

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

**ENVIRONMENTAL RESOURCES COLLECTION VERSUS CHILDREN'S
SCHOOLING: EVIDENCE FROM TIGRAY, NORTHERN ETHIOPIA**

BY

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List of Acronyms

AERC	African Economic Research Consortium
CSA	Central Statistical Authority
ETB	Ethiopian Birr
ILO	International Labor Organization
MoE	Ministry of Education
n.d.	no date
RESET	Regression Equation Specification Error Test
TFAP	Tigray Forestry Action Program
TLDAP	Tigray Livestock Development Action Program
TRBoARD	Tigray Region Bureau of Agriculture and Rural Development
TRBoE	Tigray Region Bureau of Education
TRBoWR	Tigray Region Bureau of Water Resources
UNICEF	United Nations Children's Fund

Abstract

Previous studies on child labor and schooling in Ethiopia were general and did not distinctively show the adverse effect of natural resources scarcity on schooling. The objective of this paper is, therefore, to see the environmental resources collection and schooling relationship for children aged 7 to 18 years and see if there is any gender bias in schooling due to resource collection work. It uses a cross sectional data of 120 rural households from Enderta and Hintalo Wajerat woredas in Tigray, which represents one of the most environmentally degraded regions in Ethiopia. The two-Stage Conditional Maximum Likelihood (2SCML) estimation technique is employed to take care of endogeneity between schooling and resource work hours.

The empirical analysis revealed that longer hours spent on environmental resources collection influences the likelihood of child schooling negatively. But we find no evidence about the gender based difference against girls' schooling due to resource collection hours though they do often participate in resource gathering tasks. Among others, household head's ability to read and write, owning large number of cattle and child age significantly increases the probability of collecting resources, the collection intensity and schooling likelihood while large sizes of cultivated land bear a negative effect on each outcome. The presence of more children in the 7 to 18 age category indicates the quantity (number of children) and quality (investment in child education) trade-off regarding parents' decision to send their children to school.

Provision of functional adult literacy programs to parents, timely collection of fodder resources from cultivated land, planting fodder-rich tree species, promoting collective agricultural work ("wofera"), introduction of flexible academic calendar and maintenance of the non-operating constructed water services can be important policy tools to reduce environmental resources collection time and improve the likelihood of schooling. Grass-root based experience sharing programs and awareness creation can also be worthwhile in this regard.

Key words: *Environmental resources collection, Collection intensity, Schooling, 2SCML, Tigray*

CHAPTER ONE

INTRODUCTION

This chapter presents the background information, statement of the problem, objectives, scope and limitations, significance and organization of the thesis consecutively.

1.1. Background

Children are economic assets in the rural areas of developing economies. Their importance becomes explicit when rural households base their livelihoods on environmental resources including firewood, water and fodder. Predominantly, collection¹ is from the commons and lies on the shoulder of children and women (Cooke, 2000). With natural resources scarcity, such groups will travel long distances, spending more labor time and effort. According to the International Peace Institute (2009), rapid increases in global population and economic activities have further increased the need for environmental resources. This situation has resulted in pressurized environment with negative implications on education, poverty and health outcomes. Resource scarcity influences economic growth through two mechanisms: it increases the number of people in poverty and limits access to important environmental goods.

In subsistence farming, collection of firewood, water and fodder are usually the tasks of children. With rapid deforestation, access to environmental goods will be pushed further away from the households demanding huge time for collection. Consequently, children become more valuable for their parents with high work demand at the expense of schooling. This phenomenon decreases the probability of child schooling and subsequently worsens the process of human capital formation (Winkler-Dworak, 2003). This provides a channel through which environmental resource degradation affects children's schooling and resource

¹Unless stated explicitly, "collection" refers to the collection of firewood, water and fodder resources.

collection work participation. Hence, the trend should be examined together with the issues of poverty, child labor and schooling.

In Ethiopia, forest degradation and deforestation are worsened when fuel wood and dung are used as sources of energy (Alemu and Köhlin, 2008). Nyssen et al. (2004) established that environmental degradation is a real problem in Ethiopia - reflected by overgrazed rangeland with removed trees. These challenges emanate from human activities and unsound use of natural resources. This problem is severe in Tigray, the most degraded part of the country (Hailu and Edwards, 2006). The region's natural forest and woodland vegetations were destroyed due to the escalating household's demand for firewood, grazing land, cultivable land and urbanization. Also, about 50 percent of highlands in the region experience severe environmental degradation (Yohannes and Waters-Bayer, 2007). The welfare effects of reduced access to fuel wood, water and fodder are, therefore, reflected by the time spent on gathering such resources. This has, in turn, considerable welfare implications on the school going children and women.

The argument here is that natural resources scarcity, mostly caused by environmental degradation, puts pressure on children's schooling. Previous studies in Africa (Nankhuni and Findeis, 2004; Ndiritu and Nyangena, 2010) have supported this connection. Even though population - environment - poverty nexus investigations have been appreciated in Ethiopia, there exists a dearth of empirical evidence on the nature of such relationship. To this end, this study is specifically enthused by the possible adverse effect of environmental resources scarcity on children's schooling through inadequate supply of firewood, water and fodder in Tigray, the most degraded arid area of Ethiopia (Amacher et al., 2004), for children from 7 to 18 years.

1.2. Statement of the Problem

To reduce poverty and social injustice, promote economic growth and boost the economy; education particularly of children's remains an engine of human capital development in the existing knowledge economy (Krueger and Maleckova, 2002). In line with this, governments have made unreserved efforts and, of course, registered remarkable achievements. In the case of Ethiopia, the Net Enrolment Rate (NER)² for primary education (grades 1-8) has increased from 77.5% to 79.1% and to 83.4% for the years 2005/06, 2006/07 and 2007/08, respectively though a slight decline was observed from 83% in 2008/09 to 82.1% in 2009/10. While Amhara, Tigray, Benishangul Gumuz and Gambella were identified as the best performing regions in terms of the NER; Afar, Somali and Dire Dawa were identified as relatively having low primary level rates of enrolment in 2009/10 (MoE, 2009/10)³.

The first cycle of the secondary school (grades 9-10) has also shown a 3.2% increase in NER during the past five years. The NER between boys and girls in such grade levels was 15.5% and 10.7%, respectively in 2005/06. However, this has come close - 16.8% for boys and 16.1% for girls - in the 2009/10 academic year as compared to the previous years' NER for this particular grade range. Similarly, an average of 18.4% annual growth rate was noticed regarding total enrolment in preparatory program (grades 11-12) for the last five years. The average annual growth rate of enrolment was 14.2% for boys and 28.6% for girls for the years 2005/06 to 2009/10 (MoE, 2009/10).

² NER is the ratio of the number of properly aged students enrolled in a specific grade level, say 8 and 9 years for grades two and three respectively, to the total number of children in that specific school age, that is 8 and 9 years respectively (MoE, 2009/10).

³ The report showed that the 2009/10 primary level NER was 94.9% for Amhara, 94.4% for Tigray, 91.1% for Benishangul Gumuz and 89.2% for Gambella region. The corresponding values for Afar, Somali and Dire Dawa were 30.4%, 50.8% and 72.2% respectively for the same year.

Compared to other regional states in Ethiopia, Tigray region has relatively a good student enrolment record. However, there exists a difference across woredas within the region. For instance, while the grade one Net Intake Rate (NIR)⁴ was 76.7% for Ethiopia in 2009/10 (MoE, 2009/10), it was found to be around 93% for Enderta woreda, which is less than the regional average of 97%. Also, the grade three NER was found to be 68.25% for Enderta and 67.83% for Hintalo Wajerat woredas while the regional average was 77.32% for the same year. In a nutshell, the NER on primary school (grades 1-8) for those woredas was slightly above the regional average of about 94%. But striking is the trend that the net enrolment rate falls drastically when one goes up, starting from the first cycle of the secondary school. A clear look at the grades 9-12 reveals a total NER of 1.58% for Enderta and 22.63% for Hintalo Wajerat woredas from the corresponding total school age population aged 15-18 years during the 2009/10 academic calendar. This was a record considerably lower than the 27.52% average for Tigray region as a whole (TRBoE, 2009/10).

While the desire is still to ensure education for all children, barriers occur from many angles, of which the influence of child labor is on the forefront. Though the concept of child labor lacks agreement in both academic and public policy literatures, it can generally be seen from two directions: Market oriented and household based work. While the former comprises work for wages, the latter involves the production of goods and services generally not traded outside of the households, for instance taking care of the siblings and other household chores (Edmonds, 2003). Therefore, child labor involves children's work that troubles their well-being and hampers their schooling, development and future livelihoods. Although its elimination is given top priority (Lange, 2009), it is highly spread in the rural households having debatable causes (Erasdo, 2002). While Beegle et al. (2003) viewed it as a consequence

⁴ NIR shows the percentage of the 7 years old new entrants in to grade one out of the total number of children at an official school admission age of 7 years (MoE, 2009/10)

of poverty, Edmonds (2003) argued that child specific factors affect child labor supply more significantly.

Ethiopia, a country where majority of its population relies on subsistence agriculture, has been characterized by high incidence of child labor and low school enrolment rates. Analyzing the nature and trade-off between child labor and schooling, Getnet and Beliyou (n.d.) established that the likelihood of children's school enrolment falls with involvement in long hours of work. Previous research work in Ethiopia by Assefa and Bedi (2003) also examined child labor in light with agricultural technology expansion. They concluded that while the demand for child labor diminishes with better access to agricultural machineries, it increases, at least in the short run, with improved seed provisions. Furthermore, Chaudhury et al. (2006) confirmed that children's schooling is affected by positive education externalities, availability of and access to schools and the level of school infrastructures.

Many authors have identified different factors responsible to reduce the likelihood of enrolment at school. However, whether natural resources scarcity leads to lower children's schooling attendance through the opportunity cost of time spent on collecting environmental resources (firewood, water and fodder) is left explicitly unexamined in the Ethiopian context. In order to address such issue from the situation in Tigray region, therefore, this study raises the following specific research questions.

1. Does inadequate access to environmental resources affect children's schooling attendance?
2. Does resource scarcity lead to gender bias in school enrolment through longer hours of resource collection work?

Therefore, this study empirically explores the central hypothesis that scarcity of firewood, water and fodder reduces the likelihood of children's schooling attendance.

1.3. Objectives of the Study

The overall objective of this research is to explore the influence of environmental resources scarcity on children's schooling attendance in Tigray, northern Ethiopia with a combination of both descriptive and econometric investigations. More specifically, it addresses the following specific objectives.

1. To understand the link between children's schooling and environmental resources collection.
2. To examine the gender bias, if there is any, in schooling vis-a-vis resource collection burden.
3. To draw some policy implications based on the findings.

1.4. Scope and Limitations of the Study

The issue of child labor is a broader phenomenon. Therefore, to be specific enough, the study adheres to the examination of the link between environmental resources scarcity and children's school enrolment where resource scarcity is measured by the time spent on firewood, water and fodder collection. To this end, the actual time spent on resource collection participation by children and parents is included.

The irregularities in resource collection - described by collection frequency per week - and recalling problems on the actual time spent on such activities may entail a challenge on the data. While actually spending a portion of time, some parents and children may have reported as if they did not involve in resource collection. On the other hand, the collection intensity

(hours of resource work) of others might be exaggerated. The fact that a child was not enrolled at school during the data collection time does not necessarily mean that he/she will be out of school for the whole semester. If the reason for being not enrolled is for example a family shock, say divorce, he/she may have the probability to go to school later on if the parents have settled their disagreement. The possible conclusions and consequent policy implications are, therefore, subject to such potential limitations.

