of child labour in the seven study countries and, more generally, of children's employment in those countries. School attendance is used as a proxy for whether engagement in productive activity is detrimental to children's development. Section 3 is divided into two parts. It first presents a descriptive analysis of the relationship between farm mechanisation and the employment of farm children; this is followed by an econometric analysis of the extent to which mechanisation reduces child employment in on- and off-farm activities. Section 4 offers conclusions.

Box A: Definitions of terms used in this report to describe children's employment

Children's employment can take various forms and intensities. In 2008, the International Conference of Labour Statisticians (ICLS), through its global resolutions on child labour, provided a framework for classifying different statistical categories. These included working children, children in employment, and child labour. Given the availability of information in the dataset used, our analyses particularly covered settings best termed as "children in productive activities"; which comprises "*children in employment"* and "*children in other productive*

activities." According to the ICLS resolution concerning the statistics on child labour, "Children in employment are those engaged in any activity falling within the production boundary in the SNA [System of National Accounts] for at least one hour during the reference period", while children in other productive activities include those engaged in "unpaid household services" or "household chores".

The ICLS resolution defines child labour as "children in productive activities"; however, it further categorises—depending on the nature of the work that children below the minimum age are engaged in—whether the work is ″paid or unpaid productive activities, which interfere with compulsory schooling, [and whether it] is hazardous and/or is mentally, physically, socially, or morally dangerous and harmful to them."

Use of terms in this report

The data used in this report is not specifically designed to capture these exact definitions of child labour; rather, it is more appropriate for children in employment or children in productive activities. Furthermore, the data does not capture information for all the *unpaid household services*, or *household chores* done by children; the report therefore primarily uses the term "children in employment" or "children's employment". Importantly, however, depending on the exact nature of the engagement, some of the activities captured in the data may be considered unpaid household services or household chores; the results of this study thus need to be interpreted with some caution.

It remains informative, however, to distinguish between conditions more relevant to the discussions of child labour, and other less-problematic forms of children's engagement in productive activities. Given the limitations of the datasets used, it was necessary for us to develop modified definitions of the type of work (agricultural work and all-sector work), work intensity, and schooling status of children in order to approximate the concept of child labour that is enshrined in international conventions.

As for the "schooling status" of children, we focus on situations where children mostly attend school but miss a significant number of school days; we combine this with situations where children are not enrolled in school and thus miss schooling altogether. We use these combined situations to define the conditions under which children are "missing" school. (If children were interviewed when schools were in recess, for example summer break, it was not counted as missing school.)

We define children's work engagement as "school-affecting" if the work is done by children who reported missing at least part of the school year prior to the date of the survey interview. School-affecting does not imply direction of causality, in that work may adversely affect schooling but school attendance could also be seen as limiting available work time; however, the term is used in this report to signify conditions under which employed children are partially or completely missing school.

Similarly, we differentiate between "less-intensive work" and "intensive work". Children are described as being engaged in intensive work if they work more than 14 hours a week. While there are no clearly defined "work intensity" thresholds which distinguish employment as child labour, the Food and Agriculture Organization (FAO 2020: 8) refers to "a threshold of 14 hours per week, together with the obligation to undertake working hours during daylight"; the FAO definition implies that working more than 14 hours per week can

potentially lead to conditions that would identify work as child labour. Where relevant, we also apply the stricter criterion of 20 hours per week to indicate significantly intensive work. We conduct our analyses using these two criteria.

It is important to note—because the data used do not differentiate the type of work carried out—that "intensive work" in this report is strictly based on the number of hours worked per week (duration), even though shorter-duration work can also be intensive.

"Agricultural work" refers to on-farm employment by children, while "all-sector work" refers to all the types of work in which children are engaged, be it on- or off-farm agriculture-related activities or non-farm activities.

2. CHILDREN'S EMPLOYMENT AND SCHOOLING IN AFRICA AND ASIA

This section provides key statistics regarding the nature of employment and school attendance among children in six countries with nationally representative survey data (Nepal and Vietnam in Asia and Ethiopia, Ghana, Nigeria, and Tanzania in sub-Saharan Africa). We also show data for India from available surveys of semi-arid regions in that country, though it is not nationally representative.

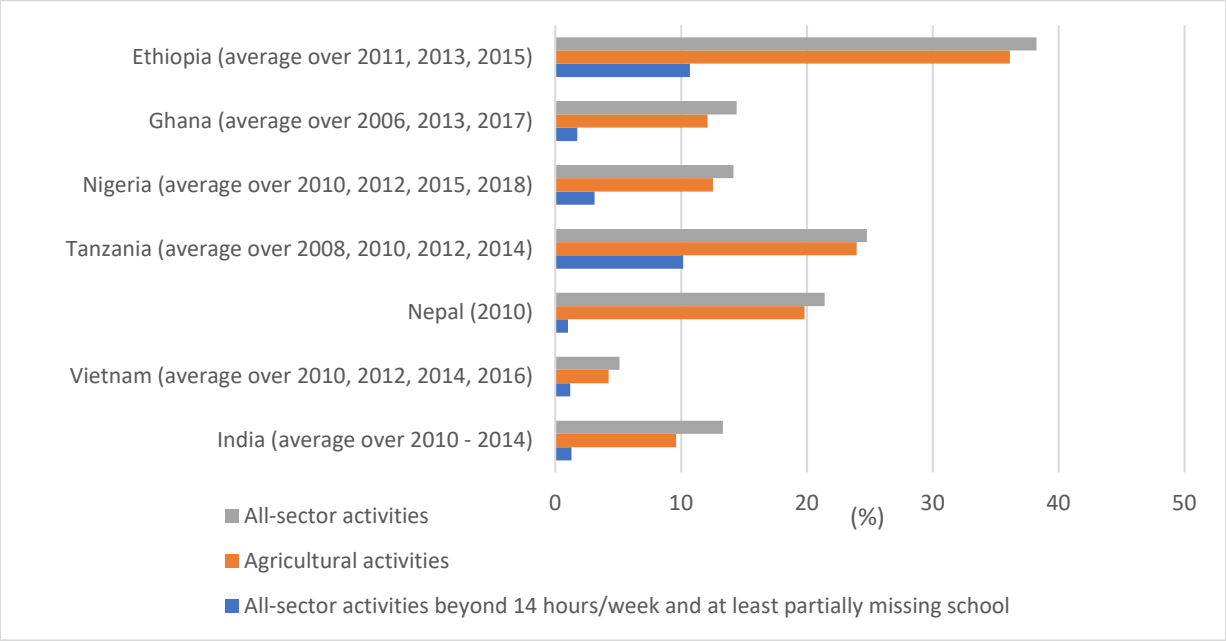
2.1 Prevalence and intensity of children working in agriculture

Figure 2.1 and Annex Tables A2 and A3 summarise children's engagement in work activities in general. Key findings include that:

- ***Children's employment is substantial in countries with less-advanced agricultural development***. One-fifth to one-third of children aged 5 to 14 years in all the studied African countries, as well as in Nepal, are engaged in at least some employment. The share is lower in countries such as Vietnam, which are at a more advanced stage of agricultural and economic transformation.
- ***Boys are more likely to be engaged in work than girls*** in four out of six countries (Ethiopia, Nigeria, Tanzania, and Vietnam).
- ***Work intensity among children working in agriculture is generally high*** (Table A3); there is, however, considerable variation across countries, with between one-quarter and three-quarters of children working at least 14 hours per week in agriculture. Between 13 and 60 percent of children

worked at least 20 hours per week. At this work intensity, the engagement of these children can be categorised as child labour that is likely detrimental to schooling and normal child development.

Figure 2.1: Average shares (percentage) of children aged 5 to 14 years who are employed, by country



Source: Authors' computations based on the various datasets used.
Note: Averages shown are from the various periods covered by the respective datasets; figures for India are not nationally representative; more detailed statistics are presented in Tables A2 through A7.

2.2 School attendance of children working in agriculture

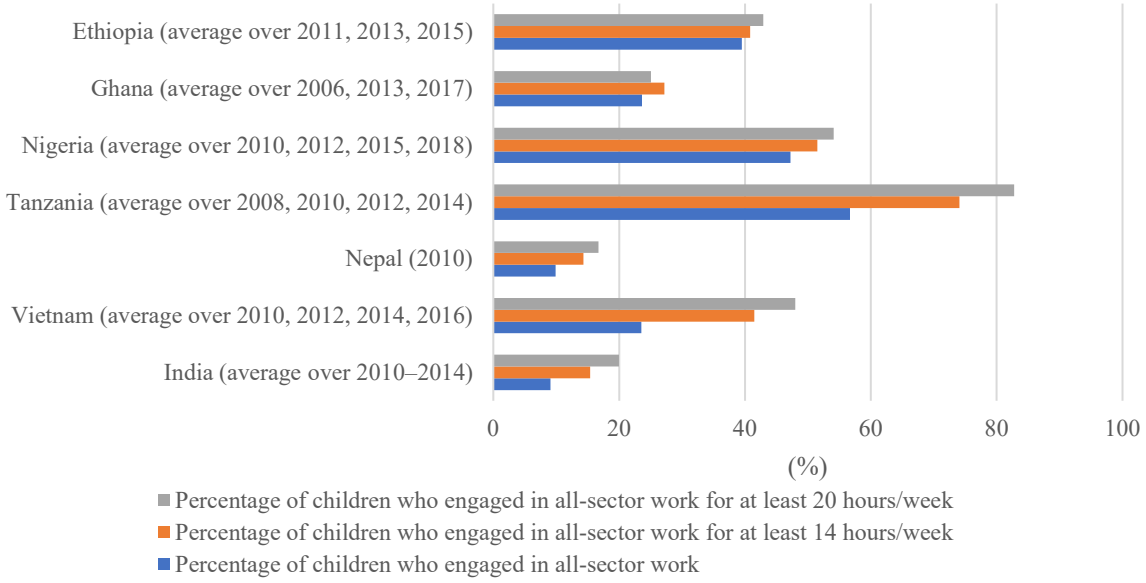
Figure 2.2 and Figure A1 summarise the schooling status of children. Key findings include that:

- ***Many children of farming households (working or not working) do not attend school regularly***. Absentee shares are particularly high in Ethiopia, Nigeria, and Tanzania; they range between 24 and 55 percent in the most recent year of observation.[2] School attendance rates are much higher (above 90 percent) in Asia (Nepal and Vietnam) (Figure A1).
- ***Boys in Ethiopia, Nigeria, and Tanzania are more likely to miss days of schools*** (Figure A1). Gender differences in school attendance are negligible in the other countries.

[2] Data on school attendance in Ghana is not strictly comparable across years because of changes in data collection– methods. Taking the average of the reported data for 2013 to 2017, about 20 percent of children in Ghana miss school days.

- ***Children with higher work intensity are more likely to miss school.*** Figure 2.2 shows that high rates of school absenteeism are clearly correlated with work intensity (i.e., with the percentage of children working 14 hours per week or more). In Ethiopia, Nigeria, and Tanzania, roughly half the children working in agriculture miss school partly or fully, while in Ghana in 2013, about one-third of children fell into this category. In Nepal, between 1995 and 2010, the share of working children who were partially missing school declined significantly.

Figure 2.2: Shares (percentage) of children aged 5 to 14 years who at least partially missed school, depending on their work intensity



Source: Authors' computations based on the various datasets used.
Note: Averages shown are from the various periods covered by the respective datasets; figures for India are not nationally representative; more detailed statistics are presented in Table A5.

- ***Proxy estimates suggest that the prevalence of child labour in agriculture is about 10 percent or less in the seven countries***. Using the information on work intensity (Table A3) and school attendance (Table A4), we construct a proxy indicator of the prevalence of child labour, defined here as the share of children aged 5 to 14 years who are working more than 14 hours per week and who also miss school wholly or partially. Figure A2 indicates that the highest incidence of child labour in agriculture is found in Ethiopia and Tanzania (between 8 and 11 percent). The prevalence of child labour, by this definition, is much lower in the other countries; it ranges between 0.7 percent in India and Vietnam and 3.3 percent in Nigeria. In absolute terms, however, these still represent sizeable

numbers of children: about 2.5 million in Ethiopia, 1.5 million in Nigeria and Tanzania, and between 50,000 and 100,000 in Ghana, Nepal, and Vietnam.

2.3 Children's engagement by type of productive activity

Farm children who work are mostly engaged in agricultural activities (Table A7). In the most recent year of observation, in most of the study countries, 90 percent of the work done by children was agricultural labour. Only in Ghana and Vietnam was a significant amount (about 30 percent) of children's labour time spent in non-agricultural activities.

In Tanzania and Nigeria, available data indicates that livestock rearing is a significant part of the agricultural work carried out by children. This is most visible in Tanzania, where more than 10 percent of children in the 5-to-14 age group are primarily responsible for some aspects of livestock rearing, either herding, feeding/watering, selling, or grazing the animals.

Few surveys report on the nature of the agricultural activities in which children are engaged. Where available, the data suggests that children working in agriculture in Nigeria and Tanzania are mainly engaged in land preparation, planting, and/or weeding, while those in Ethiopia spend more time harvesting and/or threshing (Figure A3).