1.5. Significance of the Study

Globally, child labor is a serious economic, social and psychological problem that attracts the attention of many scholars and development practitioners. The point of argument is not that children should not be involved in work, but that the incidence of child labor should be given due emphasis. The possible effects of child labor on the inter-connected development process of children can be judged from the work hours spent and degree of exposure to risk. For instance, a child who spends longer hours on work is likely to be tired and intellectually harmed.

Plenty of researches are conducted on child labor and schooling in Ethiopia. However, they were general that they did not explicitly take in to account the impact that natural resources scarcity would have on schooling. Therefore, examining the link between environmental resources scarcity, resource collection and children's schooling fills the gap in literature on child labor in Ethiopia. Notably, it adds to the population - environment - poverty argument. It can also serve as a point of reference for further researchers in the area. This kind of research is crucial by providing information in formulating sound educational, labor and environmental resources management policies by the government and other development partners.

1.6. Organization of the Thesis

The thesis is organized as follows. Following the introduction in the first chapter, chapter 2 reviews the theoretical and empirical literatures. Chapter 3 focuses on the data sources and methodology. The data analysis part is provided in chapter 4 while the conclusion and implications drawn are presented in chapter 5.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents the literature review part of the thesis. It comprises both the theoretical and empirical review of the existing literature.

2.1. Review of Theoretical Literature

As broader concepts, child and child labor do not have common characterizations across the world. In most cases, the variations in definition emanate from the differences in setting the age restriction and the circumstances under which a child performs a specific type of work. For instance, the international labor standards define child labor as one that “encompasses work that is mentally, physically, socially or morally dangerous and harmful to children, and interferes with their schooling” (ILO, 2008:13). For statistical measurement purposes, it also defines child labor as a group of individuals that fall in the age category of 5-17 years and observed to perform at least one of the following tasks in a given period of time: hazardous work⁵, worst⁶ forms of child labor other than hazardous work and lastly, other forms⁷ of child labor based on child’s age and hours of work per week. However, as long as it does not negatively influence school enrolment⁸ and their health status, this ILO’s report recognizes involvement of children aged 13 to 15 years on light work.

Likewise, article 2 of the ILO’s minimum age convention No.138 sets the minimum age below which children should not be admitted to employment or work at 15 - an age not less than the completion of a compulsory education (ILO, 1973). Depending on the age of the

⁵ Work in which children are involved in hazardous occupations including long hours, night work, unhealthy working condition and unsafe equipment.

⁶ It includes slavery and interrelated practices, use of children for prostitution and forced begging among others.

⁷ Unlike the duration, it comprises economic activities performed by the school-going children (those aged 5 to 14 years) except those permissible light works.

⁸ The terms school enrolment and school attendance are used interchangeably in this study.

child and type of work performed, UNICEF (2004) defined child labor as work beyond the minimum number of hours specified. That is a weekly economic work of at least 1 hour for those 5-11 years, 14 hours for children in the 12-14 years and 43 hours for children in the age category of 15-17 years.

While light work (work that do not adversely affect schooling likelihood) is common for children, still they might be involved in dangerous activities (including prostitution and slavery) that harms their moral and health status. These were reflected in the ILOs convention on the worst forms of child labor, No. 182 (ILO, 1999). This convention treats all persons below the age of 18 as children.

In Ethiopia, Assefa and Bedi (2003:20) described the employment admission case from the perspective of the constitution as follows:

... allows employment between the age of 14-18 only as apprentices and under a number of restrictions. These labor laws focus mainly on the manufacturing sector and disregard the rural economy. Ethiopian labor law does not make any reference to the problem of child labor in the agricultural sector and agricultural and household employments are exempt from laws. Thus, an estimated 85 percent of national economic activity falls outside the protection of labor code as it consists of small scale and subsistence farming.

The child labor literature in economics shows that even though children have low productivity and produce low quality products, their demand by employers rise periodically due to the fact that they are willing to take orders, are more punctual on work and accomplish their assignments without complaining. Even within their respective households, they enable other

family members to work elsewhere through their commitment in the home production of goods and services (Canagarajah and Nielsen, 1999).

The household decision making process in allocating children's time among rival activities (for instance, involvement in resource collection or schooling) can be examined based on two basic household bargaining (decision making) models. The unitary household model presumes that all household members enjoy the same utility function and that their joint consumption versus labor supply decision is undertaken by the family. The collective model of household, on the contrary, sees the household as an area of bargaining. Thus, household decision emanates from the bargaining process among members of that particular household whereby a precise influence of the child is taken in to account (Erasdo, 2002; Basu, 1999).

It has been argued that children remain a path to utility maximization efforts by parents as they do not possess sizeable household based bargaining power. Furthermore, it was assumed that parents are not cautious about their children's wellbeing and, thus, send them to an employer (Gupta⁹, 1998). Consequently, this paper bases its analysis on the unitary household model to trace the resource collection and children's schooling relations as parents allocate their children's time entirely based on their own preference.

In the literature, there exists a plethora of theoretical frameworks as to what determines child labor and children's enrolment at school. Employing the recent theoretical literature, Nielsen and Dubey (2002) have established four hypotheses explaining child work. These were the substitution hypothesis, the capital market hypothesis, the parental education hypothesis and the subsistence hypothesis. The substitution axiom reveals that the demand for child labor is a

⁹ As cited in Basu (1999)

function of child - adult wage and productivity ratio. That is, if the adult wage is high with low productivity, child labor will be widespread. It is still argued that factors related to the credit market imperfection (the capital market hypothesis) reflects if the degree of land ownership puts an impact on children's work. Here, the demand for children's time may be upward slopping due to the need to work in household farm enterprise with increasing land size. Yet, land ownership may boost children's school enrolment by solving the problem of household's credit restraint. Therefore, credit unconstrained households may not hamper their children from going to school.

How household head's level of education affects the time allocation pattern of children is observed from the parental education hypothesis. It is inferred that children from educated parents have high probability of being enrolled at school when compared with children from uneducated heads. Finally, the subsistence proposition presumes that households with lower income from non-child labor sources are more likely to engage their children in work, making them to be out of school. In this regard, Jensen and Nielsen (1997) argued that poverty may drive children out of school and, thus, likely to reduce the process of human capital formation among tomorrow's human resources. Their poverty explanation shows that direct schooling costs for instance, distance to school, uniform expenditure and registration fees and indirect costs like forgone income due to children's schooling reduces the probability that a child will go to school and increases involvement in resources collection - in our case.

In a broader sense, social welfare can be reflected by environmental resources to population availability. However, there exists no universal measure of natural resources scarcity among social, natural and policy scientists. According to Mackellar and Vining (1989), common among scholars is that an environmental resource is found to be economically scarce if the

opportunity cost of obtaining it is high. According to Heltberg et al. (2000), fuel wood collection and forest degradation can establish a joint relationship. Provided that collection exceeds sustainable yield, fuel wood demand may cause degradation and, in turn, degradation can result in fuel wood scarcity. Although forest degradation can at least be reduced with an alternative sources of energy (including animal dung and crop residues), according to them, this may reduce soil fertility and animal fodder availability. Thus, dependence on environmental resources and their scarcity affects households' welfare through the opportunity cost of time spent on collection.

The fact that it is replenishable by rainfall, many people consider water as a renewable resource. But in reality, its availability per time is finite like firewood. Thus, biodiversity and human activities are likely to be threatened with changes in water supply. This calls all concerned bodies to carefully utilize and conserve the scarce water resource (Pimentel et al. 2004). In rural Ethiopia, Berhanu et al. (2002) appreciated the importance of common property resources (CPRs)¹⁰ as a means of grazing land, construction material and firewood. Due to exclusion¹¹ and subtractability¹² issues, Sapkota and Odén (2008) argued that such resources are characterized by private and public goods nature. All in all, as CPRs are getting scarce, children and for that matter women may spend longer time in fetching such environmental resources.

According to Basu (1999), curbing child work¹³ requires the existence of intra-national, supranational and extra-national institutions. Laws and plans that a given country devices (for instance, compulsory education) to address child labor within its domestic territory are

¹⁰CPRs are defined as “resources owned and managed by a given community”.

¹¹ Preventing (excluding) other users from enjoying a particular resource is hardly possible.

¹² The amount of a resource available to others is reduced when that particular resource is also used by others.

¹³ Both child labor and child work are used synonymously in this study.

referred to as intra-national activities. In the case of supranational interventions, on the other hand, international organizations such as ILO and World Trade Organization protect child labor by imposing international labor standards¹⁴. The extra-national actions are pronounced when advanced nations try to prevent child work in developing countries through the formulation of country-specific legislations. This emanates from resistance to adopt international labor standards because of variations in opinion across countries.

2.2. Review of Empirical Literature

Africa experiences the highest problem of child labor in the world. In some of its regions, child labor force participation rate accounts for about 30%. When children lack time to do their academic work and get tired because of household work burdens, they are forced to forgo schooling attendance in favor of work. As a result, the continent loses 1% to 2% Gross Domestic Product annually due to the fall in human capital stock (Canagarajah and Nielsen, 1999). Despite the immense literature on the determinants of child labor and schooling; empirical studies that particularly deal with the natural resource scarcity and child schooling relationships are almost non-existent in Africa.

Nankhuni and Findeis (2004) and Ndiritu and Nyangena (2010) have examined the situation in Malawi and Kenya respectively. Using Malawi Integrated Household Survey and cross-sectional data set from Kiambu district in Kenya, their study concluded that children's probability of attending school significantly decreases with increasing hours spent on water and fuel wood collection. Female children had a better probability of school enrolment while they were really busy with resource collection and that mother's involvement in collection enhanced likelihood of children's schooling in both countries.

¹⁴ A set of labor rules that will be followed by all countries.

A survey using a cross-sectional data set of 3,373 households from Nepal was conducted to test how firewood and water scarcity affects the demand for children in resource collection activities. As a result, firewood and water collection, on average, demands 41 hours per month and 2 hours per day respectively. The authors revealed that females and children account for 61% and 13% respectively for firewood collection. However, water collection responsibility lie mainly with women and children, accounting for 69% and 18% respectively. The time spent by households collecting firewood and water has reflected the scarcity of firewood and water. This represents the amount of time spent on the double trip and time spent gathering such useful environmental resources (Loughran and Pritchett, 1997).

The pattern of firewood collection from common property forests in Terai, Nepal was also examined using a primary data and log-linear model. By treating the amount of firewood collected per household as the degree of firewood dependence indicator, they showed that poor households collect about ten times more firewood from the commons when compared to their wealthier counterparts. Equally important is that while firewood collection and consumption varies directly with family size, it is inversely related to size of land holding (Sapkota and Odén, 2008). Therefore, it is possible to postulate that, if firewood collection is children's primary function, children of poor households will spend considerable amount of time and effort in resource collection while richer parents can still afford alternative sources of energy.

Using data from the 1991 Pakistan integrated household survey, Filmer and Pritchett (1996) examined the children versus environment interaction. They revealed that while urban women and girls respectively spent about 1.3 and 0.6 hours a week on collecting firewood, fetching water and collecting animal fodder; their rural counterparts spent, respectively 8.1 and 5.2

hours a week on collection activities. It was found also that for the double trip, the average time to collect firewood was about 2 hours, which on average is almost 3 kilometers. They concluded that children represent much of the percentage of time devoted to environmental goods collection activities. In a nutshell, resource scarcity results in increased time to collect resources by women and children.

Nkamleu (2009) employed a multinomial logit model to trace the determinants of child labor and schooling in Côte d'Ivoire. He concluded that while older children, children from illiterate households and those living with relatively lower number of dependents had high probability of only working on the farm; boys were found to likely combine both schooling and work together. The study accentuated that children should be given time to attend schooling properly.

In the labor market of rural India, while children supply about 17% of the total family time, their contribution solely amounts to 6% of their family's income. The study revealed that with almost no effect on a girl's labor supply, an increase in father's wage reduces the labor force participation rate for boys by 9% (Andvig, 2000). Using primary data with a robust maximum entropy approach, another study in rural India revealed that a 10% increase in firewood collection time reduces the amount of firewood collected by 1.1%. But it increases the amount of labor time spent on collection by 8.9%. Thus, rural households have increased the resource collection time rather than a switch to alternative energy sources as a mechanism to react fuel wood scarcity.

On the other hand, an increase in farm size by 10% has led to about 2.5% reduction in the firewood collection time from the forest and a 4.5% increase in private fuels consumption like

crop residues. The study reported that livestock ownership, though not significant, increases the likelihood of private energy utilization probably in the form of animal dung. It was concluded that firewood collected from the forest and other non-forest sources are substitutes to each other (Heltberg et al., 2000). The beauty here is that if households use alternative energy sources, children may get relief from fuel wood collection and enhance schooling attendance. However, it is possible to argue that while an increase in farm size may demand more children's time through their involvement in farming, large number of livestock may also require substantial time through that of herding tasks.

By employing data collected by the Nigerian Federal Office of Statistics and the ILO on 22,000 housing units, Okpukpara and Odurukwe (2006) investigated the incidence and determinants of child labor in Nigeria. Considering children aged 5 to 14 years, they revealed that child age, household composition and father's educational attainment considerably influences the extent of children's work participation. The survey confirmed that children in female headed households were more likely to involve in work participation than schooling compared to their male headed counterparts. In addition to this, their analysis showed that children from large households do allocate a greater portion of their time endowment to work activity and, thereby, reduces the probability of enrolment at school. The highest probability of combining both work and schooling was pronounced among children within the poorest households.

Gender-wise probit models by Sackey (2007) on school attendance and attainment, using micro level data on 6,000 households in Ghana, established that parental education (often measured by the number of years of schooling) and the magnitude of household resources (particularly that of family income) have significant influence on the probability of attending

school by a child. Another household survey in Bolivia and Venezuela by Psacharopoulos (1997) also revealed that relative to the non-working children, the educational attainment of working children is likely to reduce by about 2 years of schooling. Such groups of children were noticed to have a higher probability of grade repetition.

Like any other parts of Africa, rural households in Ethiopia also rely on fast-degrading environmental resources, including fuel wood for energy needs, drinking water and fodder for animal feeding. Zenebe et al. (2010) reported that since urban households in Ethiopia rely on such rural areas for their firewood demand, environmental degradation gets worse-off with firewood scarcity. Berhanu et al. (2002) who surveyed 50 ‘tabias’¹⁵ in the Tigray highlands in 1998/99 found that woodlots management has escalated the everlasting shortage of firewood in the region.

Shylendra (2002) have examined the rehabilitation and livelihood impact of emerging trends from Tigray region (Ethiopia) and Gujarat (India). The findings established that a fair treatment of participation equity and community benefit packages reflects the livelihood contribution of rehabilitated CPRs. The area enclosure program in Tigray and the joint forest management program in India have improved livelihood of the communities at least through an increased provision of animal fodder. The author revealed that unlike its Indian counterpart, the area enclosure program in Tigray was more equitable due to the unreserved efforts of the “tabia bayto”- a village based government system - for the smooth functioning of the project. However, both programs fail to address gender equity adequately. A similar study in India by Jodha (1990) in seven major states comprising 82 villages acknowledged the importance of CPRs for rural population in the high risk areas.

¹⁵ A ‘tabia’ is the lowest administrative unit in the region, analogous to kebele in the urban setting.

TFAP (1996) portrayed that on average, fetching firewood requires 7-10 hours in the highland areas and 2-3 hours in the lowland areas of Tigray. This is probable from the situation that forests fail to meet the 4.33 million cubic meter approximate fuel wood requirement in the region. As a result, about 587,552.6 and 277,887.7 metric tons of dung and crop residues are respectively burned for fuel purpose in the rural areas of the region.

A social and agro-ecological survey by the Relief Society of Tigray and Agricultural University of Norway in Central Tigray revealed that households spent an 8 hours round trip in search of drinking water in Abergelle woreda. Regarding the sources of water; about 80% of the households reported that they obtain water from springs. The low yielding potential of the sources and disproportion with the number of users have further complicated the waiting time during fetching. This has seriously affected the lives of many women and children as they are primarily responsible for fetching. The study confirmed that shortage of firewood and agricultural expansions have resulted in high degree of deforestation in Degua-Tembien and Embaseneyti woredas respectively (Gebremedhn and Oyhus, 1994).

As far as the availability and duration of the main potable water sources is concerned; about 77% of the sample households in Tembien reported that their major sources of potable water lasts only for at most 10 months in a year and it stays for 7-9 months for 16% of the households. An average distance travelled to the nearest potable water was found to be 39 minutes for Adwa and 36 minutes for Tembien with a zone average of 37 minutes. The average family size in the surveyed households was 4.73 with about one-quarter of the households being female headed. This was probably due to the long lasting civil war in the region that makes many women to be widowed. A water supply project baseline survey in selected 13 towns in Tigray region (UNICEF, 1997) showed that, on average, households

collect 20 litres of water in a single trip. Their consumption level was found to be about 11 litres per person per day - roughly half of the 20 litres per person per day available in 1 kilometer distance from the residence of communities-the standard set by the World Health Organization.

The TLDAP (1998) showed that people in the region are heavily dependent on their livestock for many purposes. Among others, animals are sources of manure and dung, income generation, transportation particularly the pack animals, etc. Using donkeys as a means of transportation, households engaged in wood commercial trading earn approximately 1404 ETB per year per family. Such importance of donkey makes Tigray to be the first in Ethiopia regarding the number of donkey stock with an average density of 19 per 1,000 square kilometers. Regarding the feed resources in the region; crop residues and natural grasses respectively account for about 47% and 35%. It was revealed that about 3.2 million and 3.6 million hectares of the roughage fodder respectively originate from grazing lands and crop agriculture.

The TLDAP (1997) identified February, March and April as periods of critical feed shortage to feed livestock on crop residues. Due to erratic rainfall and climate variability, the regional level of crop production is below capacity, thus, in turn resulting in inadequate amount of crop residues. TFAP (1996) reported that farmers in Tigray prefer to grow fodder trees in their farms to cope with the fodder deficiency. However, their effort is not fully realized due to over pressure of cutting and browsing by the livestock. The environmental degradation rate in the region has been escalating over time due to the many interlinked factors.

Among others, the traditional culture of housing construction that demands large amounts of wood, shifting cultivation, military settlement and fuel wood trade (for instance, around some areas of Enderta woreda) were found to be critical factors. Drought is also a key factor in resource degradation by drying tree species, escalating crop failure (consequently fostering fuel wood trade among rural people) and bringing about fodder scarcity. The traditional holidays and social occasions organized in the region devastate the situation through high firewood consumption. Furthermore, it is common in the region to clear land and cultivate crops to feed new families that simultaneously demand abundant firewood for cooking and heating purposes. The traditional grazing system also contributes to deforestation when farm trees are smashed with other households' cattle. Therefore, it is possible to conclude that animals in the region are underfed and malnourished following the scarcity of feed. Children will, thus, spend their time searching for fodder from different sources to save the lives of their livestock.

Köhlin and Parks (2001) showed that to meet the demand for heating and cooking by the majority in India, fuel wood plays a pivotal role in developing economies and, thus, its scarcity aggravates the environmental degradation. Contrary to the case in Tigray, these authors reported establishment of plantations as a remedy to curb resource degradation, to reduce fuel wood collection time and purchase expenses. To this end, Descheemaeker et al. (2006) emphasized that merits and demerits of such interventions on the healthy functioning of the environment have to be thought carefully apart from mitigating the firewood and grazing land scarcity problems.

The Ethiopian Economics Association (2007/08) report indicated that Ethiopia's energy consumption mostly emanates from firewood, charcoal, crop residue and animal dung.

Annually, about 40 million and 8 million tons of fuel wood and agricultural residues are respectively consumed across the nation. While 49% of Ethiopia's urban households consumed purchased firewood, in 2004 alone, about 81% of the rural households have used collected firewood. The relative importance of children in resource gathering tasks, thus, cannot be refuted. While reduced access to biomass fuels entails a serious economic, social and environmental implication, the demand is still growing by 3.1% per annum. In Tigray alone, in majority of the woredas, its consumption outweighs the yield in forestry.

Using a panel data set collected on the years 2000, 2002 and 2005 from the rural households in East Gojam and South Wollo zones of Amhara region; Alemu and Köhlin (2008) concluded that the likelihood of using dung as fuel and manure varies directly with the size of livestock and land holdings. However, in large sized households, dung was mostly used for fuel. Furthermore, their study opens a room for the complementarities nature of fuel wood and animal dung.

Research results by Assefa and Bedi (2003) showed that on average, children aged 4 to 15 years spent about 29-30 hours per week on various work activities with no gender based differences on the total time spent. Relative to girls, boys were noticed to have higher probability of schooling. Even though schooling likelihood do not significantly reduce in response to the time spent on various domestic work and resources collection activities, child labor was found to adversely affect the process of human capital formation for majority of the rural Ethiopian children.

In a similar fashion, Assefa (2002)'s multinomial logit model about the household's decision on children's time allocation showed that ownership of land and livestock significantly

reduces the probability of attending school among rural children. Moreover, being a female child, belonging to illiterate household head and to those with large number of dependants increases the probability of working by the child and, thus, reduces schooling likelihood.

Getnet and Beliyou (n.d.)'s bivariate probit model examined the patterns of work participation and school attendance for children aged 7-15 years in rural Ethiopia using a survey data. According to them, children in Ethiopia began work specialization as of 5 years of old with males being engaged in market¹⁶ activities and females on domestic chores. Their econometric investigation showed the presence of gender bias in schooling in rural Ethiopia. While high probability of attending school and combining market work with school is common among males, females were observed to undertake domestic work with schooling or domestic work alone. While literate families were more likely to send their children to school, children from families with high number of dependents were more probable to be out of schooling. Probably due to much herding time, increases in livestock size increased the likelihood of linking schooling with market work. In a nut shell, the beauty of their analysis is that the likelihood of schooling is examined vis-à-vis market work, domestic work and educational attainment explicitly.

Tassew et al. (2008) have analyzed the invisibility of children's paid and unpaid work in Ethiopia using a combination of quantitative and qualitative approaches. A total sample of 3,115 children from Ethiopia's most populous regions (Tigray, Amhara, Oromia, Southern nations, nationalities and peoples and Addis Ababa) who fall in the age category of 7 to 17 years are incorporated in the analysis. Their study revealed that larger sizes of livestock demand greater children's involvement on herding, probably keeping them out of school.

¹⁶ To the authors, market activities include farm work and herding of animals.

Apart from this, their study did not find a significant effect of land size on the time allocation patterns of children. Even though large number of livestock and land holding size can reduce the likelihood of attending school through greater demands for herding and farm work respectively, it is possible to argue that this can foster schooling among children by reducing the resource collection intensity (through animal dung) and provision of fodder (straws and stalks).

Many papers have investigated the determinants of child labor and school attendance. However, recapitulating all available literatures is difficult due to differences in explanatory variables used, econometric models followed and dissimilar definition of child and child labor among authors. Although quantitative child labor estimates might vary proportionately with the various definitions attached, this thesis defines child labor as any activity the child undertakes for household consumption and (or) market purpose that narrows the likelihood of schooling by deterring the psychological, mental and physical circumstances for those aged 7 to 18 years.

Unlike Nankhuni and Findeis (2004) and Ndiritu and Nyangena (2010), almost all of the literatures reviewed above investigated the likelihood of schooling and children's work participation decisions with no due emphasis about the possible impact of environmental resources scarcity on children's school enrolment. To this endeavor, using a cross-sectional data set from south eastern Tigray, this thesis contributes to the literature of child labor through an econometric analysis of child schooling and resource collection interaction.