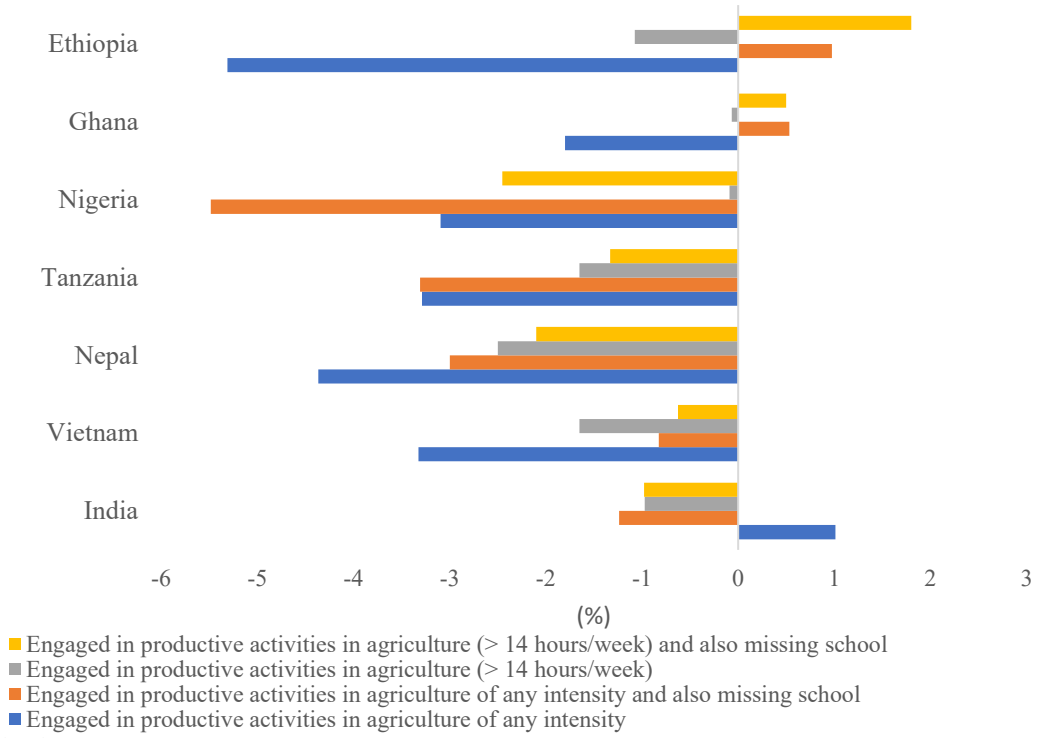
3. THE EFFECT OF MECHANISATION ON CHILDREN'S EMPLOYMENT

3.1 Descriptive analysis

This subsection provides descriptive statistics regarding the differences in children's employment within the agricultural sector, depending on whether they belong to households with or without mechanisation. As indicated in the Introduction, we take the use of tractors as a proxy for agricultural mechanisation of farming. The descriptive analysis provided in this section serves to further identify the key variables that are used in the more rigorous, econometric assessment of the relationship between mechanisation and child labour in agriculture; the econometric analysis is put forward in the next subsection.

Figure 3.1 (and Figure A4) summarise the differences between farm households that use tractors and those that do not in terms of the share of children employed in agriculture; figures are averaged over the periods covered by the respective datasets. We further assess differences in work intensity, as measured by number of hours per week of productive engagement by children. These are shown for two thresholds of work intensity: whether children work more than 14 hours per week or more than 20 hours per week, and differences in school attendance (whether children engaged in productive work also miss school days). Tables A8 through A17 provide more detailed descriptive statistics specified by survey year.

Figure 3.1: Differences in shares (percentage) of children employed in tractor-using farm households, relative to other farm households, by country



Source: Authors' estimation.
Note: Averages shown are from the various periods covered by the respective datasets; figures for India are not nationally representative; more detailed statistics are presented in Tables A8 through A17.

Key findings are that:

- ***Children belonging to tractor-using farm households are less likely to engage in farm and off-farm employment than are children in households that do not use tractors.*** Differences vary across countries, years, and types of farming operations. Averaged across survey years and

including children who are doing work at any intensity (blue bars in Figure 3.1), differences range between -5.3 percentage points in Ethiopia and -1.8 percentage points in Ghana. Differences in Nigeria, Tanzania, Nepal, and Vietnam are within that range. Semi-arid areas in India are an exception, showing a positive difference of 1 percentage point; in this case, this seems to suggest that the use of combines actually increases the likelihood of productive activity by children. As indicated below, however, the opposite is true when considering higher work intensity or children who are also missing school days.

- ***In Nigeria, Tanzania, Nepal, Vietnam, and India, children in households with mechanisation are less likely to work long hours (more than 14 hours per week) and/or miss school*** (see orange, grey, and yellow bars in Figure 3.1). Ethiopia and Ghana seem to form an exception to this pattern, showing a slight increase in this likelihood for children in households with mechanised farm equipment. These patterns may, however, also reflect the heterogeneity in production systems with different farm power needs. Such heteroneity is common in Africa. Below, we further assess whether this is attributable to mechanisation or to other factors.
- ***Children in households with mechanisation are less likely to engage in land preparation and planting activities and are also less likely to work in harvesting and other farm activities.*** This holds for Ethiopia and Nigeria, the two countries for which such information is available. In these two countries, the differences in terms of work engagement between children on mechanised and non-mechanised farms are somewhat bigger for land preparation and planting activities than for mid- and late-season activities including harvesting and threshing (Figure A4).

Overall, this descriptive evidence confirms the hypothesis that use of mechanised agricultural equipment is associated with reduced children's employment, reduced work intensity in such activities, and less likelihood of missing school. The data do show some exceptions to this more general pattern; there are also differences in the degree of variation across countries and over time. Such variation motivates the econometric analyses summarised in the next subsection.

3.2 Econometric approach

The previous subsection generally compared mechanised farm households with non-mechanised farm households. This subsection offers more insights into how mechanisation affects children's engagement in farm and other employment given the current characteristics of a particular farm household. These insights are obtained from econometric analyses, which enable us to control for other possible determinants of child labour or children's employment and to isolate the effect of mechanisation.

A simple econometric analysis was conducted to assess the associations between mechanisation and children's work engagement, while controlling for other potential exogenous factors that are also expected to affect children's work engagement. Specifically, these relationships were estimated using the following specification:

$$y_{iht} = \alpha + \beta_m \cdot m_{ht} + \beta_{xi} \cdot x_{iht} + \beta_{xh} \cdot x_{ht} + c_i + \varepsilon_{iht}, \quad (1)$$

in which y_{iht} denotes various indicators of work engagement by children i in household h at time t. The variable m_{ht} denotes the use of mechanisation by household (tractors for all countries and combine harvesters for India). x_{iht} denotes a vector of time-variant exogenous variables specific to child i. x_{ht} denotes a vector of time-variant exogenous variables specific to the child's household h, which also includes variables common within the community in which the household h resides. Parameters α, β_m, β_{xi}, and β_{xh} are estimated coefficients. Parameter c_i denotes the estimated time-invariant unobserved fixed effect for the child i. Parameter ε_{iht} refers to idiosyncratic error.

For all countries for which panel data at individual levels was available (which does not include Ghana), panel fixed effects are estimated in order to control for unobserved individual fixed effects; in this way, potential endogeneity between children's employment and a household's adoption of mechanisation is mitigated. For Ghana, for which only repeated cross-sectional data is available, we employed instrumental variable methods where households' adoption of mechanisation is instrumented by the presence of tractor owners within the community and local districts where the child resides.

Panel data from the sample of household members used in the econometric analyses include information for all children aged 5 to 14 years for each survey round for all countries (except Ghana) and for all households engaged in farming activities reporting use of tractors. Descriptive data on tractor use for all survey rounds are presented in Annex Table A1. While samples are unbalanced, the rates of accretion or attrition were found to be relatively small, and results are robust when limiting the analysis to samples that are balanced across survey rounds.

Table 3.1 summarises the list of time-variant variables x_{iht} and x_{ht} used for panel datasets for Ethiopia, Nigeria, Tanzania, India, Nepal, and Vietnam. The list of variables is also guided by the literature review in Takeshima and Vos (2021). For Ghana, for which there is repeated cross-sectional data, additional exogenous variables (which are expected to be time invariant and which would have been dropped in the model specification with panel data [1]) are included (Table 3.2).

Table 3.1: Other time-variant explanatory variables included in panel fixed effects regressions

Category of variables	Description of variables
Individual-level	
Health shocks	• Whether the child suffered serious illness or injuries during the previous 2 to 4 weeks[a] • Whether the child had been hospitalised any time during the previous 12 months

Demographic changes of other household members	• Biological mother of the child
	  o Whether she lives in the same house as the child
	• Biological father of the child
	  o Whether he lives in the same house as the child
	• Change in number of younger siblings due to death and new births between survey rounds (which affects the child's responsibility in caring for younger siblings)

Employment shocks of biological parents	• Biological mother of the child
	  o Whether she changed her primary job to the non-farm sector
	• Biological father of the child
	  o Whether he changed his primary job to the non-farm sector

Household/community-level variables	
Wages	Typical farm wages in the local area and their changes between survey rounds • Wages for adult males for land preparation activities • Wages for adult females and child workers and other farming activities where data are available

Category of variables	Description of variables
Weather	Rainfall
Community-level shocks related to education[b]	Whether the local community in which the child resides had new development projects, public investment, or shocks and disasters during the previous 12 months that directly affected local school environments • Construction of new schools in local area • Maintenance of different types of schools in local area
Community-level shocks (other types)[b]	Whether the local community in which the child resides had new development projects, public investment, or shocks and disasters during the previous 12 months • Infrastructure (such as roads, markets, irrigation facilities, storage facilities) • Public services other than education (such as healthcare, veterinary services, agricultural extension programmes) • Commercial services (such as banks, financial institutions)
Time dummies	Survey round dummies to account for any other shocks specific to each survey timing

Source: Literature survey in Takeshima & Vos (2021).
Note: [a] Reference periods vary depending on the country and also survey rounds; [b] exact measurements and definitions of related variables vary by country.

Table 3.2: Other explanatory variables included in repeated cross-sectional regressions applied to Ghanian data (in addition to variables shown in Table 3.1)

Category of variables	Description of variables
Individual-level	
Demographic characteristics of child	• gender • age
Household-level variables	
Household demographics	• Age of household head • Gender of household head • Education level of household head (years of formal education completed) • Household size
Fixed assets	• Farmland owned • Livestock assets • Household assets • Agricultural capital • Non-farm business assets
Distance to institutions	Distance to various key infrastructures • Distance to the nearest road • Distance to markets • Distance to public extension office • Distance to the nearest agricultural R&D institutions
Agroecological conditions	• Rainfall (annual total of the survey year) • Wind (annual average of the survey year)

Category of variables	Description of variables
	• Shares of area with poor drainage, medium drainage, and excessive drainage • Soil characteristics (sodicity, salinity, coarse, fine, organic content, acidity) • Elevation • Terrain ruggedness • Distance to the nearest major rivers • Slope
Region dummies	Administrative region dummies Urban/rural dummies

Source: Takeshima and Vos (2021).

3.3 Results

Summary findings are presented in Figure 3.2 as well as Figures A5 and A6 (more detailed results are found in Statistical Appendix, Tables A18 to A21). Key findings are that:

- ***Use of tractors or combine harvesters on farms generally reduces children's employment in agriculture and in other sectors*** (Figure 3.2). This holds generally for school-affecting work and intensive work.
- ***Tractor use (as well as usage of combine harvesters in India) reduces the probability of children's work engagements by an average of 5 to 10 percentage points*** (Figure 3.2). Impact varies, however, ranging from near 0 (insignificant) in Vietnam to 30 percent in Ghana, depending on the country context and whether machine power is used for land preparation and planting or for harvesting (see conclusions below).
- ***In the African study countries (except Tanzania), use of tractors reduces both children's employment and the risk that they do not attend school.*** The latter impact is less clear in the Asian context, where very few children are reported as not attending school even when they engage in farm work (Figure 3.2).

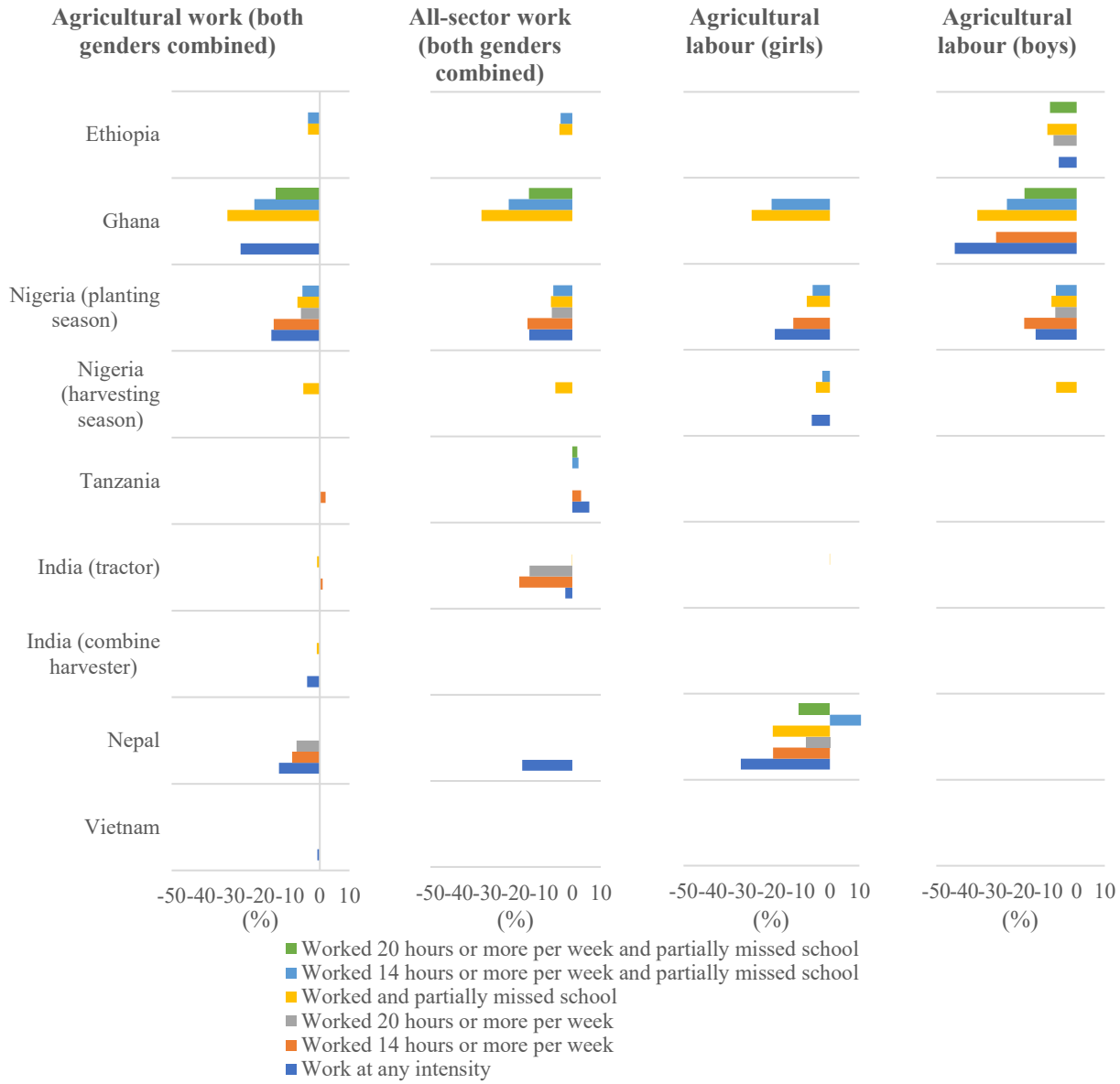
Table 3.3: Estimated associations between mechanisation and children's engagement in work: effects on the probability (percentage) that a child engages in work, combined with schooling status and working beyond certain thresholds