CHAPTER THREE

DATA SOURCE AND METHODOLOGY

This chapter provides issues related to the data source, conceptual framework, econometric model and selection of explanatory variables used in the regression analysis.

3.1. Data Source

One of the regional states in Ethiopia, Tigray region, is situated in the northern most tip of the country. It is bordered by Amhara region in the south, Afar region in the east, Sudan in the west and Eritrea in the north. The CSA (2010) report shows that Tigray has a total population of 4,664,071 of which men account for 49%. It has an area of 84,721.77 square kilometers and a population density of 55.1 persons per square kilometer.

Looking at the regional ecology, while ‘Wurch’, ‘Dega’ and ‘Woina dega’ covers 0.07%, 5.31% and 32.69%; ‘Upper Kolla’, ‘Lower Kolla’ and ‘Bereha’ accounts for 26.18%, 35.74% and 0.01% respectively. The region has an elevation range of 600-3,460 meters above sea level. Annual temperature ranges from 22 to 27 degree centigrade in ‘Kola’ and 10 to 22 degree centigrade in ‘Dega’ and ‘Woina dega’ areas respectively. Tigray has a cultivable land of about 1.2 million hectares and around 1,795, 750 hectares of land that can be covered with forests. It has 47 woredas and two development corridors - Humera and Maichew. About 83% of the population lives in the rural areas (TRBoARD, 2010/11).

The study was carried out in South Eastern Tigray covering two woredas - Enderta and Hintalo Wajerat – using a cross-sectional data set of 120 rural households. Enderta and Hintalo Wajerat have a population of 123,537 and 164,554 with a population density per square kilometer of 38.9 and 57.4 persons respectively (CSA, 2010). These woredas were chosen purposively for two reasons: (i) The relative proximity of the two woredas to Mekelle

(the regional capital) increase the demand on children to collect and sale natural resources (firewood and fodder) beyond their family's domestic consumption. A report from TRBoARD (2010/11) revealed that 1,400 donkey load firewood per day is supplied to Mekelle city in every Saturday where 95% of this supply is expected to emanate from farmers in Enderta woreda. (ii) The time and financial limitations have made impossible for other areas to be included in the study.

To achieve the objectives, a detailed structured and close ended questionnaire was prepared and then translated in to Tigrigna, the local language. The questionnaire was pre-tested in the study areas. Consequently, important corrections were made and some redundancy totally removed. Two enumerators were recruited and, then trained by the author on issues concerning neutrality and interviewing approaches. More specifically, in cases where the respondents are children, enumerators were trained to check for their willingness and to be understanding. They were also oriented to respect the household's diversified tradition, living standard and knowledge. At last, familiarization exercise with the envisaged questions and response recording techniques have been offered before leaving to the field. The actual field survey was conducted between February and March 2011. Using a multi-stage sampling, two 'tabias' (5 villages) from the total of 21 'tabias' in Hintalo Wajerat woreda and three 'tabias' (6 villages) from a total of 17 'tabias' in Enderta woreda are chosen. A simple random sampling technique is employed to select 'tabias', villages and households consecutively.

The survey collected provides evidence on children's participation on schooling and resource collection tasks, household socio-economic factors (characteristics), household income means, sources of environmental resources and the time spent by adults and children on other domestic tasks. Moreover, data on children's school progress and the influences of resource

work participation on their schooling was surveyed. Focus group discussions were carried out with teachers and students in two selected schools (with one from each woreda) and with firewood distributors in Quiha and Mekelle.

Even though rural children in Ethiopia actually begun work - including environmental resources collection - in their early ages, this study focuses on children in the 7-18 years age category. While the lower limit of the age range was chosen because it is an official age for any child to start schooling (Assefa, 2002 ; Getnet and Beliyou, n.d.), the maximum age boundary was selected following the ILO's 1999 convention that regards all persons under 18 years as children (ILO, 1999). As a result, 316 children (175 males and 141 females) who fall in this age category are used for the analysis. While 184 children (103 males and 81 females) are from Enderta, the remaining 132 (72 males and 60 females) are from Hintalo Wajertat Woreda. STATA, VERSION-10 is used for analysis once the survey data is appropriately coded.

3.2. The Conceptual Framework

Theoretically, this paper bases its analysis on Becker's (1965) seminal paper on the allocation of time and its extensions to household behavior. This household production model assumes that parents' utility maximization is shaped by market purchased goods and time endowment. As per this model, the number of children that a family desires to have and the pattern of household member's time allocation towards schooling, market work and household production demands joint decisions.

In the original specification of the model, home produced goods (like collecting firewood, water and fodder in our case) and market goods (for instance, oil lamp) are perfect substitutes

to each other. Granau (1977) has further developed the model by arguing that household's home good production is characterized by diminishing marginal productivity mainly due to tiredness and limited access to local resources. With increasing local resources scarcity, this may require more helping hands (large number of children) spending considerable portion of their time on the collection of firewood, water and fodder resources. The implication is that resource collection tasks may ultimately keep children out of school. This is substantiated by Rosenzweig and Evenson (1977) who examined the joint parents' decision concerning child work, schooling and that of fertility in the rural economic setups.

Parents maximize utility from the quality (measured by investment in human capital formation) and quantity (measured by the number of children), household leisure, schooling per child and home produced goods subject to their income and time restriction in the agricultural sector. In doing so, parents allocate their time between work and leisure. Children, on the other hand, can for simplicity purposes be assumed to distribute their time towards leisure, education and home production activities.

One of the many testable hypotheses that can be derived is that with an increase in resource scarcity, parent's claim on their children to collect firewood, water and fodder is likely to increase. This, in turn, forces children to involve in resource collection instead of being enrolled at school.

3.3. The Econometric Model

Decisions concerning children's time allocation by parents are likely to consider more than one activity and calls for modeling simultaneous equations. For any child, the decisions to go to school or work are joint activities competing with his/her time endowments. To this end,

the following bivariate probit model (Greene, 1998; Nankhuni & Findeis, 2004; Ndiritu & Nyangena, 2010) is adopted to trace the resource collection and schooling interactions.

$$Y_{1i}^* = \beta_1' X_{1i} + \varepsilon_{1i} \dots \dots \dots (1)$$

$$Y_{2i}^* = \beta_2' X_{2i} + \varepsilon_{2i} \dots \dots \dots (2)$$

Where Y_{1i}^* and Y_{2i}^* are the latent variables observed by the following conditions:

$$Y_{1i} = 1 \text{ if } Y_{1i}^* > 0, Y_{1i} = 0, \text{ Otherwise}$$

$$Y_{2i} = 1 \text{ if } Y_{2i}^* > 0, Y_{2i} = 0, \text{ Otherwise}$$

Y_{1i} and Y_{2i} represent the schooling and environmental resources collection participation of each child in each household respectively. They are dummy variables based on the following outcomes.

1. Y_{1i} refers whether the child is currently attending school based on the question: "Is [name of the child] attending school at present?". The value is 1 if the answer is yes and 0 if otherwise.
2. Y_{2i} refers whether [name of the child] participated in the collection of at least any one of the resources - firewood, water and fodder - in the past seven days before the survey. The value is 1 if the answer is yes and 0 if otherwise.

Both the schooling and collection participation choices are modeled as a function of some explanatory variables (the complete explanation of these variables is given in section 3.4). β_i' is the coefficient of each explanatory variable. ε_{1i} and ε_{2i} are the disturbance terms in the school attendance and resource collection participation activities respectively. They are assumed to be independently and identically distributed as bivariate normal $[\varepsilon_{1i}, \varepsilon_{2i}, \rho] \sim$ bivariate normal. ρ stands for the correlation coefficient between the schooling and collection participation equations.

Since environmental resources collection participation and school enrolment are likely to be jointly decided, the bivariate probit model is firstly estimated. Consequently, if the rho coefficient - correlation of the error terms in the two probit equations - is statistically significant, then we conclude that children's involvement in schooling and collection participation are undertaken jointly. All in all, the bivariate probit model is used if the error terms in the schooling and collection participation models are correlated. On the other hand, univariate probit models will be employed if the error terms are not correlated (Greene, 1998).

Because the children's time spent to collect firewood, water and fodder increases with natural resources scarcity, their likelihood of attending school may be negatively affected. Consequently, the amount of time spent on environmental resources collection (henceforth, called the collection intensity)¹⁷ is considered as an endogenous regressor in the school attendance model.

$$Y_1 = \beta_1 X_{1i} + \omega Y_3 + \varepsilon_1 \dots \dots \dots (3)$$

$$Y_3 = \beta_2 X_{2i} + \varepsilon_2 \dots \dots \dots (4)$$

Here, Y_3 stands for the collection intensity introduced as a continuous variable in the school participation model and ω is its coefficient.

An important estimation issue emanates from the anticipation that resource collection intensity may be an endogenous predictor in the school enrolment equation. If so, the Rivers and Vuong (1988) correcting technique will be used. They argued that the Two-Stage Conditional Maximum Likelihood (henceforth, 2SCML) procedure is preferred to other

¹⁷ Collection intensity reflects children's weekly hours spent on gathering firewood, water and fodder (further details are given at the descriptive analysis section).

estimators on at least three grounds. Firstly, it is computationally easy; secondly, it works well relative to its competitors with small samples, and is also suitable to construct exogeneity tests based on the statistical significance of the coefficient of the residual.

Greene (1998) argued that the two-stage procedure works well if at least one endogenous and continuous explanatory variable exists in the probit model. Following the Rivers and Vuong (1988), the computation of the 2SCML involves two steps. Firstly, a reduced form Ordinary Least Square regression is carried out on resource work intensity as a function of all exogenous explanatory variables, the Instrumental Variable (IV) and then residuals are saved. Next, both the saved residuals and the endogenous collection intensity variable are included in the probit for school enrolment equation. If the standard t-statistics for the estimated coefficient of the residual is statistically different from zero, one can conclude that resource hours are found to be endogenous in the school attendance probit model (Wooldridge¹⁸, 2002).

The structural form equation for the school enrolment model and the reduced form equation for resource collection intensity model is applied, thus, to use an instrumental variable as follows.

$$Y_1 = \beta X_i + \omega Y_3 + \varepsilon_1 \dots \dots \dots (5)$$

$$Y_3 = \theta X_i + \delta Z + \varepsilon_2 \dots \dots \dots (6)$$

Equation (5) and equation (6) show the structural equation for the schooling model and the reduced form equation for the collection intensity model respectively. ‘X’ stands for the common exogenous covariates in both equations (as detailed in section 3.4), Z is an instrumental variable in the collection intensity model with δ as its coefficient.

¹⁸ Interested readers can refer to Wooldridge (2002:482) on the detailed further treatment of a continuous endogenous explanatory variable.

3.4. Selection of Variables Used in the Econometric Analysis

The joint decisions of involvement in resource collection and schooling are governed by many economic, environmental and societal considerations. This study takes in to account, among others, some child attributes, characteristics of parents, characteristics of the household and geographic location of the child as important in explaining the resource work participation, resource intensity and schooling by children in the age range of 7-18 years.

To begin with, child sex bears an important implication where collecting resources is usually the task of females in the rural areas. Girls are likely not to get registered at school to assist their parents in resource collection due to the scarcity of environmental resources. They spend more time in pursuit of such resources and are more likely to be taken out of school even after they are already enrolled. The hypothesis is, therefore, that females are more likely to involve in resource collection and less likely to be enrolled at school compared to males.

A child may be liable to travel long for gathering firewood and fodder resources and wake up at night for water queuing. Thus, collection of resources by children may be not only time demanding but also seeks muscle strength where obtaining a nearby resources is hardly possible with the problems of environmental degradation. The hypothesis is, therefore, that involvement in resource collection and intensity of work varies directly with a child's age. With delay in school enrolment among rural children, it is again hypothesized that the likelihood of attending school gets improved as the age of the child increases. A child's age is specified as a quadratic function to control for nonlinear effects.

The number of children in the 7-18 age category is included as an explanatory variable in all the three models to see if quantity of children improves and/or worsens the child's probability

of collecting a resource and/or attending school. The hypothesis is that large number of children reduces pressure on resource hours among school-range children since they can collect turn by turn or on a shift basis. It is also hypothesized that this will reduce enrolment at school due to high educational expenses - like registration fees and uniform expenditures - encountered by parents with large number of children in the 7-18 age groups.

The decision to collect resources and (or) attend school is also affected by the type of relationship that the child has with the head of the household. In this case, sons and daughters of the head are expected to have an inverse relationship with resource collection participation and intensity but a direct relationship with the likelihood of schooling relative to the fostered children in the household. Furthermore, that a male headed household does not relatively face a labor constraint, their children are expected to have a lower level of resource participation but a better likelihood of schooling.

Previous literatures (Nielsen and Dubey, 2002; Assefa, 2002; Gage, 2005 and others) have accredited the positive impact that educated household heads would have on children's schooling. The argument, on the contrary, is that such rural literate people (with at least the ability to read and write) may be busily engaged in social and public administrative issues in their localities , thus, constrained to relieve their children through participation in natural resources collection. Therefore, the potential impact of parental education on the probability of resource collection and intensity by a child is ambiguous.

The effect of poverty on child labor is well documented. Empirical analysis have shown that poverty influences the likelihood of working positively (Assefa, 2002 and Edmonds, 2005) and schooling negatively (Okpukpara and Odurukwe, 2006 and Sacky, 2007). It is

hypothesized that poverty - proxied by monthly income - tends to increase collection and decreases school enrolment. To take care of the simultaneity bias, the income from selling environmental resources like selling of firewood, charcoal and fodder was excluded from the empirical analysis.

The number of cattle in the household was also incorporated in the analysis. Large sizes of cattle prevent children from attending school due to high demand for herding animals. They can, however, provide dung that can be used in substitution (complementation) with firewood in the rural areas reducing the firewood collection time. But large number of cattle may also imply increasing demand for fodder and water resources, hence, high involvement in collecting environmental resources. Therefore, the impact of the number of cattle on resource collection and intensity is ambiguous.

The size of cultivated land is expected to bear a negative impact on the likelihood of collection and schooling participation by a child. While larger farm size can secure children from intensively working on resources through the provision of straws, stalks and crop residues; it can keep them out of school through the need for more labor inputs on the farm.

The number of dependents in a given household also plays a crucial role in explaining the schooling and resource collection interaction. Large number of dependents may be associated with greater likelihood of children's engagement in caring siblings, the sick and the elderly leaving no time to collect environmental resources and attend school. On the contrary, the probability of involvement in collection for those in the 7-18 age group can be increased if their siblings and the old aged members of the household cannot fetch resources from distant sources due to lack of strength or maturity.

By sharing the resource work burden, father's involvement in resource collection is, in turn, supposed to reduce the collection intensity by children and promote schooling attendance considerably. Finally, yet importantly, the woreda specific dummy variable is included in each model to see if the degree of resource intensity and schooling really varies across woredas (locations). A brief description of the variables used in the econometric investigation is summarized in the following table.

Table-1: Definition and Observation levels of Variables used in the Econometric Analysis

Variables:	Definition of the Variables	Obs. level
Dependent Variables		
Model-1. Collection	Child collected at least one environmental resource over the reference period: 1 if yes, 0 otherwise	Child
Model-2. ln(collection time)	Weekly hours of resource collection by a child in natural logarithm	Child
Model-3. Schooling	Child currently attends school: 1 if yes, 0 otherwise	Child
Independent Variables		
Child Attributes		
Child sex	Sex of the child: 1 if female, 0 otherwise	Child
Child age	Age of the child in years	Child
Age squared	Square of the child's age in years	Child
No. children	Number of children per household in the 7-18 years	Child
Own child	Child is own child of the household head: 1 if yes, 0 otherwise	Child
Parental Characteristics		
Male headship	Household is headed by male: 1 if yes, 0 otherwise	Household

Literate head	Household head can at least read and write: 1 if yes, 0 otherwise	Household
Household Characteristics		
ln(Income)	Exogenous monthly income of the household in natural logarithm	Household
No. cattle	Number of cattle owned by the household	Household
Farm size	Total area of land cultivated by the household in 'tsmdi' ¹⁹	Household
Dependents	Number of persons less than 7 years and above 60 years in the household	Household
Father hours	Weekly hours of resource collection by a father	Household
Woreda (Child Location) Dummy		
Hintalo dummy	Child lives in Hintalo Wajerat woreda: 1 if yes, 0 otherwise	Child

¹⁹ It is a local word indicating about one-fourth of a hectare.

CHAPTER FOUR

DATA ANALYSIS

This chapter basically provides the data analysis part of the study. The descriptive and econometric analyses are provided in section 4.1 and 4.2, respectively.

4.1. Descriptive Analysis

This section presents the descriptive analyses of children's involvement on environmental resources collection and issues related to schooling. It consists of two sub-sections. The first part describes the time spent on the collection of firewood, water and fodder resources, while the second part is geared to the analysis of school related phenomena.

4.1.1. Collection of Environmental Resources

As portrayed in Table-2, a descriptive analysis of the survey data confirmed that about 79% of the households are headed by males. In 75% of the households, the father and mother live together. But for the rest of the families, they are either divorced or widowed. On average, the age of household heads is found to be 48 years and only about 33% of them are literate - at least they attained an informal²⁰ education. The mean household size per each household is 7. Their composition depicts that 1 and 3 individual(s) fall on average, within the 1 to 6 and 7 to 18 years age range, while 1 and 2 are average number of individual(s) between 19 to 24 years and 25-60 years respectively. The average number of elderly (above 60 years) is 1. Households have an average monthly per capita income of about ETB 84.7 from various sources of income. The minimum and maximum monthly per capita income is reported to be ETB 33 and 333 respectively.

²⁰ It includes religious education and basic education.

Table-2: Summary Statistics of Households' Socio-economic Characteristics

Household Characteristics	Mean	Standard Deviation	Minimum	Maximum
Male headed households	0.792	0.408	0	1
Parents living together	0.750	0.435	0	1
Household head's Age	48.017	9.706	28	68
Literate household heads	0.325	0.470	0	1
Household Size	6.458	1.748	3	11
Household Composition				
1- 6 years	1.050	0.897	0	4
7-18 years	2.633	1.053	1	6
19-24 years	0.658	0.783	0	3
25-60 years	1.733	0.590	0	4
Above 60 years	0.383	0.638	0	2
Dependents (<7 and >60)	1.475	0.970	0	4
Monthly per capita income	84.684	42.781	33	333

Source: Computations from the Survey Data, 2011

To better recognize the relationship between resource scarcity and schooling on the later parts of this chapter, the study looks into the extent to which rural households spend their time on environmental resources collection. Children from the sample households on average make a one trip per week in each resource collection. While parents collected firewood and water for about 2 and 3 times per week respectively, they collected fodder once during the reference period. As far as the average time spent is considered, children spent about 7 hours per week on firewood, 1 hour on water and 3 hours on fodder collection (see Table-3).

Table-3: Mean time (minutes) Spent on firewood, water and fodder collection

Group	Mean firewood ²¹				Mean water				Mean fodder				AMP W
	Trip	Coll	Freq	MPW	Trip	Coll	Freq	MPW	Trip	Coll.	Freq	MPW	
Children	152.6	78.4	1.2	401.9	11.1	17.5	1.2	86.2	35.3	55.5	0.7	152.5	641
Boys	199.6	77.9	1.2	503.4	12.5	19.8	1.0	96.2	56.09	85.0	1.1	240.7	840
Girls	94.4	79.1	1.1	276.0	9.3	14.7	1.3	73.8	9.59	18.9	0.2	43.1	393
Parents	343.8	107	1.6	768.7	42.6	74.5	3.2	430.8	70.21	107.1	1.3	312.4	1512
Father	326.5	94.5	1.2	721	4.2	8.8	0.3	28.3	68.8	103.3	1.3	307.1	1056
Mother	17.3	12.5	0.4	47.7	38.4	65.8	2.9	402.5	1.4	3.8	0.02	5.25	455

Source: Computations from the Survey Data, 2011

However, their parents spent about 13 hours on firewood, 7 hours on water and 5 hours on fodder collection. To sum up, children spent about 11 hours per week while parents did actually spend about 25 hours on the collection of the three environmental resources. The fact that children spent less than one-half of the time their parents have spent on resource collection is not startling because parents, particularly of fathers, collect firewood from the forest areas travelling for a longer time.

When the issue is examined from gender perspective, one can see that boys and fathers spent about double time in search of all resources as compared to their girls and mothers counterparts respectively. Given the firewood source for majority of the respondents is from the lowland areas adjacent to Afar regional state, it is not astonishing for boys and fathers to spend higher proportion of time in this resource. On water, boys and girls have spent an almost equivalent time. But the amount that mothers spent on this resource is about fourteen times higher than the one spent by fathers, showing that collecting water is mainly the task of women.

In gathering fodder, it was reported that a father spent more than a double time relative to the time spent by all school-going children. In this case, girls and mothers are almost freed with

²¹ For each resource, Trip refers the double trip travel time, Coll refers time spent on collection, Freq refers the resource collection frequency per week and MPW shows the average time in minutes per week spent on the resource . AMPW is used to represent the total mean time in minutes spent on the three resources per week.

insignificant contributions. This is by and large probable because even in the other parts of Tigray, collecting fodder is either the task of fathers or boys. Here, the importance of pack animals, particularly of donkeys, is highly accredited in transporting these resources. On average, the respondents have about two donkeys with the minimum and maximum being 0 and 4, respectively.

A focus group discussion is also made with students in selected schools regarding children's participation on resource collection. They revealed that fathers make their children wake up at the middle of night for the firewood collection. This is common since they usually fulfill their schooling equipments by selling firewood resources. This was confirmed by a group of firewood distributors in Mekelle and Quiha that they receive firewood from farmers in Enderta woreda where the usual suppliers are children. The marketing channel of firewood passes through many hands where the lowlanders supply to the highlanders who in turn, deliver it to the main firewood distributors in Quiha and Mekelle.

About 89% of the households have identified forests as an important source of firewood followed by valleys and hills (not reported). Households spent more than 9 hours on forest firewood, of which the largest proportion (about 7 hours) is allotted to travelling. This is followed by valleys and hills with total time spent of about 4 hours and 23 minutes per a single journey. About 91% of the households have regarded village taps as a dominant source of water where queuing takes about 1 hour and 7 minutes. A useful observation is that almost all of the households fetch water from village taps except in village Hilishe, 'tabia' Derge-Ajen in Enderta woreda. Households fetch water almost entirely from a river in this village. The most common source (for 95% of the sample households) of fodder is an own-farmland which demands a total time of 4.3 hours. All results are summarized below.

Table-4: Basic Sources of Environmental Resources and Mean time spent (Minutes)

Indicators	Firewood	Water	Fodder
	Forest	Village taps	Farmland
Travel time	390.3	37.0	97.2
Collection time	180.3	67.0	159.1
Total time	565.3	104	256.3
% of households	89.2	90.8	95

Source: Computations from the Survey Data, 2011

Generally speaking, the regional government has made an utmost effort to foster the expansion of various water sources since 2002/03. As a result, during the last eight years; 152 deep well, 2563 shallow well, 3664 hand dug well and 862 spring development are constructed throughout the region (Look at Table-5).