Country	Ethiopia	Ghana[a]	Nigeria (post-planting season)	Nigeria (post-harvesting season)	Tanzania	India	India	Nepal	Vietnam
Estimation models	**Panel fixed effects**	**GMM cross-section**	**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**
Summary	**Tractors**	**Tractors**	**Tractors**	**Tractors**	**Tractors**	**Tractors**	**Combine harvesters**	**Tractors**	**Tractors**
Whether worked in agricultural sector									
Work at any intensity	-2.012	-26.726*	-16.390***	-3.303	2.867	0.433	-4.298**	-13.810***	-0.847**
Worked 14 or more hours/week	-1.104	-13.983	-15.580***	-0.014	1.893*	0.968**	0.953	-9.362**	0.711
Worked 20 or more hours/week	0.034	5.449	-6.395**	0.097	0.374	0.051	0.018	-7.817**	1.082
Worked and partially missed school	-4.014*	-31.189***	-7.536***	-5.525***	0.155	-0.912*	-0.997*	-2.434	0.697
Worked 14 or more hours/week, missed school	-3.991†	-22.087***	-5.853**	-1.616	1.097	0.392	1.340	-3.322	0.367
Worked 20 or more hour/week, missed school	1.104	-14.793***	-1.602	0.192	1.152	0.000	0.000	-2.204	0.769
Whether worked in any sector (including agricultural sector)									
Work at any intensity	-0.491	-8.535	-15.180***	-4.734	6.020***	-2.522***	-0.152	-17.680***	-0.498
Worked 14 or more hours/week	-0.758	3.284	-15.790***	-2.196	3.092**	-18.650***	-2.323	-3.918	0.604
Worked 20 or more hours/week	-0.537	18.150	-7.225***	-2.123	1.094	-15.050*	-0.570	-1.522	0.541
Worked and partially missed school	-4.568*	-32.010***	-7.528***	-6.037***	1.577	-0.009*	-0.003	-3.872	0.899
Worked 14 or more hours/week, missed school	-4.118*	-22.460***	-6.735***	-2.150	2.169**	-0.864	0.530	-2.598	0.552
Worked 20 or more hours/week, missed school	0.548	-15.340***	-3.021	-0.357	1.754*	-0.685	-0.405	-1.866	0.509
Sample size (all rounds combined)	**2,395**	**27,889**	**16,473**	**16,473**	**8,410**	**3,182**	**3,182**	**1,625**	**6,721**
Number of survey rounds	**2**	**3**	**4**	**4**	**3**	**5**	**5**	**3**	**4**

Source: Authors' estimations based on LSMS-ISA survey data.

Note: [a] For Ghana, estimations are based on the generalised method of moments (GMM) to address potential endogeneity of mechanisation adoption, using two instrumental variables (whether there are any tractor owners within the community or district in the sample); the Hansen orthogonality test suggests that the instrumental variables used satisfy that models are not overidentified, which ensures the consistency of the results; *, **, and *** indicate statistical significance at the $p < 0.1$, $p < 0.05$, and $p < 0.01$ levels.

Figure 3.2: Statistically significant associations between the adoption of tractors or combine harvesters and children's employment (percentage point effects)



Source: Econometric estimation by authors.
Note: Only statistically significant associations are shown.

- ***In contexts where access to education is limited, introduction of agricultural machinery may end up merely shifting children's labour time from farm to non-farm activities***. In Tanzania, for example, school attendance among rural children is generally low and farm households using tractors engage more children in livestock rearing (Figure A6) or non-farm activities (Figure 3.2).

- ***The effect of tractor adoption in reducing children's engagements in work activities is generally stronger during the planting season (except in India)*** (Figure A5), for the reason that most farm households in the study countries use tractors mainly for planting and land preparation. Tractors may allow adult household members to spend less time on land preparation and more on activities that previously were carried out by children, thus reducing children's engagement in production.
- ***Extended use of tractors or other machinery for off-farm work can expand the scope for mitigating child labour beyond the planting season*** (Figure A5). In India, for instance, the adoption of combine harvesters significantly reduces the likelihood that children work on the farm, while the use of tractors reduces the likelihood of any type of work by children whether on- or off-farm.
- ***Mechanisation has gender-sensitive impacts, but implications for boys and girls are context specific*** (Figure 3.2). Where work engagement of boys is significantly higher, such as in Ethiopia and Ghana, mechanisation strongly reduces productive engagement on farms by boys. In other contexts, such as in Nepal, mechanisation seems more likely to reduce engagement of girls in agricultural work. It is not obvious what contextual factors cause these gendered differences, and further research is required.

4 CONCLUSIONS

Most child labour is found in the agricultural sector, which remains a global concern. Children's employment occurs due to widespread poverty among farming households in developing countries. This study focuses on the extent to which agricultural mechanisation contributes to reducing child labour. More than children's engagement in farm activities per se, international concern regarding child labour in agriculture is about the detrimental effects of this labour on their overall educational development, their mental and physical health, and their future opportunities. There is little evidence regarding whether farm

mechanisation contributes to a decline in children's productive engagement and whether it reduces risks to their growth and development. The study addresses this to some extent by analysing the nature of children's employment and the relationship between their employment and school attendance; it examines the associations between these factors and levels of agricultural mechanisation deployed by the farm households' children belong to. The study provides household-level evidence using survey data for seven African and Asian countries.

Though agricultural mechanisation can take many forms, this study focuses on the use of tractors because they are one of the most versatile farm mechanisation tools and are a universal power source for all other driven implements and equipment in agriculture. They have significant potential to replace animal draught power and human (including children's) muscle power. Tractors are typically the first type of machine-powered equipment to be adopted at lower levels of agricultural development, where most child labour is also found.

Summarising:

- Children's engagement in productive activities is common in developing countries. The prevalence is particularly high in parts of Africa; in Ethiopia, for example, more than one-third of children aged 5 to 14 years engage in farm or off-farm work.
- The prevalence of "child labour" in agriculture—officially defined as when children's productive engagement in farming is detrimental to their schooling and growth—is much lower: in the seven African and Asian study countries, it was at 10 percent or less. While this share may seem low, at least six million children in these countries are informally employed in agriculture at the expense of their future opportunities.
- Agricultural mechanisation, as reflected in a farm household's use of machinery such as tractors, significantly reduces the likelihood of child labour and increases the likelihood of children attending school.

- These impacts of mechanisation are only modest at best, however, and are likely indirect; that is, they are dependent on the extent to which mechanisation helps improve household income, and they also depend on local conditions such as quality of rural infrastructure and accessibility of education and other social services.

A possible policy implication of this study is that promotion of agricultural mechanisation may help prevent use of child labour. By itself, however, the introduction of mechanisation will not suffice, for several reasons. First, the findings in the studied low-income contexts indicate that tractor use may reduce children's productive engagement by less than 10 percentage points. Second, the use of children for farm and non-farm work has multiple causes, with poverty likely being the main factor; hence, mechanisation should be considered as only one of the measures aimed at removing the root causes of child labour, which can also include the enhancement of agricultural productivity and improving the livelihoods of poor farm households.

Other studies in similar contexts have provided recommendations on how to promote mechanisation in agriculture and how to embed these into broader agricultural development strategies (see, for example, FAO and AUC 2018; Diao, Takeshima, and Zhang 2020). Key recommendations to this end include:

- Promoting farmer-to-farmer custom-hired mechanisation services (where individual farmers owning tractors provide mechanisation services such as ploughing and transport to other farmers) and training of both farmers and mechanisation service providers. Training for multifunctional uses can be key to helping service providers remain profitable; it can support their achievement of sufficiently high machine-utilisation rates and can help keep costs low in order to ease access for smallholders.
- Promoting the development of rental markets for machines and equipment through subsidies which do not distort the market, but which encourage affordable access to a broad range of machinery and brands.

- Supporting the development of local engineering capacity and investing in R&D to adapt agricultural machinery and equipment to local needs and conditions.

Lastly, while it is beyond the scope of this study, the observed effects of conventional mechanisation such as tractors on children's employment offer insights into the potential roles of recent digital innovation, and of information and communications technology (ICT). The role of conventional mechanisation technologies in the reduction of children's employment suggests that more modern, digital forms of mechanisation such as automation, robotics, and precision technologies have a similar or even greater potential to reduce child labour. The first set of precision technologies adopted worldwide included the monitoring of crop conditions such as moisture and yield (Griffin and Lowenberg-DeBoer 2005). Investments in continuous innovation and research to make these technologies more viable for developing countries can potentially contribute further to the enhancement of efficiency and the reduction of children's engagement in crop management such as pest control, watering, and weeding. Improved market information through ICT may also be relevant to the reduction of children's engagement in market transactions and transportation. Increased use of digital technologies for mechanisation service provision can also potentially reduce the cost of accessing conventional mechanisation technologies (Birner, Daum, and Pray 2021; Diao et al. 2021). Such broad linkages among digital technologies, mechanisation, and children's employment suggest that the reduction of child labour should continue to be one of the goals of the promotion of both conventional and modern forms of mechanisation.

REFERENCES

Alvi, E. & Dendir, S. 2011. Weathering the storms: Credit receipt and child labour in the aftermath of the great floods (1998) in Bangladesh. *World Development,* 39(8): 1398–1409.

André, P., Delesalle, E. & Dumas, C. 2021. Returns to farm child labour in Tanzania. *World Development,* 138: 105181.

Birner, R., Daum, T. & Pray, C. 2021. Who drives the digital revolution in agriculture? A review of supply-side trends, players and challenges. *Applied Economic Perspectives and Policy*, in press.

Dammert, A. C., De Hoop, J., Mvukiyehe, E. & Rosati, F. C. 2018. Effects of public policy on child labour: Current knowledge, gaps, and implications for program design. *World development,* 110: 104–123.

Del Carpio, X. V., Loayza, N. V. & Wada, T. 2016. The impact of conditional cash transfers on the amount and type of child labour. *World Development,* 80: 33–47.

Diao, X., Takeshima, H. & Zhang, X. 2020. *An Evolving Paradigm of Agricultural Mechanization Development: How Much Can Africa Learn from Asia?* Washington D. C., IFPRI.

Diao, X., Reardon, T., Kennedy, A., DeFries, R. S., Koo, J., Minten, B., Takeshima, H. & Thornton, P. 2021. *The Future of Small Farms: Innovations for Inclusive Transformation*. Food Systems Summit Brief Prepared by Research Partners of the Scientific Group for the Food Systems Summit April 2021.

FAO. 2020. *FAO framework on ending child labour in agriculture*. 148 pp. Rome. (also available at https://doi.org/10.4060/ca9502en).

FAO and AUC. 2018. *Sustainable Agricultural Mechanization: A Framework for Africa*. 127pp. Rome and Addis Ababa.

Griffin, T. W. and Lowenberg-DeBoer, J. 2005. Worldwide adoption and profitability of precision agriculture. *Revista de Politica Agricola*, 14: 20–38.

ILO. 2018. *Ending child labour by 2025: A review of policies and programmes.* Geneva, ILO.

Oryoie, A. R., Alwang, J. & Tideman, N. 2017. Child labour and household land holding: Theory and empirical evidence from Zimbabwe. *World Development,* 100: 45–58.

Pingali, P. 2007. *Agricultural mechanization: adoption patterns and economic impact*. In *Handbook of Agricultural Economics*, by Evenson, R. & Pingali, P. (eds.). Amsterdam, Elsevier.

Self, S. & Grabowski, R. 2009. Agricultural technology and child labour: Evidence from India. *Agricultural Economics,* 40(1): 67–78.

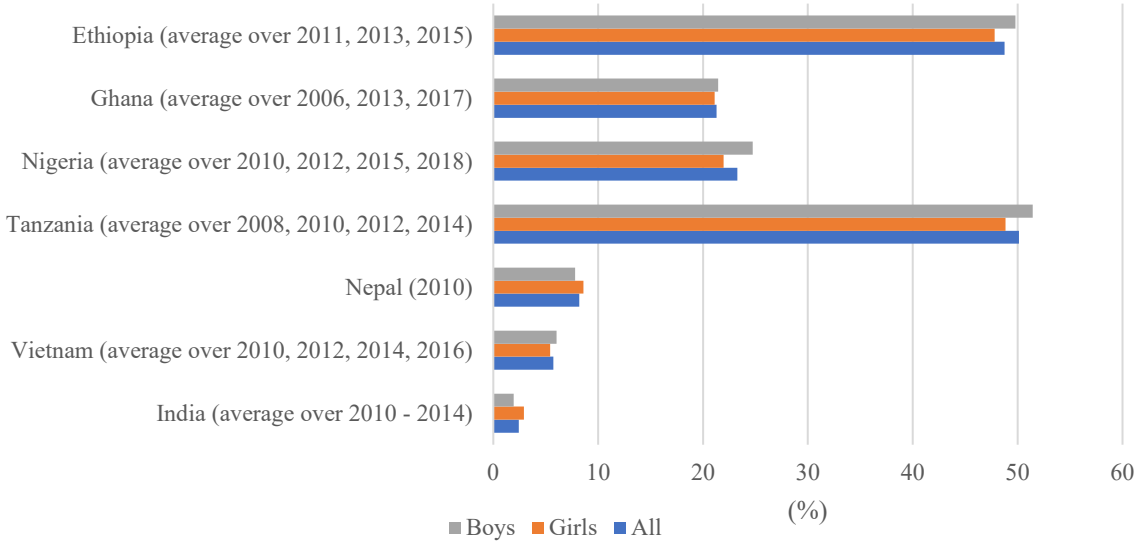
Sim, A., Suryadarma, D. & Suryahadi, A. 2017. The Consequences of Child Market Work on the Growth of Human Capital. *World Development,* 91: 144–155.