Table-5: Water Facilities Constructed in Tigray: 2002/03-2009/10

Year	Deep Well	Shallow well	Hand Dug well	Spring Development	Total
2002/03	12	134	29	30	205
2003/04	17	345	333	87	782
2004/05	27	329	304	94	754
2005/06	19	207	414	92	732
2006/07	24	311	473	99	907
2007/08	18	282	801	137	1238
2008/09	12	433	790	187	1422
2009/10	23	522	520	136	1201
Total	152	2563	3664	862	7241

Source: Compiled from TRBoWR reports, 2010/11

However, considerable numbers of the constructed sources of water are not functioning properly. This can be visualized from Table-6 for the region as a whole.

Table-6: Status of Water Source Facilities by Urban and Rural Areas as of 2009/10

Water Sources	Urban Areas			Rural Areas		
	Functional	Non-functional	Easy to repair	Functional	Non-functional	Easy to repair
Spring Development	10	0	0	843	227	227
Hand Pump	3	1	1	3813	385	385
Shallow Well	53	12	2	2641	356	356
Deep Well	101	18	12	94	10	10
Grand total	167	31	15	7391	978	978

Source: Compiled from TRBoWR reports, 2010/11

A close look at the current status of various water sources signify that about 50% and 100% of the non-operating water sources were those that would have been easily repaired both in the urban and rural areas respectively. Therefore, one possible explanation for the longer time spent on queuing water (1 hour and 7 minutes) might be due to the non-proper functioning of the different constructed water sources. Households are rarely observed fetching water in a 3 days round basis and compete for water lining as of 9 o'clock at night, particularly during social occasions (wedding and holidays). In the sample respondents, households contribute on average ETB 1 to 3 per month for guards and simple maintenances. The problem is when actual repairing costs are beyond their capacity.

In the study areas, parents reported that there is no enough grazing lands available, hence, irregularly keeping their cattle at home. Since cattle demand fodder and water, one can argue that this will exacerbate the possibility of involvement on resource collection. Sample respondents have an average of 5 cattle and the amount of fodder (straws, stalks, etc) they collect from the cultivated farm this year was about 17 donkey-load with the minimum and maximum values of 5 and 70 respectively. Households are asked if they bought (will buy)

fodder in cases of shortage. The results indicated that they spent (will spend) about ETB 401 this year with ETB 0 and 4,000 be the minimum and maximum actual (expected) expenditures made on fodder respectively. Last year, households cultivated an average farm size of about 6 'tsimdi' with a minimum of 2 and maximum of 10.

4.1.2 Children's Schooling

Another interesting point that can be acknowledged in the economics of child labor is whether children are specializing in schooling, resource collection and joint combination of the two tasks or being left idle from all activities. Henceforth, a close look at Table-7 dictates us that majority of the children (about 69%) are simultaneously undertaking both tasks, followed by involvement on collection only (about 22%), schooling only (about 7%) and neither of the tasks (about 2%) . This may be the manifestation of natural resources scarcity - a situation that induce children to be involved in gathering firewood, drinking water and fodder resources for home consumption and for market purpose, too.

Compared to their respective sub-samples, about 9% of the male children participated only in schooling while 18% are solely involved on resource collection tasks. While 70% of the males combine both activities, the remaining balance represents the idle children - neither attending school nor collecting resources at that time. On the other hand, while 5% of the female children involved on schooling only, 26% of them were collecting resources as their sole task. 68% of them were combining school and collection while 1% was left idle. This clearly indicates that high proportion of girls was observed on resource collection though their proportion at school was lower. However, almost equal proportions are noticed on the joint activities among both sexes.

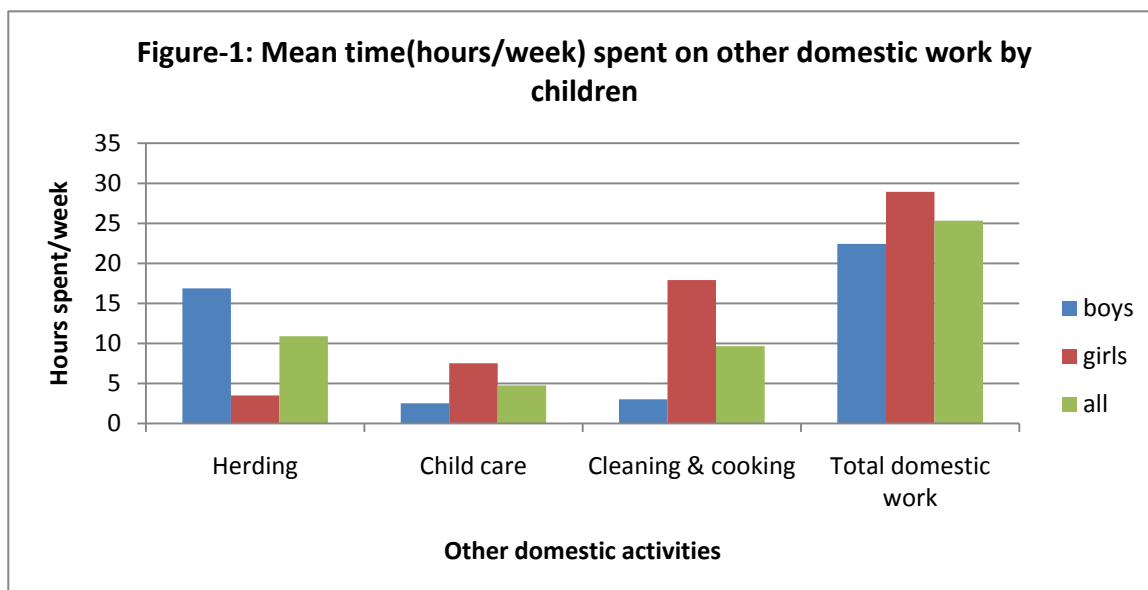
Table-7: Summary of Children's involvement on Schooling and Collection

Age	Schooling only			Collection only			Both tasks			Neither Collection nor Schooling			Total
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	
7	2	3	5	0	1	1	3	4	7	1	0	1	14
8	2	1	3	2	1	3	4	4	8	1	0	1	15
9	5	0	5	1	0	1	10	5	15	0	0	0	21
10	1	0	1	1	1	2	15	6	21	0	1	1	25
11	2	1	3	1	0	1	9	7	16	0	0	0	20
12	2	1	3	1	2	3	16	9	25	0	0	0	31
13	1	0	1	1	0	1	11	6	17	0	0	0	19
14	0	0	0	1	2	3	15	14	29	0	0	0	32
15	1	0	1	4	5	9	14	18	32	0	0	0	42
16	0	0	0	2	5	7	6	6	12	1	0	1	20
17	0	0	0	3	9	12	6	7	13	0	0	0	25
18	0	1	1	15	11	26	13	10	23	2	0	2	52
Total	16	7	23	32	37	69	122	96	218	5	1	6	316
% share	7.28			21.84			68.99			1.89			100

Source: Computations from the Survey Data, 2011

Of the total households interviewed, we found 316 children who are in the 7 to 18 age range. The distribution is 175 boys and 141 girls. 75 and 29 children are respectively reported being out of school and environmental resources collection participation. We find a total of 35 fostered children - children living with other relatives, of which 19 are out of school. About 91% of such children are involved on resource collection. While 37 boys and 38 girls are out of school, 21 boys and 8 girls did not participate on resource gathering tasks. However, a total of 241 and 287 children are actively involved on school and resource work participation activities respectively. The gender disaggregation was 138 males and 103 females for schooling and 154 males and 133 females for collection. As might be expected, rural children are also involved on other²² domestic chores (See Figure-1).

²² It includes animal herding, caring children and the elderly, cleaning and food preparing tasks.

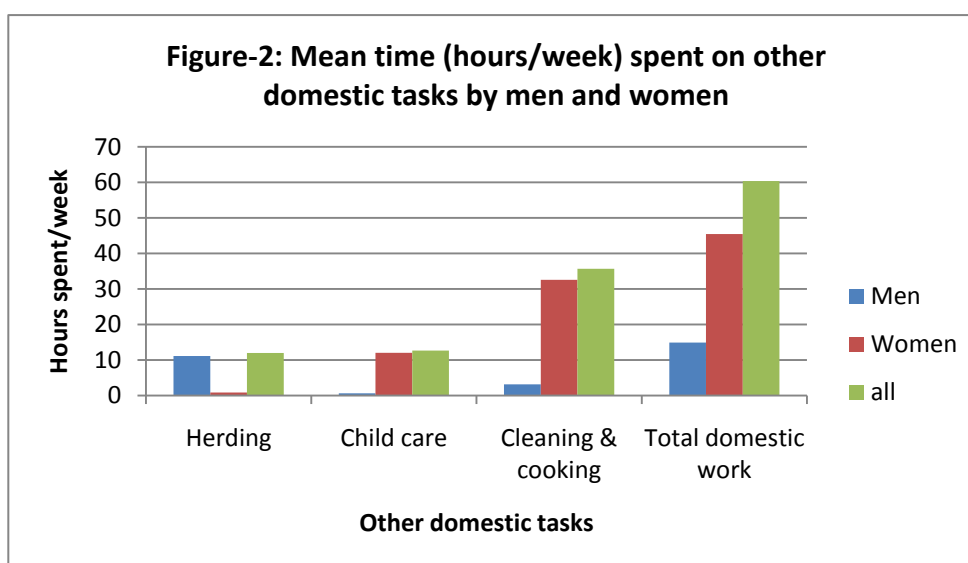


Source: Computations from the Survey Data, 2011

On average, children spent about 25 hours per week on all other domestic activities with the highest portion of time (about 11 hours/week) recorded on herding animals followed by cleaning and cooking (about 10 hours). Looking at their gender, female children spent about 29 hours per week on all tasks where cleaning & cooking accounts for a lion’s share of 18 hours per week. Boys spent about 22 hours on all other domestic activities²³ where herding takes the largest share - about 17 hours per week. Therefore, we can conclude that girls and boys are overloaded with cleaning & cooking and herding involvements respectively at least during the study period.

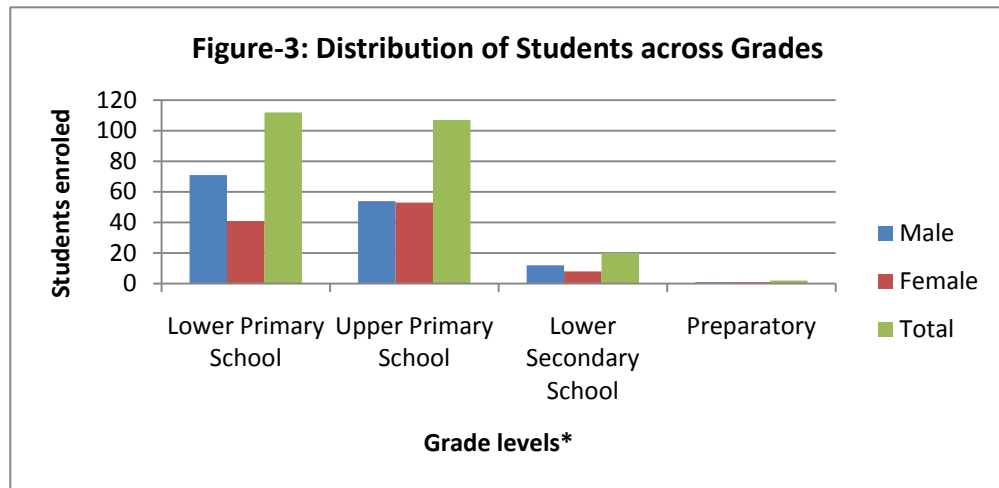
Another interesting issue is that men and women are also involved on herding, child caring and cleaning and cooking responsibilities in rural Ethiopia. The issue is, however, on the degree of involvement towards such other domestic endeavors. It is clearly revealed that men and women jointly incurred about 60 hours per week on such activities where the highest (38 hours) and the lowest (12 hours) are reported on cleaning and animals’ herding respectively.