Takeshima, H. & Vos, R. 2021. Agricultural mechanization and child labour in developing countries. Background study prepared for FAO. Rome: Food and Agriculture Organization of the United Nations and International Food Policy Research Institute (mimeo).

Xia, F. & Deininger, K. 2019. Spillover effects of tobacco farms on the labour supply, education, and health of children: Evidence from Malawi. *American Journal of Agricultural Economics,* 101(4): 1181–1202.

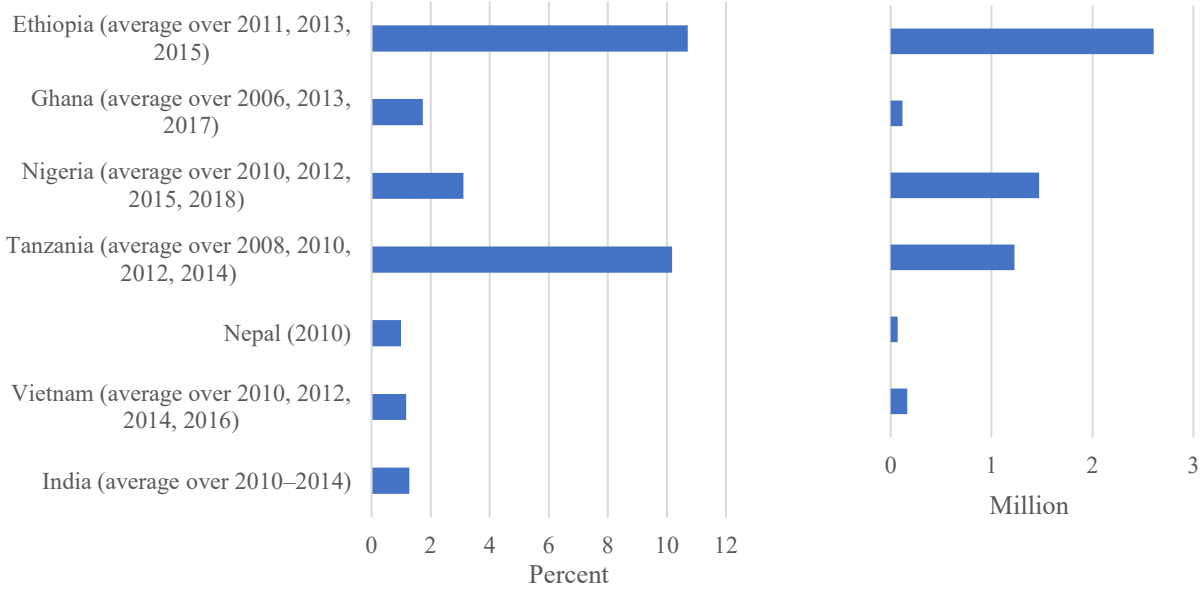
STATISTICAL APPENDIX

Figure A1: Shares (percentage) of children 5 to 14 years old who are at least partially missing school



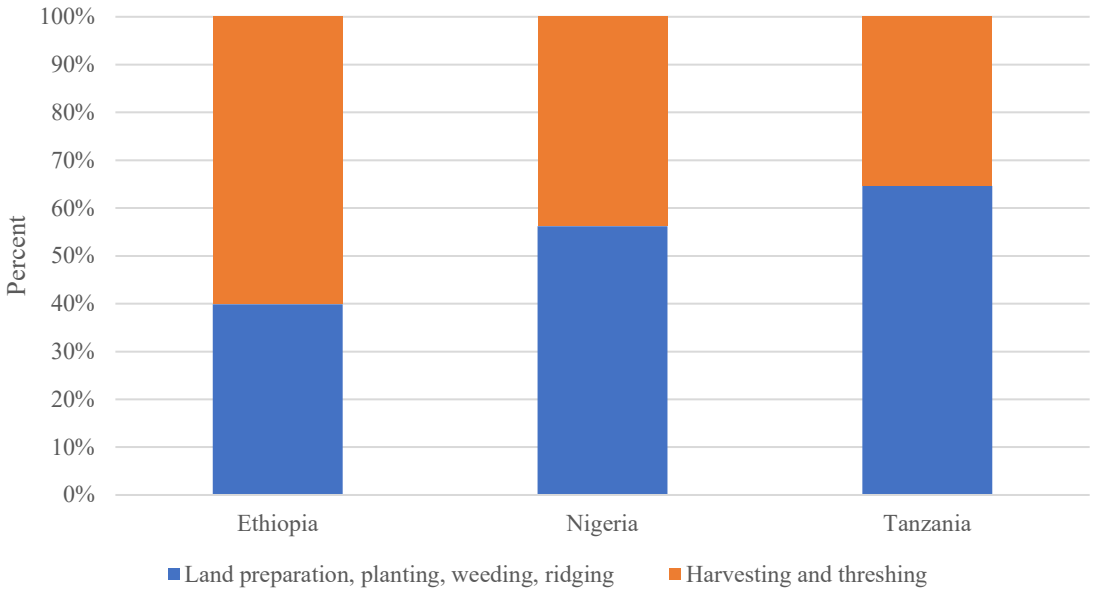
Source: Authors' computations based on the various datasets used.
Note: Averages are from the various periods covered by the respective datasets; figures for India are not nationally representative; more detailed statistics are presented in Table A4.

Figure A2: Left panel: shares (percentage) of "child labour" (proxy)[a]; right panel: number of children experiencing "child labour"



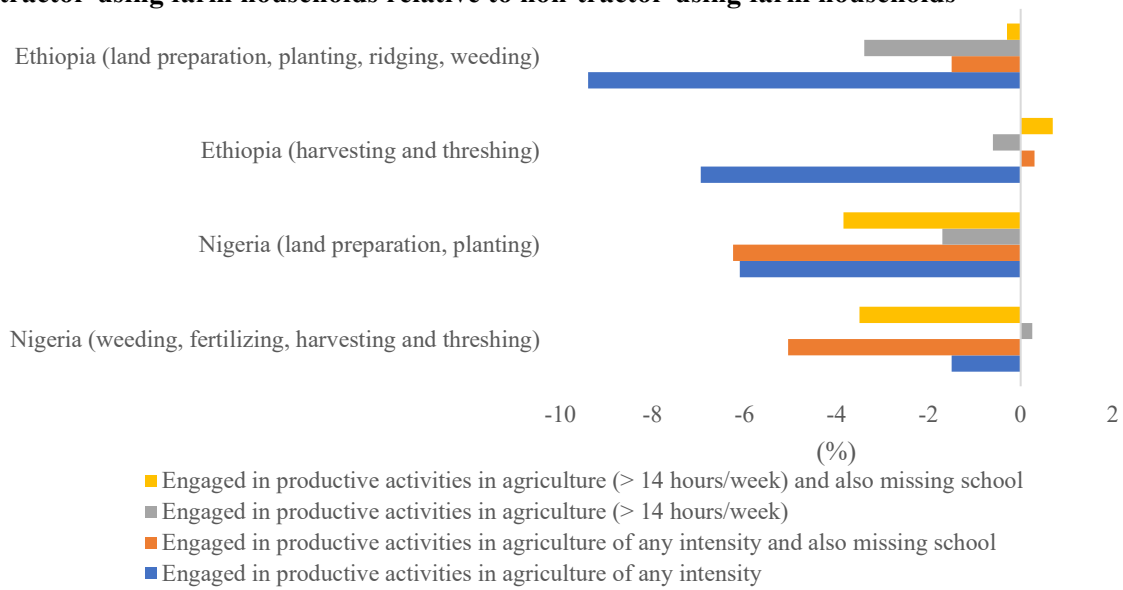
Source: Authors' computations based on the various datasets used.
Note: The figure for India is not nationally representative, and therefore not shown in the right panel; [a] "child labour" is defined here as children aged 5 to 14 who are employed beyond certain threshold levels of intensity and who do not attend school regularly; more detailed statistics are presented in Table A6.

Figure A3: Main types of agricultural work done by children in Ethiopia, Nigeria, and Tanzania (percentage of time engaged in crop production activities



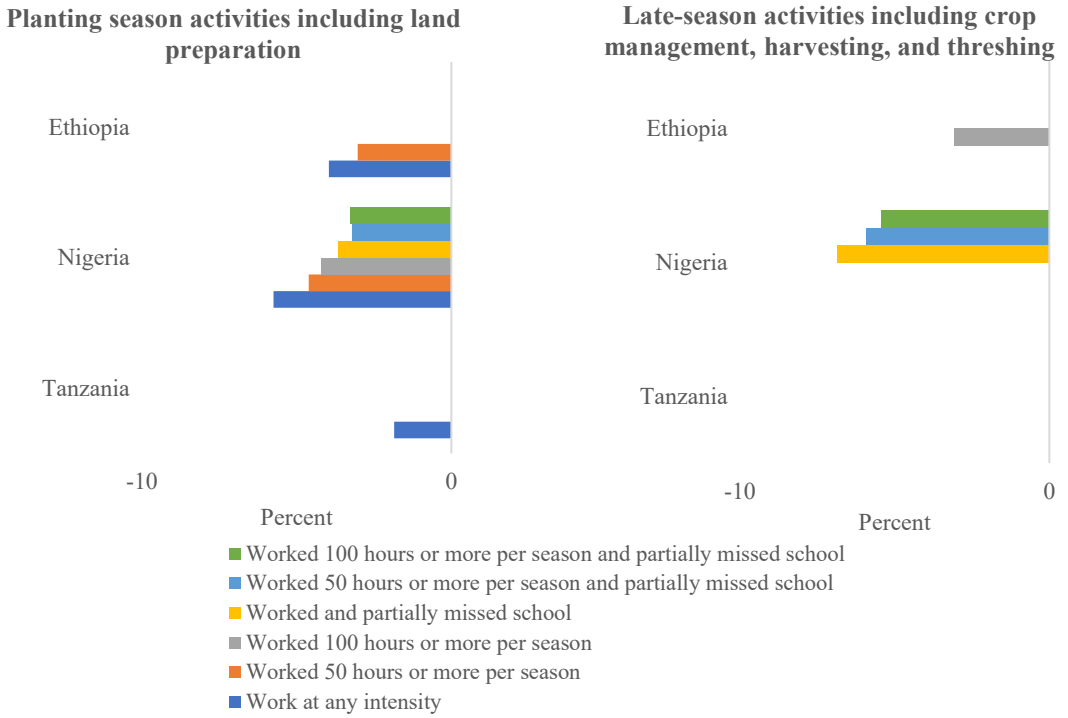
Source: Authors' computations based on the various datasets used.
Note: Averages are from the various periods covered by the respective datasets; more detailed statistics are presented in Table A7.

Figure A4: Differences in shares (percentage) of children employed in different farming operations in tractor-using farm households relative to non-tractor-using farm households



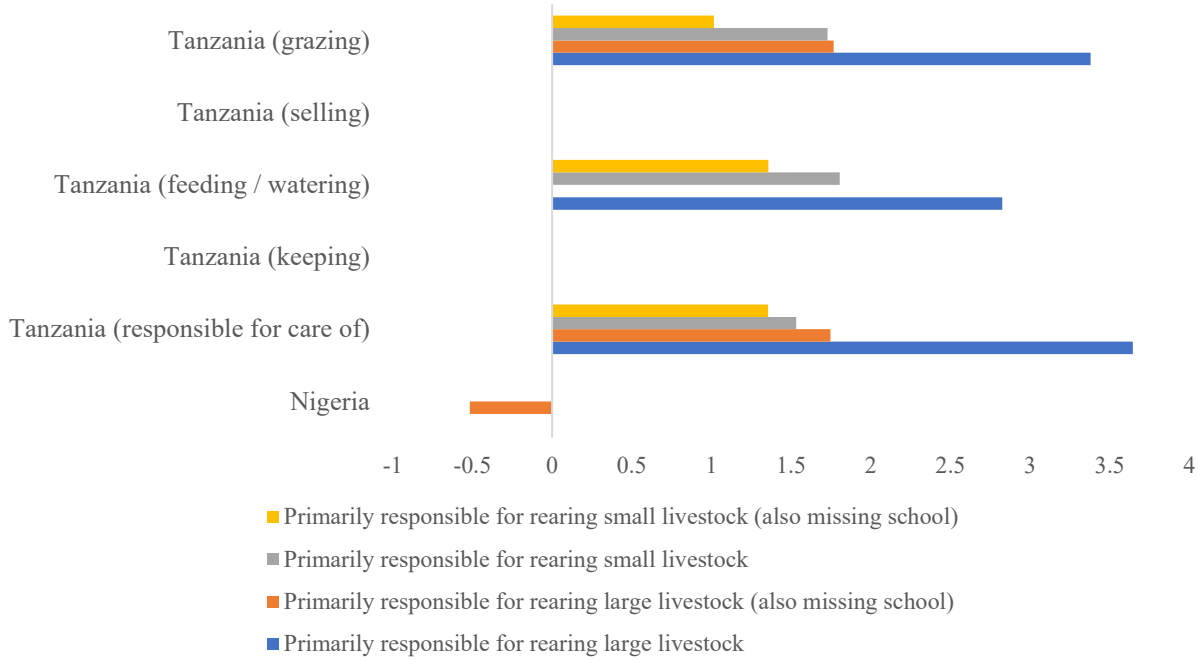
Source: Authors' estimations.
Note: Averages are from the various periods covered by the respective datasets; more detailed statistics are presented in Tables A9 and A12.

Figure A5: Statistically significant associations (percentage point effects) between the adoption of tractors and children's employment in planting season (left) and in harvesting season (right)
Source: Econometric estimation by authors.