We see that the time spent by women on all domestic works outweighs that of their men counterparts by more than three times. While women are highly involved on cleaning & cooking and child caring issues, majority of men’s time is spent on herding (about 11 hours). The following figure shows the relative contribution of men and women towards such domestic activities.



Source: Computations from the Survey Data, 2011

If children not enrolled at school are excluded from the analysis, mean grade attained will be grade 5 for the whole sample and same across genders. As shown in the figure, 47% of the students are enrolled at lower primary school, 44% at upper primary school, 8% at lower secondary school and the remaining balance are enrolled at preparatory school level. School enrolment declines rapidly in both sexes as one goes to the highest grade levels. A relatively fast decline is noticed among female children. One possible explanation on this for girls is the customary traditional practices (CTPs) associated with early marriage and high burden of domestic work. The mean study time per day is about 3 hours which is also equal for both boys and girls.



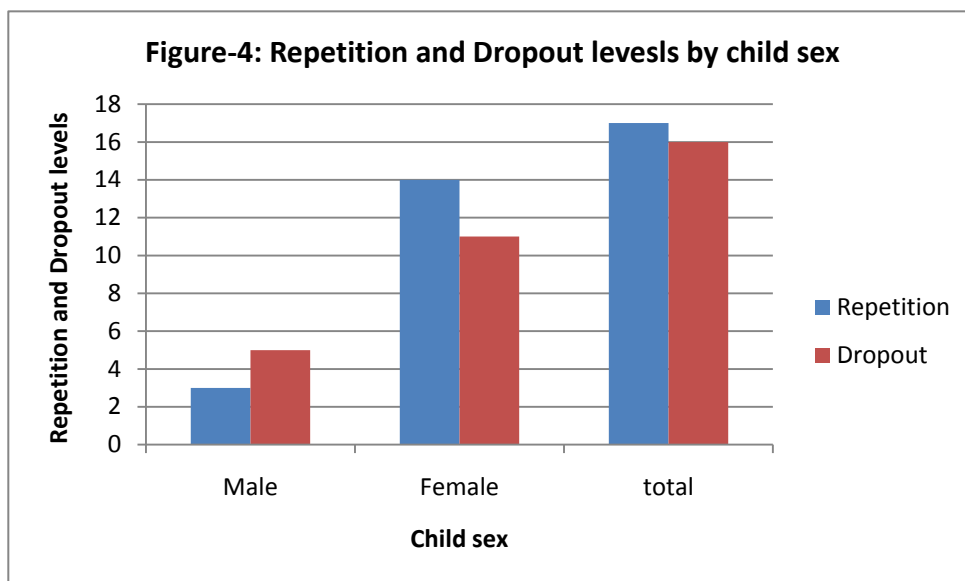
Source: Computations from the Survey Data, 2011

*Note: *Grade levels are defined in the following way: Lower primary runs from grades 1-4, Upper primary from grades 5-8, Lower secondary from grades 9-10. Finally, the preparatory school includes grades 11-12 (TRBoE, 2009/10)*

Parents are asked as to why their children are kept out of school, if any. Among others, while 16% of them did not send their children to school due to huge domestic work burden, 13% and 9% of the households revealed that their children are not enrolled at school because of resource collection burden and their interest in informal education respectively. Looking at children's academic repetition²⁴ and dropout²⁵ record, 17 and 16 students are reported to have a repetition and dropout experience for at least a time respectively. Female repetitions and dropouts are more than their male counter parts - 14 versus 3 for repetition and 11 versus 5 for dropout cases respectively. Burden on other domestic work is reported as a major reason behind. This might have in turn worsened the failure to pass the national primary school leaving certificate examination (MoE, 2009/10) through tight study times. A high repetition rate is observed among girls of grades 4-8 and high dropout experience is perceived for girls enrolled at grades 5-8 in Tigray during the 2005/06 academic year (TRBoE, 2009/10).

²⁴ Repeteators are students who are enrolled at least twice in the same grade (TRBoE, 2009/10)

²⁵ Dropout students are defined as students who never appear in the education system for at least a semester.



Source: Computations from the Survey Data, 2011

As outlined in section 4.1.1, the focus group discussion is carried out with selected teachers and students in two schools. The findings show that resource scarcity has an adverse effect on school enrolment. Even for those who are already involved in school, many students are not doing their home work on time - a reflection of long hours of work on domestic activities including environmental resources collection. This is further complicated when parents discourage their children from doing their academic assignments - “home work is not an academic but domestic work”. The availability of large farm size is also reported putting pressure on children’s schooling through the demand for farm work.

4.2. Econometric Analysis

An initial analysis of the data has been made ahead of any usual regressions to take care of transformation of variable(s) for normality. A symmetric distribution is observed for the other count variables in their level forms while the variables ‘Collection time’ and ‘Income’ attained their normal distribution after transformation into their respective natural logarithms.

Not to have missing values in transforming the child resource work hours, a one minute collection time per week is given for each child reported not collecting resources at all.

The degree of correlation is also investigated between the regressors. The results assure that there exists no serious multicollinearity problem since the correlation coefficient in almost all of the variables is less than 80% (Gujarati, 2004) in all the three estimated models (Annexes-1 to 3). The problem of heteroscedasticity is also checked in the resource work hours equation using the Breusch-Pagan /Cook-Weisberg test. The results reveal that there exists evidence for heteroskedastic model errors (See Annex-4). This, therefore, necessitates the use of Huber-White sandwich technique for estimating the standard errors to deal with minor problems of normality and Heteroskedasticity issues. Specification test is also conducted by employing the Ramsey RESET test using powers of the fitted values of 'Ln (collection time).' The test indicates no presence of omitted variables' bias in the model (See Annex-5).

Following the Hendry approach of model building – a general-to-specific, downward reduction to the final specification (Greene, 2003 and Verbeek, 2004), many variables that are assumed to affect children's schooling and resource collection activities are initially incorporated in the preliminary estimation. Based on their coefficients, insignificant variables are consequently dropped from the bivariate probit model. This is carried out using the Wald and Likelihood-Ratio tests.

4.2.1. Children's Resource Work Participation and Intensity

In the descriptive analysis section of this thesis, we showed that a very significant proportion of children's time (amounting to 25 hours/week) is spent on other domestic activities including herding, cleaning & cooking and caring of young siblings & the elderly. In a similar

fashion, it is also realized that, on average, children aged 7-18 years have allocated 11 hours/week on gathering environmental resources from various sources.

This sub-section of the empirical analysis part examines what causes children to participate on the collection of at least one environmental resource. Of course, since it is not only the likelihood of involvement on resource collection but also the resource work hours that matters more for policy purpose, the determinants of collection intensity are investigated accordingly.

In the bivariate probit model for schooling and resource collection participation equations, the rho coefficient between the equations' disturbance terms is found to be -0.12. Following this, we performed the likelihood ratio test on the null hypothesis that the correlation coefficient (rho) is zero against the alternative that rho is statistically different from zero. The results show a chi-squared statistics with one degree of freedom of 0.42 and a P-value of 52%. Therefore, the null hypothesis cannot be rejected at any conventional level of significance (See Annex- 6 for details).

As a result, univariate probit models are preferred to bivariate probit model. Subsequently, this section provides an estimated univariate probit model for participation on environmental resources collection and an Ordinary Least Square model for collection intensity. The final model, the 2SCML school enrolment probit model is estimated and portrayed under the resource collection work and school enrolment sub-section in 4.2.2.

Table-8: Estimated Results of Resources Collection participation and Collection Intensity: Models 1 and 2

	Model-1:Collection Participation		Model-2:Collection Intensity	
<i>Variables</i>	<i>Marginal Effects</i>	<i>P> Z </i>	<i>Coefficients</i>	<i>P> t </i>

Constant			-4.273(2.941)	0.15
Male headship	-0.022 (0.017)	0.19	-0.464(0.291)	0.11
Literate head	0.071***(0.024)	0.00	0.508**(0.219)	0.02
No. children	-0.008(0.009)	0.35	-0.122(0.104)	0.24
Ln (Income)	-0.039(0.025)	0.12	-0.285 (0.319)	0.37
No. cattle	0.013**(0.005)	0.02	0.096*(0.057)	0.09
Farm size	-0.017***(0.005)	0.00	-0.183***(0.067)	0.01
Dependents	0.001(0.010)	0.92	0.072 (0.129)	0.58
Own child	0.038(0.043)	0.37	0.315(0.349)	0.37
Hintalo dummy	0.006 (0.018)	0.75	-0.120 (0.259)	0.64
Child sex	0.035**(0.015)	0.02	-0.528***(0.20)	0.01
Child age	0.068**(0.034)	0.05	0.974***(0.317)	0.00
Age squared	-0.002*(0.001)	0.08	-0.027**(0.011)	0.02
Father hours	0.001 (0.001)	0.17	0.017*(0.009)	0.06
No. donkeys			0.308***(0.11)	0.01
Summary Statistics of the Models				
No of observations	316		316	
Significance level	0.00		0.00	
R-Squared			0.279	
Log pseudo likelihood	-67.05			
Wald Chi-Squared	43.61			
Pseudo R ²	0.31			
Iterations Completed	5			
Correct predictions	91.77%			

Note: Numbers in the parenthesis are robust standard errors. * Significant at 10%; ** significant at 5%; *** significant at 1%.

(*) dy/dx is for discrete change of dummy variable from 0 to 1

The goodness-of-fit measures are obtained by using the percentage of correctly classified observations for the univariate probit regressions. Given the explanatory variables, X_i , the predicted probability that $y_i=1$ is calculated for each i . If $G(X_i\beta) > 1/2$ and $G(X_i\beta) \leq 1/2$, y_i is predicted to be one and zero respectively. The percent correctly predicted is the number of times the predicted and actual values of y_i are matched to each other. The overall percent

correctly predicted reflects a weighted average of the two (Wooldridge, 2002; Verbeek, 2004 ; Cameron & Trivedi, 2009).

For the collection participation model (Mode-1), therefore, the ratio $282/287=98.26$, called the sensitivity measure, gives the fraction of observations with $y=1$ that are correctly specified. The ratio $8/29=27.59\%$, called the specificity measure, gives the fraction of observations with $y=0$ that are correctly specified. The probit model of resource collection correctly predicts “the child collects resource” about 98.26 percent of the time and it correctly predicts “he/she will not involve on resources collection” about 27.59 percent of the time. In terms of the overall percent predicted correctly, the model correctly classifies 91.77 percent of the observations and, thus, it is a good model (See Annex-7 for further details).

On the other hand, an Ordinary Least Square regression of the resource intensity model provides an R-square of 0.279. This indicates that about 28% of the variation in resource collection hours is explained by the predictor variables included in the model. Thus, the model fits the data. Furthermore, the 1% statistical significance of the F-test rejects the null hypothesis that the numbers of donkeys (the IV-instrument) and the other variables have no effect in explaining collection intensity by children.

The interest in binary models is to calculate the marginal effect (ME) - derivative of the probability that the dependent variable equals one with respect to the change in a particular covariate (Wooldridge, 2002), after estimating the parameters. According to Cameron and Trivedi (2009), the calculations of marginal effects vary noticeably with regard to the evaluation point taken in to account in non-linear models like ours. The three common evaluation choices are the Marginal effect at mean - defined as ME at $X = \bar{X}$, Average

marginal effect - defined as the average of ME at each $X = X_i$ and Marginal effect at a representative value - defined by ME at $X = X^*$, where X_i stands for the i^{th} regressor variable in the model. Therefore, which marginal effect is appropriate to use is subject to argument. However, the authors suggested ME at the mean as a frequently used choice since “it gives the rough gauge of the magnitude of the ME”. The interpretations of the results from Model-1 are, thus, made using the marginal effect at the mean concept.