Source: Econometric estimation by authors.
Note: Only statistically significant associations are shown.

Figure A6: Associations (percentage points) between tractor adoption and the probability of children's engagement in livestock rearing



Note: Only statistically significant associations are shown.

Table A1: Shares (percentage) of farm households using tractors and/or draught animals

		Human power only	Draught animal but not tractors	Tractors	Combine harvester
Country	**Years**				
Ethiopia	**2011/2012**	N/A	N/A	N/A	
	2013/2014	34.7	62.4	2.9	
	2015/2016	37.9	58.9	3.2	
Ghana	**2006**	N/A	N/A	6.4	
	2013	N/A	N/A	13.7	
	2017	N/A	N/A	15.0	
Nigeria	**2010/2011**	71.2	24.6	4.3	
	2012/2013	75.2	22.3	2.5	
	2015/2016	72.7	23.6	3.7	
	2018/2019	77.2	18.6	4.2	
Tanzania	**2008**	76.3	20.2	3.4	
	2010	75.5	15.4	9.1	
	2012	68.1	19.0	12.9	
	2014	58.3	25.1	16.6	
Nepal	**1995**	N/A	N/A	4.9	
	2003	15.5	69.7	14.8	
	2010	11.8	63.6	24.5	
Vietnam	**2010**	N/A	N/A	53.5	
	2012	N/A	N/A	54.0	
	2014	N/A	N/A	51.1	
	2016	N/A	N/A	52.4	
India[a]	**2010**	N/A	N/A	43.5	10.1
	2011	N/A	N/A	56.0	10.6
	2012	N/A	N/A	55.6	12.5
	2013	N/A	N/A	56.3	12.6
	2014	N/A	N/A	64.5	10.9

Source: Authors' computations based on the various datasets.
Note: N/A = data not available; [a] figures for India are converted to annual level; India figures are not nationally representative.The 2011/2012 Ethiopia survey did not include information on tractor use. The 2014 survey for Tanzania, while nationally respresentive, did not include panel housedols from previous rounds.

Table A2: Shares (percentage) of employed children aged 5 to 14 years

Country	Years/waves	Percentage engaged in agricultural work	Percentage engaged in all-sector work	Reference period
Ethiopia	**2011/2012**	40.6 % G – 33.5, B – 47.6	45.1 % G – 39.7, B – 50.2	Seasonal (Feb–Apr)
	2013/2014	35.1 % G – 29.1, B – 40.7	36.1 % G – 30.1, B – 41.6	Seasonal (Feb–Apr)
	2015/2016	32.7 % G – 27.3, B – 37.8	33.5 % G – 28.1, B – 38.7	Seasonal (Feb–Apr)
Ghana	**2006**	9.5 % G – 10.3, B – 8.6 %	9.6 % G – 10.4, B – 8.8 %	Nonseasonal
	2013	18.8% G – 20.0, B – 17.5	22.7% G – 22.9, B – 22.5	Nonseasonal
	2017	8.0% G – 9.6, B – 6.4	10.9% G – 11.6, B – 10.1	Nonseasonal
Nigeria	**2010/2011 – post-planting**	9.6 % G – 7.3, B – 11.6 %	16.0 % G – 14.5, B – 17.3 %	Any 7 days during Aug–Oct
	2012/2013 – post-planting	8.4 % G – 6.5, B – 10.0 %	11.4 % G – 10.0, B – 12.6 %	
	2015/2016 – post-planting	22.3 % G – 15.2, B – 28.5 %	22.3 % G – 15.3, B – 28.6 %	
	2018/2019 – post-planting	27.8 % G – 22.4, B – 33.1 %	27.9 % G – 22.4, B – 33.2 %	
	2010/2011 – post-harvesting	7.9 % G – 6.3, B – 9.3 %	10.3 % G – 8.8, B – 11.6 %	Any 7 days during Feb–Apr
	2012/2013 – post-harvesting	5.3 % G – 3.7, B – 6.6 %	6.4 % G – 4.9, B – 7.6 %	
	2015/2016 – post-harvesting	8.4 % G – 5.6, B – 10.9 %	8.5 % G – 5.7, B – 11.0 %	
	2018/2019 – post-harvesting	10.5 % G – 7.8, B – 13.1 %	10.5 % G – 7.8, B – 13.1 %	
Tanzania	**2008**	18.6% G – 15.8, B – 21.4	N/A	Nonseasonal
	2010	22.5% G – 19.5, B – 25.7	24.4% G – 21.6, B – 27.3	Nonseasonal
	2012	30.4% G – 28.8, B – 32.2	31.0% G – 29.3, B – 32.8	Nonseasonal
	2014	24.3% G – 21.1, B – 27.2	25.0 % G – 22.0, B – 27.8 %	Nonseasonal
Nepal	**1995**	16.6 % G – 19.2, B – 14.0	17.3 % G – 19.5, B – 15.1	Nonseasonal
	2003	29.5 G – 30.0, B – 29.1	30.5 G – 30.8, B – 30.2	Nonseasonal
	2010	19.8 G – 21.8, B – 17.7	21.4 G – 23.2, B – 19.6	Nonseasonal
Vietnam	**2010**	6.1 % G – 5.6, B – 6.5	7.4 % G – 7.0, B – 7.8	Nonseasonal
	2012	5.1 G – 4.9, B – 5.2	6.0 G – 6.1, B – 5.9	Nonseasonal
	2014	3.2 G – 2.8, B – 3.5	3.9 G – 3.6, B – 4.1	Nonseasonal
	2016	2.5 G – 2.4, B – 2.6	3.1 G – 2.9, B – 3.2	Nonseasonal
India	**2010**	11.5 (G – 9.1, B – 14.2)	17.7 (G – 14.2, B – 21.3)	Nonseasonal
	2011	10.8 (G – 9.9, B – 11.9)	16.3 (G – 14.7, B – 17.9)	Nonseasonal

Country	Years/waves	Percentage engaged in agricultural work	Percentage engaged in all-sector work	Reference period
	2012	9.4 (G – 7.8, B – 11.1)	13.4 (G – 11.6, B – 15.2)	Nonseasonal
	2013	7.4 (G – 6.9, B – 7.9)	9.2 (G – 8.8, B – 9.5)	Nonseasonal
	2014	8.9 (G – 8.6, B – 9.2)	10.0 (G – 10.0, B – 9.9)	Nonseasonal

Source: Authors' computations based on the various datasets.
Note: G = girls; B = boys; figures for India are not nationally representative.

Table A3: Shares (percentage) of children aged 5 to 14 years who are employed beyond certain threshold levels of intensity

Country	Years/seasons of surveys	Percentage working at least 14 hours/week (among those who are engaged in all-sector work)	Percentage working at least 20 hours/week (among those who are engaged in all-sector work)	Reference period
Ethiopia	**2011/2012**	67.1	51.1	Seasonal (Feb–Apr)
	2013/2014	71.2	58.1	Seasonal (Feb–Apr)
	2015/2016	64.2	50.5	Seasonal (Feb–Apr)
Ghana	**2006**	61.1	56.8	Nonseasonal
	2013	37.8	30.9	Nonseasonal
	2017	41.3	28.8	Nonseasonal
Nigeria	**2010/2011 – PP**	61.5	31.3	Seasonal (Aug–Oct)
	2012/2013 – PP	50.0	21.4	Seasonal (Aug–Oct)
	2015/2016 – PP	50.2	31.4	Seasonal (Aug–Oct)
	2018/2019 – PP	29.9	16.5	Seasonal (Aug–Oct)
	2010/2011 – PH	75.5	57.0	Seasonal (Feb–Apr)
	2012/2013 – PH	71.7	41.5	Seasonal (Feb–Apr)
	2015/2016 – PH	36.9	26.2	Seasonal (Feb–Apr)
	2018/2019 – PH	21.0	11.4	Seasonal (Feb–Apr)
Tanzania	**2008**	50.0	30.6	Nonseasonal
	2010	42.2	29.3	Nonseasonal
	2012	24.3	13.5	Nonseasonal
	2014	53.9	39.1	Nonseasonal
Nepal	**1995**	73.2	57.3	Nonseasonal
	2003	58.9	40.7	Nonseasonal
	2010	55.4	35.6	Nonseasonal
Vietnam	**2010**	37.7	21.3	Nonseasonal
	2012	31.4	23.5	Nonseasonal
	2014	34.4	25.0	Nonseasonal
	2016	40.0	32.0	Nonseasonal
India	**2010**	55.9	42.3	Nonseasonal
	2011	60.5	36.6	Nonseasonal
	2012	64.7	48.0	Nonseasonal
	2013	48.8	34.5	Nonseasonal
	2014	6.4	39.7	Nonseasonal

Source: Authors' computations based on the various datasets.
Note: PH = post-harvesting; PP = post-planting; figures for India are not nationally representative; thresholds used for Nigeria are three days/week and four days/week, respectively, due to the nature of the available data.

Table A4: Shares (percentage) of children aged 5 to 14 years who are at least partially missing school

Country	Years of surveys	Boys	Girls	All
Ethiopia	**2011**	54.0	50.6	52.3
	2013	50.7	50.0	50.3
	2015	44.7	42.8	43.7
Ghana	**2013**	33.3	32.4	32.9
	2017	9.6	9.8	9.7
Nigeria	**2010/2011**	24.5	21.2	22.7
	2012/2013	23.9	22.4	23.1
	2014/2015	25.8	22.3	24.0
Tanzania	**2008**	49.3	46.2	47.7
	2010	49.9	47.3	48.5
	2012	49.1	47.7	48.4
	2014	57.4	54.2	55.9
Nepal	**1995**	31.5	48.6	39.9
	2003	20.2	29.4	24.7
	2010	7.8	8.6	8.2
Vietnam	**2010**	7.7	7.0	7.4
	2012	7.1	6.3	6.7
	2014	5.1	4.7	4.9
	2016	4.2	3.7	3.9
India	**2010**	3.8	4.3	4.0
	2011	1.8	3.8	2.9
	2012	1.8	2.3	2.1
	2013	1.3	1.6	1.4
	2014	1.0	2.6	1.7

Source: Authors' computations based on the various datasets.
Note: Figures for India are not nationally representative; information for Nigeria refers only to those who are entirely missing school; for Ghana, figures for 2017 may not be directly comparable to 2013 and thus need to be interpreted with caution.

Table A5: Shares (percentage) of children aged 5 to 14 years who are at least partially missing school, depending on their work intensity

Country	Years of surveys	Percentage among children engaged in all-sector work	Percentage among children engaged in all-sector work for at least 14 hours/week	Percentage among children engaged in all-sector work for at least 20 hours/week	Note
Ethiopia	**2011/2012**	44.7	46.9	50.0	Seasonal (Feb–Apr)
	2013/2014	36.2	38.0	38.7	Seasonal (Feb–Apr)
	2015/2016	37.6	37.6	40.0	Seasonal (Feb–Apr)
Ghana	**2006**	N/A	N/A	N/A	Nonseasonal
	2013	33.5	42.3	41.4	Nonseasonal
	2017	13.8	12.1	8.7	Nonseasonal
Nigeria	**2010/2011 – PP**	44.8	44.1	40.0	Seasonal (Aug–Oct)
	2012/2013 – PP	66.7	64.3	77.8	Seasonal (Aug–Oct)
	2015/2016 – PP	34.1[a]	38.4	38.6	Seasonal (Aug–Oct)
	2018/2019 – PP	33.8 [a]	39.8	45.7	Seasonal (Aug–Oct)
	2010/2011 – PH	41.8	43.3	48.9	Seasonal (Feb–Apr)
	2012/2013 – PH	60.4	63.2	63.6	Seasonal (Feb–Apr)
	2015/2016 – PH	52.4	64.5	68.2	Seasonal (Feb–Apr)
	2018/2019 – PH	43.8	54.5	50.0	Seasonal (Feb–Apr)
Tanzania	**2008**	53.8	69.9	75.4	Nonseasonal
	2010	51.6	71.6	80.3	Nonseasonal
	2012	52.3	71.6	82.9	Nonseasonal
	2014	69.1	83.2	92.6	Nonseasonal
Nepal	**1995**	62.8	70.8	75.5	Nonseasonal
	2003	34.6	46.7	56.1	Nonseasonal
	2010	9.9	14.3	16.7	Nonseasonal
Vietnam	**2010**	19.7	30.4	46.2	Nonseasonal
	2012	25.5	50.0	58.3	Nonseasonal
	2014	25.0	45.5	50.0	Nonseasonal
	2016	24.0	40.0	37.5	Nonseasonal
India	**2010**	14.3	24.2	32.0	Nonseasonal
	2011	8.6	14.2	16.6	Nonseasonal
	2012	8.8	13.5	18.2	Nonseasonal
	2013	7.1	14.5	16.3	Nonseasonal
	2014	6.7	10.5	16.8	Nonseasonal

Source: Authors' computations based on the various datasets.
Note: PH = post-harvesting; PP = post-planting; figures for India are not nationally representative; thresholds used for Nigeria are three days/week and four days/week, respectively, due to the nature of the available data.

Table A6: Shares (percentage) of children aged 5 to 14 years who are employed beyond certain threshold levels of intensity and who are also at least partially missing school

Country	Years of surveys	Percentage working at least 14 hours/week	Population of children working at least 14 hours/week and missing some school	Percentage working at least 20 hours/week	Reference period
Ethiopia	**2011/2012**	14.2	2,895,947	11.4	Seasonal (Feb–Apr)
	2013/2014	9.8	2,489,874	8.1	Seasonal (Feb–Apr)
	2015/2016	8.1	2,433,833	6.8	Seasonal (Feb–Apr)
Ghana	**2006**	0.9	57,815	0.9	Nonseasonal
	2013	3.8	264,724	3.0	Nonseasonal
	2017	0.5	33,370	0.3	Nonseasonal
Nigeria	**2010/2011 – PP**	4.2	2,072,253	2.7	Seasonal (Aug–Oct)
	2012/2013 – PP	3.9	1,837,483	2.1	Seasonal (Aug–Oct)
	2015/2016 – PP	4.3	2,001,816	2.8	Seasonal (Aug–Oct)
	2018/2019 – PP	3.3	1,533,658	2.1	Seasonal (Aug–Oct)
	2010/2011 – PH	3.3	1,611,762	2.6	Seasonal (Feb–Apr)
	2012/2013 – PH	2.7	1,282,239	1.7	Seasonal (Feb–Apr)
	2015/2016 – PH	2.0	907,521	1.5	Seasonal (Feb–Apr)
	2018/2019 – PH	1.2	534,167	0.6	Seasonal (Feb–Apr)
Tanzania	**2008**	16.8	1,783,259	11.2	Nonseasonal
	2010	7.3	920,802	5.6	Nonseasonal
	2012	5.5	689,390	3.6	Nonseasonal
	2014	11.1	1,509,366	8.9	Nonseasonal
Nepal	**1995**	6.7	276,360	5.7	Nonseasonal
	2003	6.6	322,313	5.4	Nonseasonal
	2010	1.0	71,091	0.8	Nonseasonal
Vietnam	**2010**	1.5	201,864	1.3	Nonseasonal
	2012	1.6	231,760	1.4	Nonseasonal
	2014	0.9	126,641	0.7	Nonseasonal
	2016	0.7	104,674	0.7	Nonseasonal
India	**2010**	2.4	N / A	2.4	Nonseasonal
	2011	1.4	N / A	1.0	Nonseasonal
	2012	1.2	N / A	1.2	Nonseasonal
	2013	0.7	N / A	0.5	Nonseasonal
	2014	0.7	N / A	0.7	Nonseasonal

Source: Authors' computations based on the various datasets.
Note: PH = post-harvesting; PP = post-planting; N/A = not applicable; figures for India are not nationally representative; thresholds used for Nigeria are three days/week and four days/week, respectively, due to the nature of the available data.

Table A7: Key compositions of the work engaged in by working children (percentage)

Country	Years/waves	Share (percentage) of total hours worked by children		Share (percentage) of different types of agricultural work			Share (percentage) of children		
		Non agricultural work	Agricultural work	Types of agricultural work			Engaged in agricultural work	Primarily responsible for livestock rearing	Engaged in non-farm/off-farm work
				Land preparation and planting	Weeding/ridging	Harvesting and threshing			
Ethiopia	**2011/2012**	9.8	90.2	48.6		51.4	40.6		9.6
	2013/2014	2.7	97.3	34.6		65.4	35.1		1.7
	2015/2016	2.6	97.4	36.5		63.5	32.7		1.4
Ghana	**2006**	1.5	98.5				9.5		0.2
	2013	18.7	81.3				18.8		4.6
	2017	27.9	72.1				8.0		3.3
Nigeria	**2010/2011 – post-planting**	40.0	60.0				9.6	1.2	6.6
	2012/2013 – post-planting	26.2	73.8	52.2			8.4	1.5	3.1
	2015/2016 – post-planting	0.4	99.6	44.0			22.3	3.1	0.1
	2018/2019 – post-planting	0.2	99.8	72.5			27.8	4.8	0.1
	2010/2011 – post-harvesting	23.5	76.5				7.9		2.6
	2012/2013 – post-harvesting	17.4	82.6			47.8	5.3		1.2
	2015/2016 – post-harvesting	1.0	99.0			56.0	8.4		0.1
	2018/2019 – post-harvesting	0.4	99.6			27.5	10.5		0.1
Tanzania	**2008**	40.7	59.3	35.4	33.0	31.6	18.6		
	2010	1.6	98.4	29.7	31.6	37.6	22.5	11.7	2.6
	2012	1.5	98.5	32.3	32.6	34.5	30.4	10.9	1.7
	2014	0.7	99.3	31.7	32.2	36.0	24.3	13.1	1.1
Nepal	**1995**	2.3	97.7				16.6		0.4
	2003	2.1	97.9				29.5		0.9
	2010	4.3	95.7				19.8		1.8
Vietnam	**2010**	25.9	74.1				6.1		2.6
	2012	26.8	73.2				5.1		2.5
	2014	25.3	74.7				3.2		1.4
	2016	31.8	68.2				2.5		1.1
India	**2010**	38.8	61.2				11.5		7.5
	2011	41.2	58.8				10.8		7.8
	2012	34.1	65.9				9.4		5.0
	2013	19.5	80.5				7.4		1.9
	2014	14.2	85.8				8.9		1.6

Source: Authors' computations based on the various datasets.
Note: Figures for India are not nationally representative.

Table A8: School-affecting work by children and its relationship to the mechanisation status of farm households in Ethiopia (Labour Module), by share (percentage) of farm children aged 5 to 14 years

Work types by intensity, and schooling status of working children	Wave 2 (2013/2014)				Wave 3 (2015/2016)			
	M	D	T	Difference between T and D	M	D	T	Difference between T and D
Work for household agricultural activities								
All schooling status	30.2	39.3	33.8	– 5.5	27.7	40.4	41.0	+ 0.6
Missing school	10.6	14.1	13.7	– 0.4	10.6	14.9	20.4	+ 5.5
Not missing school	18.0	25.3	20.1	– 5.2	17.1	25.5	20.6	– 4.9
Worked for more than 14 hours/week								
All schooling status	21.1	27.6	24.6	– 3.0	16.8	26.3	29.0	+ 2.7
Missing school	7.5	10.5	12.6	+ 2.1	6.9	9.3	14.0	+ 4.7
Not missing school	13.6	17.1	12.0	– 5.1	9.9	17.0	15.0	– 2.0
Worked for more than 20 hours/week								
All schooling status	16.4	23.0	19.7	– 3.3	12.9	20.9	21.1	+ 0.2
Missing school	5.7	9.0	9.7	+ 0.7	5.7	7.9	13.3	+ 5.4
Not missing school	10.7	14.0	10.0	– 4.0	7.2	13.0	7.8	– 5.2

Source: Ethiopia Living Standards Measurement Study—Integrated Surveys on Agriculture.
Note: Figures are nationally representative; M = manual power; D = draught power; T = tractors; reference periods are any seven days during February–April.

Table A9: School-affecting work by children and its relationship to the mechanisation status of farm households in Ethiopia (Agricultural Module), by share (percentage) of farm children aged 5 to 14 years

Work types by intensity and schooling status of children worked	Wave 2 (2013/2014)				Wave 3 (2015/2016)			
	M	D	T	Difference between T and D	M	D	T	Difference between T and D
Land preparation, planting, ridging, weeding and fertilising (during the season leading up to the post-planting interview in Sept–Oct)								
All schooling status	8.3	15.9	6.9	– 9.0	6.8	14.8	5.0	– 9.8
Missing school	2.6	4.6	3.4	– 1.2	2.5	4.4	2.6	– 1.8
Not missing school	5.8	11.2	3.5	– 7.7	4.3	10.4	2.4	– 8.0
More than 100 hours/planting season								
All schooling status	1.9	5.8	3.5	– 2.3	1.9	5.6	1.1	– 4.5
Missing school	0.4	1.4	2.4	+ 1.0	0.8	1.7	0.1	– 1.6
Not missing school	1.5	4.4	1.1	– 3.3	1.0	3.9	1.0	– 2.9
Harvesting and threshing (during the production season leading up to the post-harvesting interview in Feb–Apr)								
All schooling status	15.5	24.5	18.7	– 5.8	12.4	22.4	14.3	– 8.1
Missing school	5.0	7.4	6.6	– 0.8	5.0	7.1	8.5	+ 1.4
Not missing school	10.5	17.1	12.1	– 5.0	7.4	15.3	5.8	– 9.5
More than 100 hours/harvesting season								
All schooling status	3.0	6.8	5.9	– 0.9	2.4	5.3	5.0	– 0.3
Missing school	1.1	2.0	2.4	+ 0.4	1.2	2.0	3.0	+ 1.0
Mot missing school	1.9	4.8	3.5	– 1.3	1.2	3.3	2.0	– 1.3

Source: Ethiopia Living Standards Measurement Study—Integrated Surveys on Agriculture.
Note: Figures are nationally representative; M = manual power; D = draught power; T = tractors.

Table A10: School-affecting work by children and its relationship to the mechanisation status of farm households in Ghana, by share (percentage) of farm children aged 5 to 14 years

Work types by intensity and schooling status of children worked	Wave 1 (2006)			Wave 2 (2013)			Wave 3 (2017)		
	M/D	T	Difference between T and M/D	M/D	T	Difference between T and M/D	M/D	T	Difference between T and M/D
Any agricultural activities in the past 7 days									
All schooling status	12.6	9.7	– 2.9	31.3	25.0	– 6.3	13.9	17.7	+ 3.8
Missing school	2.1	2.8	+ 0.7	10.3	9.6	– 0.7	1.8	3.4	+ 1.6
Not missing school	10.5	6.9	– 3.6	21.0	15.4	– 5.6	12.0	14.3	+ 2.3
Any agricultural activities in the past 7 days (14 or more hours)									
All schooling status	7.8	5.9	– 1.9	11.6	10.0	- 1.6	5.4	8.7	+ 3.3
Missing school	1.2	1.7	+ 0.5	4.8	4.6	– 0.2	0.4	1.6	+ 1.2
Not missing school	6.7	4.2	– 2.5	6.7	5.4	– 1.3	4.9	7.1	+ 2.2
Any agricultural activities in the past 7 days (20 or more hours)									
All schooling status	7.2	5.7	– 1.5	9.6	7.6	– 2.0	3.8	5.9	+ 2.1
Missing school	1.1	1.7	+ 0.6	4.1	3.3	– 0.8	0.4	0.9	+ 0.4
Not missing school	6.1	4.1	– 2.0	5.5	4.3	- 1.2	3.4	5.0	+ 1.6

Source: Ghana Living Standard Surveys.
Note: Figures are nationally representative; M = manual power; D = draught power; T = tractors; reference period = throughout the year.

Table A11: School-affecting work by children and its relationship to the mechanisation status of farm households in Nigeria (Labour Module), by share (percentage) of farm children aged 5 to 14 years

Work types by intensity and schooling status of children worked	Percentage of children aged 5 to 14 years who worked															
	Wave 1 (2010/2011)				Wave 2 (2012/2013)				Wave 3 (2015/2016)				Wave 4 (2018/2019)			
	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D
Households' agricultural activities in the past 7 days (post-planting season)																
All schooling status	10.6	22.4	21.6	– 0.8	10.1	14.3	22.7	+ 8.4	27.6	36.5	32.6	– 3.9	30.7	34.0	31.2	– 2.8
Missing school	4.5	11.6	3.6	– 8.0	6.3	10.1	8.2	– 1.9	8.9	14.7	3.8	– 10.9	8.1	17.0	10.0	– 7.0
Not missing school	6.0	10.8	18.0	+ 7.2	3.8	4.2	14.6	+ 10.4	18.7	21.8	28.8	+ 7.0	22.6	17.0	21.2	+ 4.2
Three days/week (post-planting season)																
All schooling status	7.0	13.1	12.6	– 0.5	4.8	6.6	15.6	+ 9.0	14.4	16.7	17.3	+ 0.6	8.2	11.1	14.2	+ 3.2
Missing school	3.0	6.6	2.9	– 3.7	3.2	4.2	5.4	+ 1.2	5.4	7.0	2.8	– 4.2	2.3	6.5	5.7	– 0.8
Not missing school	4.1	6.5	9.6	+ 3.1	1.7	2.3	10.2	+ 7.9	9.0	9.7	14.5	+ 4.8	5.9	4.6	8.5	+ 3.9
Four days/week (post-planting season)																
All schooling status	5.0	4.5	3.4	– 1.1	2.0	2.0	8.7	+ 6.7	9.6	8.7	13.8	+ 5.1	4.3	6.3	8.5	+ 2.2
Missing school	1.8	2.5	2.0	– 0.5	1.4	1.5	4.7	+ 3.2	3.6	4.0	1.9	– 2.1	1.6	3.9	2.5	– 1.4
Not missing school	3.2	2.0	1.4	– 0.6	0.5	0.6	4.0	+ 3.4	6.0	4.8	11.9	+ 7.1	2.8	2.4	6.0	+ 3.6
Households' agricultural activities in the past 7 days (post-harvesting season)																
All schooling status	12.3	14.6	6.7	– 7.9	5.7	9.5	13.4	+ 3.9	10.6	14.3	5.4	– 8.9	10.4	15.4	11.2	– 4.2
Missing school	4.8	7.3	1.7	– 5.6	3.6	4.8	3.1	– 1.7	4.6	9.8	1.6	– 8.2	3.5	9.9	3.3	– 6.6
Not missing school	7.5	7.4	5.0	– 2.4	2.1	4.7	10.3	+ 5.6	6.0	4.5	3.8	– 0.7	6.9	5.5	8.0	+ 2.5
Three days/week (post-harvesting season)																
All schooling status	10.0	9.8	5.0	– 4.8	3.7	7.1	11.4	+ 4.3	3.8	4.7	0.9	– 3.8	2.0	4.1	1.0	– 3.1
Missing school	4.1	4.6	1.7	– 2.9	2.8	3.0	3.1	+ 0.1	2.5	3.0	0.7	– 2.3	0.8	2.6	0.4	– 2.2
Not missing school	5.9	5.2	3.2	– 2.0	0.9	4.1	8.3	+ 4.2	1.3	1.7	0.3	– 1.4	1.2	1.5	0.6	– 0.9
Four days/week (post-harvesting season)																
All schooling status	8.6	5.4	1.6	– 3.8	2.2	3.0	7.9	+ 4.9	2.6	3.3	0.7	– 2.6	1.1	1.9	0.2	– 1.7
Missing school	3.8	3.4	0.9	– 2.5	1.6	1.0	3.1	+ 2.1	1.9	2.1	0.7	– 1.4	0.5	1.2	0.2	– 1.0
Not missing school	4.8	2.0	0.7	– 1.3	0.6	2.0	4.7	+ 2.7	0.7	1.2	0.0	– 1.2	0.6	0.7	0.0	– 0.7

Source: Nigeria Living Standards Measurement Study—Integrated Surveys on Agriculture.
Note: Figures are nationally representative; M = manual power; D = draught power; T = tractors.

Table A12: School-affecting work by children and its relationship to the mechanisation status of farm households in Nigeria (Agricultural Module), by share (percentage) of farm children aged 5 to 14 years

Work types by intensity and schooling status of children worked	Percentage of children aged 5 to 14 years who worked															
	Wave 1 (2010/2011)				Wave 2 (2012/2013)				Wave 3 (2015/2016)				Wave 4 (2018/2019)			
	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D
Land preparation, planting (during the season leading up to the post-planting interview in Aug–Oct)																
All schooling status									15.8	21.5	15.6	– 5.9	33.2	38.7	32.4	– 6.3
Missing school									4.7	8.2	1.5	– 6.7	7.6	16.9	11.1	– 5.8
Not missing school									11.1	13.3	14.1	+ 0.8	25.7	21.8	21.3	– 0.5
Working 100 hours/post-planting season																
All schooling status									8.6	15.8	13.0	– 2.8	8.5	13.5	12.9	– 0.6
Missing school									3.2	6.0	1.1	– 4.9	1.9	7.5	4.7	– 2.8
Not missing school									5.4	9.8	11.9	+ 2.1	6.6	6.0	8.2	+ 2.2
Weeding, fertilising, harvesting, and threshing (during the season leading up to the post-planting interview in Feb–Apr)																
All schooling status	11.4	14.4	7.0	– 7.4	12.3	14.5	10.0	– 4.5	19.7	25.5	27.1	+ 1.6	14.3	20.4	15.8	– 4.6
Missing school	3.2	6.7	1.1	– 5.6	3.5	6.5	1.7	– 4.8	6.1	8.6	2.6	– 6.0	3.7	8.7	4.6	– 4.1
Not missing school	8.3	7.7	5.9	– 1.8	8.8	8.0	8.4	+ 0.4	13.5	16.9	24.6	+ 7.7	10.6	11.6	11.1	– 0.5
Working 100 hours/post-harvesting season																
All schooling status	5.9	9.2	3.1	– 6.1	5.3	6.8	1.8	– 5.0	9.8	16.5	21.0	+ 4.5	5.1	11.0	7.0	– 4.0
Missing school	2.4	4.3	0.4	– 3.9	2.1	2.9	0.0	– 2.9	3.5	5.2	2.6	– 2.6	1.7	5.9	1.5	– 4.4
Not missing school	3.6	4.9	2.7	– 2.2	3.2	3.9	1.8	– 2.1	6.3	11.3	18.4	+ 7.1	3.4	5.1	5.4	+ 0.3

Source: Nigeria Living Standards Measurement Study—Integrated Surveys on Agriculture.
Note: Figures are nationally representative; M = manual power; D = draught power; T = tractors.

Table A13: School-affecting work by children and its relationship to the mechanisation status of farm households in Nigeria (Livestock), by share (percentage) of farm children aged 5 to 14 years

Work types and schooling status of children worked	Percentage of children aged 5 to 14 years who are responsible for keeping livestock															
	Wave 1 (2010/2011)				Wave 2 (2012/2013)				Wave 3 (2015/2016)				Wave 4 (2018/2019)			
	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D
Responsible for keeping livestock																
All schooling status	0.6	3.8	1.5	– 2.3	1.7	3.2	4.8	+ 1.6	2.8	7.6	1.4	– 6.2	4.2	8.0	5.6	– 2.4
Missing school	0.3	1.8	0.0	– 1.8	0.3	1.5	0.0	– 1.5	0.6	3.0	0.0	– 3.0	1.3	4.3	1.1	– 3.2
Not missing school	0.4	2.0	1.5	– 0.5	1.4	1.7	4.8	+ 3.1	2.1	4.7	1.4	– 3.3	2.8	3.7	4.6	+ 0.9
Responsible for keeping livestock (large animal)																
All schooling status	0.3	3.2	1.5	– 1.7	1.1	3.0	2.9	– 0.1	2.2	7.3	1.0	– 6.3	2.6	6.9	4.5	– 2.4
Missing school	0.2	1.4	0.0	– 1.4	0.3	1.4	0.0	– 1.4	0.5	2.7	0.0	– 2.7	1.1	3.7	1.1	– 2.6
Not missing school	0.2	1.8	1.5	– 0.3	0.9	1.6	2.9	+ 1.3	1.7	4.5	1.0	– 3.5	1.5	3.2	3.4	+ 0.2
Responsible for keeping livestock (small animal)																
All schooling status	0.4	1.0	0.0	– 1.0	0.8	0.8	2.4	+ 1.6	1.3	1.4	0.7	– 0.7	2.6	2.9	4.0	+ 1.1
Missing school	0.1	0.6	0.0	– 0.6	0.1	0.6	0.0	– 0.6	0.3	0.4	0.0	– 0.4	0.7	1.1	0.9	– 0.2
Not missing school	0.3	0.4	0.0	– 0.4	0.7	0.2	2.4	+ 2.2	1.0	1.0	0.7	– 0.3	2.0	1.1	3.2	+ 2.1

Source: Nigeria Living Standards Measurement Study—Integrated Surveys on Agriculture.
Note: Figures are nationally representative; M = manual power; D = draught power; T = tractors.

Table A14: School-affecting work by children and its relationship to the mechanisation status of farm households in Tanzania, by share (percentage) of farm children aged 5 to 14 years

Work types by intensity and schooling status of children worked	Percentage of children aged 5 to 14 years who worked															
	Wave 1 (2008)				Wave 2 (2010)				Wave 3 (2012)				Wave 4 (2014)			
	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D
Agricultural activities in the past 7 days																
All schooling status	**19.3**	**27.8**	**20.4**	**– 7.4**	**24.1**	**31.4**	**34.7**	**+ 3.3**	**33.6**	**39.0**	**44.5**	**+ 5.5**	**23.7**	**37.9**	**29.9**	**– 8.0**
Missing school	10.4	15.3	5.9	**– 9.4**	12.5	16.7	18.5	**+ 1.8**	16.9	23.2	21.6	**– 1.6**	15.2	28.2	20.9	**– 7.3**
Not missing school	8.8	12.6	14.5	+ 1.9	11.6	14.6	16.2	+ 1.6	16.6	15.8	22.9	+ 7.1	8.5	9.7	9.1	**– 0.6**
Working more than 14 hours/week																
All schooling status	**9.1**	**15.9**	**4.7**	**– 11.2**	**8.5**	**15.2**	**20.2**	**+ 5.0**	**6.7**	**10.9**	**15.8**	**+ 4.9**	**10.1**	**25.1**	**18.2**	**– 6.9**
Missing school	6.8	10.4	1.8	**– 8.6**	6.4	10.8	14.5	**+ 3.7**	4.8	8.1	10.0	**+ 1.9**	8.0	21.5	15.0	**– 6.5**
Not missing school	2.3	5.5	3.6	**– 1.9**	2.2	4.5	5.7	+ 1.2	1.8	2.8	5.9	+ 3.1	2.0	3.5	3.2	**– 0.3**
Working more than 20 hours/week																
All schooling status	**5.5**	**10.4**	**1.8**	**– 8.6**	**6.1**	**10.6**	**13.2**	**+ 2.6**	**3.6**	**6.9**	**8.1**	**+ 1.2**	**6.7**	**18.7**	**13.2**	**– 5.5**
Missing school	4.3	7.7	0.0	**– 3.4**	5.0	8.0	10.7	**+ 2.7**	3.0	5.9	6.2	**+ 0.3**	6.2	17.6	12.0	**– 5.6**
Not missing school	1.2	2.7	1.8	**– 0.9**	1.0	2.6	2.4	**– 0.2**	0.6	1.0	1.9	+ 0.9	0.5	1.1	1.2	+ 0.1
Agricultural activities during the long rainy season (March–May)																
All schooling status	**21.3**	**20.3**	**15.0**	**– 5.3**	**22.0**	**23.0**	**18.4**	**– 4.6**	**23.6**	**24.9**	**17.8**	**– 7.1**	**25.8**	**27.1**	**20.4**	**– 6.7**
Missing school	9.3	8.2	5.7	**– 2.5**	10.2	9.9	8.6	**– 1.3**	12.0	12.9	8.5	**– 4.4**	14.3	16.4	11.7	**– 4.7**
Not missing school	12.0	12.1	9.2	**– 2.9**	11.8	13.0	9.8	**– 3.2**	11.5	12.0	9.4	**– 2.6**	11.5	10.7	8.7	**– 2.0**
Working more than 40 days/season																
All schooling status	**5.3**	**4.6**	**0.6**	**– 4.0**	**4.3**	**5.1**	**2.8**	**– 2.3**	**5.8**	**4.3**	**4.6**	**+ 0.3**	**6.1**	**8.5**	**5.2**	**– 3.3**
Missing school	2.7	2.6	0.6	**– 2.0**	2.1	2.2	1.7	**– 0.5**	3.4	2.1	3.2	**+ 1.1**	4.2	5.6	3.2	**– 2.4**
Not missing school	2.6	2.0	0.0	**– 2.0**	2.1	2.9	1.1	**– 1.8**	2.4	2.2	1.4	**– 0.8**	1.9	2.9	2.0	**– 0.9**
Working more than 60 days/season																
All schooling status	**3.6**	**2.8**	**0.6**	**– 2.2**	**2.2**	**2.2**	**0.9**	**– 1.3**	**3.3**	**1.5**	**2.5**	**+ 1.0**	**3.4**	**5.5**	**3.0**	**– 2.5**
Missing school	1.7	1.7	0.6	**– 1.1**	1.3	1.3	0.4	**– 0.9**	2.2	0.8	1.7	+ 0.9	2.8	4.1	1.7	**– 2.4**
Not missing school	1.9	1.0	0.0	**– 1.0**	0.9	0.9	0.4	**– 0.5**	1.1	0.6	0.7	+ 0.1	0.6	1.5	1.2	**– 0.3**
Agricultural activities during the short rainy season (Nov–Jan)																
All schooling status	**10.1**	**9.4**	**5.9**	**– 3.5**	**13.5**	**12.4**	**8.4**	**– 4.0**	**14.7**	**14.6**	**6.9**	**– 7.7**	**14.1**	**6.3**	**5.8**	**– 0.5**
Missing school	4.6	2.3	2.2	**– 0.1**	6.6	5.0	3.2	**– 1.8**	8.0	7.9	2.5	**– 5.4**	7.8	3.0	3.3	+ 0.3
Not missing school	5.6	7.1	4.5	**– 2.6**	7.0	7.4	5.2	**– 2.2**	6.7	6.7	4.4	**– 2.3**	6.3	3.3	2.6	**– 0.7**
Working more than 40 days/season																
All schooling status	**2.7**	**3.0**	**2.8**	**– 0.2**	**2.2**	**2.8**	**2.5**	**– 0.3**	**2.0**	**1.2**	**0.9**	**– 0.3**	**1.4**	**0.8**	**0.9**	**+ 0.1**
Missing school	1.2	0.8	1.4	+ 0.6	1.5	1.2	1.5	+ 0.3	1.2	0.8	0.5	**– 0.3**	0.9	0.0	0.9	+ 0.9
Not missing school	1.5	2.2	1.4	**– 0.8**	0.7	1.6	1.0	**– 0.6**	0.8	0.4	0.4	0.0	0.5	0.0	0.0	0.0
Working more than 60 days/season																
All schooling status	**2.4**	**2.4**	**0.0**	**– 2.4**	**1.1**	**1.1**	**2.4**	**+ 1.3**	**1.6**	**0.4**	**0.6**	**+ 0.2**	**0.6**	**0.0**	**0.6**	**+ 0.6**
Missing school	1.1	0.8	0.0	**– 0.8**	0.9	0.6	1.3	+ 0.7	1.0	0.4	0.2	**– 0.2**	0.4	0.0	0.6	+ 0.6
Not missing school	1.3	1.7	0.0	**– 1.7**	0.1	0.5	1.0	+ 0.5	0.6	0.0	0.4	+ 0.4	0.2	0.0	0.0	0.0

Source: Tanzania Living Standards Measurement Study—Integrated Surveys on Agriculture.
Note: Figures are nationally representative; M = manual power; D = draught power, T = tractors.

Table A15: School-affecting work by children and its relationship to the mechanisation status of farm households in Tanzania (Livestock), by share (percentage) of farm children aged 5 to 14 years

Work types by intensity and schooling status of children worked	Percentage of children aged 5 to 14 years who worked															
	Wave 1 (2008)				Wave 2 (2010)				Wave 3 (2012)				Wave 4 (2014)			
	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D	M	D	T	Difference between T and D
Livestock work – as main provider of labour																
All schooling status	N/A	N/A	N/A	N/A	9.4	17.6	16.1	– 1.5	8.7	13.6	16.4	+ 2.8	10.0	19.4	17.0	– 2.4
Missing school	N/A	N/A	N/A	N/A	5.1	9.5	11.3	+ 1.8	4.8	9.0	9.5	+ 0.5	6.3	13.9	9.2	– 4.7
Not missing school	N/A	N/A	N/A	N/A	4.4	8.1	4.8	– 3.3	3.9	4.5	6.9	+ 2.4	3.8	5.5	2.8	– 2.7
Livestock work – as main provider of labour (large animals)																
All schooling status	N/A	N/A	N/A	N/A	6.2	12.3	11.7	– 0.6	5.8	9.7	11.1	+ 1.4	6.9	14.9	8.2	– 6.7
Missing school	N/A	N/A	N/A	N/A	3.8	6.9	8.0	+ 1.1	3.3	6.9	6.5	– 0.4	4.8	11.3	6.3	– 5.0
Not missing school	N/A	N/A	N/A	N/A	2.5	5.3	3.7	– 1.6	2.5	2.8	4.6	+ 1.8	2.0	3.7	1.8	– 1.9
Livestock work – as main provider of labour (small animals)																
All schooling status	N/A	N/A	N/A	N/A	4.8	9.2	8.9	– 0.3	4.5	4.5	6.8	+ 2.3	5.8	8.4	4.8	– 3.6
Missing school	N/A	N/A	N/A	N/A	2.3	4.8	6.0	+ 1.2	2.2	2.6	3.6	+ 1.0	3.4	5.8	3.2	– 2.6
Not missing school	N/A	N/A	N/A	N/A	2.5	4.3	2.8	– 1.5	2.3	2.0	3.2	+ 1.2	2.4	2.6	1.6	– 1.0

Source: Tanzania Living Standards Measurement Study—Integrated Surveys on Agriculture.

Note: Figures are nationally representative; M = manual power; D = draught power; T = tractors.

Table A16: School-affecting work by children and its relationship to the mechanisation status of farm households in Nepal, by share (percentage) of farm children aged 5 to 14 years

Work types by intensity and schooling status of children worked	Percentage of children aged 5 to 14 years who worked								
	1995			2003			2010		
	D	T	Difference between T and D	D	T	Difference between T and D	D	T	Difference between T and D
Any work activities in the past 12 months									
All schooling status	17.5	23.5	+ 6.0	34.3	24.0	– 10.3	25.8	18.4	– 7.4
Missing school	11.4	7.8	– 3.6	11.7	5.5	– 6.2	2.0	2.7	+ 0.7
Not missing school	6.1	15.6	+ 9.5	22.6	18.5	– 4.1	23.8	15.7	– 8.1
Any agricultural activities in the past 12 months (either for the household or for wage-earning on other farms)									
All schooling status	17.1	22.9	+ 4.8	33.6	23.5	– 10.1	24.9	17.1	– 7.8
Missing school	11.2	7.8	– 3.4	11.4	5.5	– 5.9	1.8	2.1	+ 0.3
Not missing school	5.9	15.1	+ 9.2	22.2	18.0	– 4.2	23.1	14.9	– 8.2
Any agricultural activities in the past 7 days (either for the household or for wage-earning on other farms)									
All schooling status	16.0	21.6	+ 5.6	29.4	19.9	– 9.5	11.8	4.8	– 7.0
Missing school	10.5	7.8	– 2.7	10.5	4.9	– 5.6	1.0	1.0	0.0
Not missing school	5.5	13.8	+ 8.3	18.8	15.0	– 3.8	10.8	3.8	– 7.0
Any agricultural activities in the past 7 days – 14 hours/week									
All schooling status	11.8	14.3	+ 2.5	17.5	10.8	– 6.7	6.4	3.1	– 3.3
Missing school	8.7	6.4	– 2.3	8.3	4.2	– 4.1	0.8	0.9	+ 0.1
Not missing school	3.2	7.9	+ 4.7	9.2	6.6	– 2.6	5.6	2.3	– 3.3
Any agricultural activities in the past 7 days – 20 hours/week									
All schooling status	9.4	10.0	+ 0.6	12.5	5.0	– 7.5	4.1	1.9	– 2.2
Missing school	7.3	4.2	– 3.1	7.0	3.0	– 4.0	0.5	0.8	+ 0.3
Not missing school	2.1	5.7	+ 3.6	5.5	2.0	– 3.5	3.5	1.1	– 2.4

Source: Nepal Living Standard Surveys.
Note: Figures are nationally representative; M = manual power; D = draught power; T = tractors.

Table A17: School-affecting work by children and its relationship to the mechanisation status of farm households in Vietnam, by share (percentage) of farm children aged 5 to 14 years

Work types by intensity and schooling status of children worked	Percentage of children aged 5 to 14 years old who worked											
	2010			2012			2014			2016		
	D	T	Difference between T and D	D	T	Difference between T and D	D	T	Difference between T and D	D	T	Difference between T and D
Worked in any sectors in the past 30 days												
All schooling status	12.6	7.8	– 4.8	11.0	6.0	– 5.0	6.7	4.9	– 1.8	5.8	3.3	– 2.5
Missing school	2.8	1.7	– 1.1	3.2	1.4	– 1.8	1.9	1.2	– 0.7	1.6	0.9	– 0.7
Not missing school	9.7	6.1	– 3.6	7.8	4.6	– 3.2	4.8	3.7	– 1.1	4.2	2.4	– 1.8
Worked in any sectors in the past 30 days for more than 14 hours/week												
All schooling status	7.4	3.2	– 4.2	5.2	2.1	– 3.1	3.2	2.0	– 1.2	3.4	1.4	– 2.0
Missing school	2.2	1.4	– 0.8	2.9	1.0	– 1.9	1.5	0.9	– 0.6	1.3	0.6	– 0.7
Not missing school	5.2	1.8	– 3.4	2.2	1.1	– 1.1	1.7	1.1	– 0.6	2.1	0.9	– 1.2
Worked in any sectors in the past 30 days for more than 20 hours/week												
All schooling status	4.8	2.4	– 2.4	4.1	1.8	– 2.3	2.4	1.6	– 0.8	3.1	1.1	– 2.0
Missing school	1.9	1.2	– 0.7	2.4	0.9	– 1.5	1.2	0.7	– 0.5	1.3	0.6	– 0.7
Not missing school	2.9	1.1	– 1.8	1.6	0.9	– 0.7	1.2	0.8	– 0.4	1.8	0.5	– 1.3
Worked in any agricultural activities in the past 30 days												
All schooling status	11.4	6.6	– 4.8	10.2	5.5	– 4.7	5.6	4.3	– 1.3	5.2	2.7	– 2.5
Missing school	2.1	1.3	– 0.8	2.8	1.3	– 1.5	1.5	1.0	– 0.5	1.2	0.7	– 0.5
Not missing school	9.3	5.3	– 4.0	7.4	4.3	– 3.1	4.1	3.3	– 0.8	4.0	1.9	– 2.1
Worked in any agricultural activities in the past 30 days for more than 14 hours/week												
All schooling status	4.7	2.2	– 2.5	3.6	1.4	– 2.2	2.0	1.4	– 0.6	2.2	0.9	– 1.3
Missing school	1.2	0.9	– 0.3	2.0	0.6	– 1.4	0.9	0.6	– 0.3	0.8	0.3	– 0.5
Not missing school	3.5	1.3	– 2.2	1.6	0.8	– 0.8	1.0	0.8	– 0.2	1.4	0.6	– 0.8
Worked in any agricultural activities in the past 30 days for more than 20 hours/week												
All schooling status	2.4	1.5	– 0.9	2.6	1.1	– 1.5	1.4	1.0	– 0.4	1.8	0.6	– 1.2
Missing school	0.9	0.7	– 0.2	1.6	0.6	– 1.0	0.8	0.4	– 0.4	0.7	0.3	– 0.4
Not missing school	1.5	0.8	– 0.7	1.1	0.5	– 0.6	0.7	0.5	– 0.2	1.1	0.3	– 0.8

Source: Vietnam Living Standard Surveys.
Note: Figures are nationally representative; M = manual power; D = draught power; T = tractors.

Table A18: Results based on Agricultural Modules

Country	Ethiopia		Ethiopia	Nigeria	Nigeria	Tanzania	Tanzania
Season	Planting season		Harvesting season	Post-planting season	Post-harvesting season	Long rainy season	Short rainy season
Work category							
Engaged in farming work	-3.957*		-.0.965	-5.749**	-0.926	-3.428**	-4.717***
Worked more than 50 hours/season	-3.033**		-2.013	-4.618*	2.132	0.105	0.518
Worked more than 100 hours/season	-1.386		-3.091***	-4.215*	1.927	0.874	0.246
Worked and missed school	-.0.176		0.305	-3.649**	-6.851***	-2.888**	-2.008***
Worked more than 50 hours/season and missed school	0.423		1.401	-3.229*	-5.932***	0.702	-0.139
Worked more than 100 hours/season and missed school	0.575		0.491	-3.274*	-5.433***	0.442	-0.245

Source: Authors' estimations.
Note: *, **, and *** indicate statistical significance at the $p < 0.1$, $p < 0.05$, and $p < 0.01$ levels.

Table A18: Associations (percentage point effects) between tractor adoption and children's engagement in different types of farming operations in Tanzania

Country	Tanzania	Tanzania	Tanzania	Tanzania	Tanzania	Tanzania
Season	Long rainy season	Long rainy season	Long rainy season	Short rainy season	Short rainy season	Short rainy season
	Land preparation	Weeding/ridging	Harvesting	Land preparation	Weeding/ridging	Harvesting
Work category						
Engaged in farming work	-1.846**	-2.444**	-1.668	-0.822	-1.787	-1.695
Worked and missed school	-0.932	0.198	-0.361	-1.002	-1.322	-1.464

Source: Authors' estimations.
Note: *, **, and *** indicate statistical significance at the p < 0.1, p < 0.05, and p < 0.01 levels.

Table A19: Associations (percentage point effects) between tractor adoption and children's engagement in livestock rearing

Country	Nigeria	Tanzania	Tanzania	Tanzania	Tanzania	Tanzania
Type of livestock-rearing activity	Responsible for keeping	Responsible for caring	Responsible for keeping	Responsible for feeding / watering	Responsible for selling	Responsible for grazing
Primarily responsible for rearing large livestock	-0.433	3.644***	0.878	2.825***	-0.007	3.379***
Also missed school	-0.516**	1.746***	0.146	0.788	0.064	1.767***
Primarily responsible for rearing small livestock	0.597	1.532***	-0.724	1.804***	-0.089	1.729***
Also missed school	-0.135	1.354**	-0.203	1.356***	0.093	1.015***

Source: Authors' estimations.
Note: *, **, and *** indicate statistical significance at the p < 0.1, p < 0.05, and p < 0.01 levels.

Table A20: Same sets of results for Table 3.3, by gender

Country	Gender of child	Ethiopia	Ghana[a]		Nigeria (post-planting season)	Nigeria (post-harvesting season)	Tanzania	India	India	Nepal	Vietnam
Estimation models		**Panel fixed effects**	**GMM Cross Section**		**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**	**Panel fixed effects**
Summary		**Tractors**	**Tractors**		**Tractors**	**Tractors**	**Tractors**	**Tractors**	**Combine harvesters**	**Tractors**	**Tractors**
Whether worked in agricultural sector (post-planting season for Nigeria)											
Worked at any intensity	**Girls**	1.917	--11.820		-18.810***	-6.243**	0.124	0.016	-0.033	-30.420***	2.488
	Boys	-6.409*	-43.400**		-14.580***	-1.723	5.853	-0.032	-0.044	6.299	-0.509
Worked 14 or more hours/week	**Girls**	3.065	-2.658		-12.530***	-1.028	0.704	1.184	0.255	-19.400**	0.683
	Boys	-5.470	-28.690*		-18.690***	-0.997	3.336**	0.991	1.972	10.000	0.564
Worked 20 or more hours/week	**Girls**	4.365	19.050		-5.858	-0.825	-0.055	0.000	0.000	-8.286*	0.419
	Boys	-8.250**	-11.060		-7.588*	-0.982	0.878	0.415	0.063	8.588	1.351
Worked and partially missed school	**Girls**	-1.019	-26.710***		-7.927**	-4.811**	-0.666	-0.018*	-0.010	-19.500**	0.050
	Boys	-10.430***	-35.360***		-9.040***	-7.364**	1.187	-0.003	-0.010	10.070	0.630
Worked 14 or more hours/week and partially missed school	**Girls**	1.775	-19.930**		-5.901*	-2.644*	0.827	0.330	0.525	-12.060***	0.206
	Boys	-3.075	-24.850***		-7.472**	-2.373	1.685	0.346	2.368	6.750	1.364
Worked 20 or more hours/week and partially missed school	**Girls**	-1.631	-11.800		-3.128	-1.344	0.878	0.000	0.000	-10.540***	0.056
	Boys	-9.513***	-18.630**		-1.863	-0.254	1.717	0.000	0.000	9.848	0.593
Whether worked in any sector (including agricultural sector)											
	Girls	4.187	2.100		-15.860***	-6.075*	1.218	-2.531**	-0.428	-27.760***	2.306
	Boys	-5.471	-21.400		-13.500**	-4.392	11.500***	-3.172***	0.492	1.681	-0.480
Worked 14 or more hours/week	**Girls**	2.260	6.619		-10.450**	-1.135	1.049	-20.60***	-3.067	-14.060**	0.500
	Boys	-5.642	-2.897		-19.450***	-4.892	5.097***	-12.900***	-0.368	11.860*	0.863
Worked 20 or more hours/week	**Girls**	5.314	25.210		-4.396	-0.962	-0.866	-8.588	-1.727	-6.033*	0.378
	Boys	-8.404**	8.795		-9.156**	-4.902*	2.765**	-37.60*	2.251	11.800*	2.603***
Worked and partially missed school	**Girls**	-1.079	-29.290***		-6.283*	-4.701**	-0.649	-0.017*	-0.011	-13.670**	-0.057
	Boys	-11.640***	-34.500***		-9.136***	-8.412**	3.372	-0.000	0.009	11.320*	0.950
Worked 14 or more hours/week and partially missed school	**Girls**	0.802	-22.730***		-4.759	-2.577*	2.183***	-1.708*\	-0.815	-8.598*	1.050
	Boys	-3.149	-22.620***		-8.807**	-3.472	2.233	-0.397	-1.185	10.540	1.373
Worked 20 or more hours/week and partially missed school	**Girls**	-1.714	-14.240*		-2.582	-1.306	0.961***	-1.575	-0.772	-5.243*	0.432
	Boys	-9.663***	-17.170**		-3.804	-1.347	2.557	-0.288	0.258	8.086	0.684

Source: Authors' estimations.

Note: [a] For Ghana, estimations are based on the generalised method of moments (GMM) to address potential endogeneity of mechanisation adoption, using two instrumental variables (whether there are any tractor owners within the community or within the district in the sample); the Hansen orthogonality test suggests that the instrumental variables used satisfy that models are not overidentified, which ensures the consistency of the results; *, **, and *** indicate statistical significance at the $p < 0.1$, $p < 0.05$, and $p < 0.01$ levels.

ALL IFPRI DISCUSSION PAPERS

All discussion papers are available **here**

They can be downloaded free of charge

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
www.ifpri.org

IFPRI HEADQUARTERS
1201 Eye Street, NW
Washington, DC 20005 USA
Tel.: +1-202-862-5600
Fax: +1-202-862-5606
Email: ifpri@cgiar.org