The 1% statistical significance of the “literate head” variable in the resource collection participation model conveys that children living in literate household heads are more likely to involve in the collection of environmental resources by 7 percentage points on average, compared to those whose household heads are illiterate. Such children are expected to increase collection intensity by about 51% per week relative to children from the illiterate household heads, holding others constant. A possible reason advanced to explain this result is that literate household heads might be occupied by ‘tabia’-based government administrative issues in the rural areas, thus, lacking time to collect resources by themselves and being poor to hire daily laborers on their behalf. The same holds correct for the religious (spiritual leaders) who are always busy with social issues.

An increase in the number of cattle owned by the household is more likely to increase the probability that a child in the 7-18 years will participate in natural resources collection on average, by 1.3 percentage points. Though weak, increasing the number of cattle, *ceteris paribus*, will also force them to spend additional weekly hours on gathering resources by 9.6%. This is reflected by the 10% statistical significance level of the ‘No. cattle’ variable. In this regard, the results are inconsistent with Heltberg et al.’s (2000) report that livestock ownership had a positive significant effect on alternative private energy consumption like

animal dung but an insignificant effect on collection time. This is not surprising because though large livestock size can protect children from frequently collecting firewood through animal dung, it can result in higher demand for fodder and water resources. With the prevailing feed resource scarcity (Berhanu et al., 2002), this finding seems valid particularly in Tigray where farmers have started to keep their cattle at home with pressurized grazing lands.

Another interesting finding is the possible impact that farm size poses on the likelihood that a child will be involved in collection. The high, statistically significant negative coefficient of the 'Farm size' variable dictates that on average, having larger plots of cultivated land will reduce the likelihood that the school –going children will be involved in collecting natural resources by 1.7 percentage points. In a similar argument, the 1% significance level of this variable in the collection intensity model reveals that a unit increase in farm size operated by the household reduces children's expected weekly resource hours' burden by about 18.3%, others held fixed. These findings are in line with the results of Heltberg et al. (2000) where larger land holding reduces resource collection labor time and increases consumption of private fuels generated from own farmland in rural India. One possible explanation for this is that with larger farm sizes, greater amounts of fodder and crop-residues can be obtained, thus, narrowing the likelihood of resource collection and intensity among rural children.

The child labor literature gives a considerable attention for the potential gender-based work participation differentials and its consequent implication on work hours. From the literature, a 'Child sex' dummy variable was included in both the resource collection participation and collection intensity models. The results reveal that relative to boys, a female child is about 3.5 percentage points more likely to involve in resource collection. This might be resulted from

the periodic engagement of women and girls particularly on water and firewood resources around their residences. Other things held fixed, being a female child, however, is expected to reduce collection intensity by about 53% per week. This suggests that while male children are benefited from less resource collection frequency, their female counter parts were found to be advantageous in terms of the less actual time (hours per week) spent on resource collection.

As children get older, *ceteris paribus*, they are on average, more likely to gather firewood, water and fodder resources by 7 percentage points. *Ceteris paribus*, older children also spent an extra weekly collection hours by about 97% relative to the younger ones. These results are reflected by the 5% and 1% positive and statistically significant coefficients of the 'Child age' variable in both the collection participation and collection intensity models respectively. Previous literatures (Psacharopoulos, 1997; Okpukpara and Odurukwe, 2006; Nkamleu, 2009) also acknowledged that older children did significantly contribute to work.

Nevertheless, the statistically significant but negative coefficient estimate of the 'Age squared' variable in both models refers that that the probability of collecting resources and spending longer time falls over time suggesting a non-linear relationship - consistent with the findings by Nankhuni and Findeis (2004), Okpukpara and Odurukwe (2006) and Nkamleu (2009).

Though weak, an increase in father resource hours is expected to increase the weekly collection burden by an approximated 1.7%, *ceteris paribus*. While this result contradicts with the findings in Malawi (Nankhuni and Findeis, 2004), it resonates with the results from Kenya (Ndiritu and Nyangena, 2010). This is likely to happen in the sense that a child might go together if collecting that resource takes a longer time to accomplish by the father alone. when

their fathers collect high quality firewood, children may collect the “thick firewood” while keeping the donkeys for transporting the resources side by side. Fodder resources are also commonly transported by donkeys and, thus, children actively participate in such tasks helping their fathers.

Although they bear their expected sign, we find no evidence concerning the impact of being headed by male, income and the number of children in the 7-18 age group on resources collection and intensity by children. Moreover, the number of dependents, being own offspring of the household head and residence (location dummy) are not statistically significant in explaining both the collection participation and hours of intensity models.

4.2.2. Children’s Resource Collection Work and School Enrolment

The first part of sub-section 4.2.1 has provided an explanation for why children are likely to engage in the collection of some important environmental goods. This was followed by the determinants of the intensity of environmental goods collection. This sub-section particularly looks at if the time spent on resources collection does really matter for children’s enrolment at school. The econometric results of the 2SCML probit model concerning the likelihood of enrollment at school are shown in Table-9.

Table-9: Estimated Results of the Probit Model for Schooling: Model-3

2SCML Probit Model for Schooling		
Variable	Marginal Effects	P> Z
Ln (collection time)	-0.246***(0.091)	0.01
Male headship	-0.027 (0.076)	0.72
Literate head	0.252***(0.059)	0.00
No. children	-0.064***(0.028)	0.02

Ln (Income)	0.006 (0.071)	0.93
No. cattle	0.034**(0.016)	0.03
Farm size	-0.059*** (0.019)	0.00
Dependents	-0.035 (0.025)	0.16
Own child	0.356*** (0.113)	0.00
Hintalo dummy	-0.002 (0.055)	0.97
Child sex	-0.163**(0.070)	0.02
Child age	0.450*** (0.10)	0.00
Age squared	-0.016*** (0.003)	0.00
Father hours	0.004 (0.003)	0.15
Residuals	0.229*** (0.092)	0.01
Summary Statistics of the Model		
No. of observations	316	
Level of Significance	0.00	
Log pseudo likelihood	-128.69	
Wald Chi-Squared	92.40	
Iterations Completed	4	
Correct predictions	80.38%	

Note: Numbers in the parenthesis are robust standard errors. * Significant at 10%; ** Significant at 5%; *** significant at 1%.

(*) dy/dx is for discrete change of dummy variable from 0 to 1.

The sensitivity and specificity measures of the probit model for schooling are found to be 92.12% and 42.67% respectively. That is the schooling model correctly predicts “the child attends school” about 91.12 percent of the time and it correctly predicts “the child will not involve in school” about 42.67 percent of the time. With a correctly classified observation of about 80.38 percent, the schooling model also does well (Details are attached in Annex-8).

As shown in Table-8, the first stage estimation (the collection intensity model) in the 2SCML procedure shows that the number of donkeys used as an instrument for the endogenous ‘Ln (collection time)’ variable is statistically significant at the 1% level. The explanation is that

about 31% increase in collection intensity per week is expected by a child when his (her) household owns an extra donkey, other things being constant. This is not unusual especially in Enderta woreda that supply 450 donkey loads of firewood to Mekelle on a daily basis (TRBoARD, 2010/11) through Endayesus²⁶. It may be such importance of donkeys that makes Tigray to have a large number of donkey stock in the nation (TLDAP, 1998).

According to the second step in the 2SCML procedure, whether the child is enrolled in school or not was regressed as a function of all exogenous predictors, the endogenous regressor and the predicted residuals from the first step estimation. The marginal effect of such saved residuals in the school probit model shows that the residuals have a positive statistical significance at 1% level. Hence, there is a substantiation to treat resource collection intensity as an endogenous explanatory variable in the schooling model. This supported the use of an instrumental variable in our estimation process.

While Nankhuni and Findeis (2004) used wood and water scarcity variables and own-piped water access dummy as in IV instrument for resource collection intensity, Ndiritu and Nyangenna (2010) employed household energy fuel expenditure and the ratio of children who collect resources in a household to family size as justifiable instruments. Unlike the above authors, the number of pack animals(donkeys) available per household is chosen here as a valid instrument for resource work hours so as to judge the impact of environmental resources collection work on the likelihood that a child will be enrolled at school.

Such an IV is preferred because children living in households where such animals are available are likely to reduce their frequency and intensity of engagement in collection. On

²⁶ It is a name of a place where Mekelle University main campus is situated currently. It is a main gate to Mekelle from Addis Ababa.

the other hand, households having pack animals may seek their children to handle some extra resource related tasks frequently. Even though it is also applicable for fetching water, the instrument particularly seems valid in collecting firewood and fodder resources since most of the sample households have acknowledged the importance of such animals in this regard. This may, therefore, justify the appropriateness of the number of donkeys (No. donkeys) as an instrument for environmental resources collection intensity.

As expected, the weekly time spent on environmental resources collection significantly reduces the school enrolment likelihood. Doubling the resource collection hours reduces the probability of schooling by one-fourth. When environmental resource degradation causes scarcity of natural resources, the likelihood of not attending school will be aggravated through the opportunity cost of time spent in resources collection. The negative effect of collection intensity on a child's probability of schooling was documented from previous research findings (Nankhuni and Findeis, 2004; Ndiritu and Nyangena, 2010).

The impact on school enrolment of household head's education was tested through the 'literate head' dummy variable. As anticipated, at least having the ability to read and write by the household head turns out to have a 1% level of significance. Literate household heads are by 25 percentage points more likely to send their children to school, as compared to their illiterate counter parts. The significant positive effect of the parental education hypothesis on fostering human capital formation has been widely acknowledged in the literature by previous research works (Nielsen and Dubey, 2002; Assefa, 2002; Gage, 2005; Sackey, 2007).

Important is the finding that the probability of attending school by a child falls when the number of school-range children increases in that household, as reflected by the negative and statistically significant coefficient of the 'No. children' variable. An increase in the number of

7-18 years children per family is likely to adversely affect the household's probability of sending that child to school by about 6 percentage points. This gives a signal for the quantity-quality trade-off as poor households may be constrained to cover the school expenses of their children appropriately.

Striking is the positive and significant coefficient of the 'No. cattle' variable. An increase in the number of cattle by one unit improves the probability of attending school for a child by 3 percentage points. This is against the finding by Assefa (2000) and Tassew et al. (2008) in Ethiopia who established a negative relationship between ownership of livestock and child schooling. In the first glance, this seemed surprising. However, rural parents with greater sizes of livestock may still prefer to currently invest their assets on human than physical capital, given an informal contract (Nielsen and Dubey, 2002) between the children's income and the head of the household at large. With strong social interactions, parents may think that educated children will subsidize them during old age, hence, committed for their enrolment currently. It is convincing to educate a child in such context to be the later bread winner where, according to Nielsen and Dubey (2002) credit rationing and high interest rate make inter-generation borrowing simpler than borrowing from the capital market. On the other hand, an increment in the size of cultivated land reduces the child's likelihood of attending school by about 6 percentage points. Similar evidence is reported from India (Nielsen and Dubey, 2002) that large farm size reduces the likelihood of school enrolment by increasing the work demand on the farm.

It is acknowledged in the literature that being an own child to the head of the household has also an important implication for schooling. In our case, it was found that relative to the non-own ones, an own child of the household head is about 36 percentage points more likely to

attend school. This reflects that household heads favour for their own children in deciding who should attend school and who should carry out other household tasks. These results resonate with the previous findings by Jensen and Nielsen (1997) and Assefa (2002).

The likelihood of enrolment at school is also investigated from the gender perspective. The result shows that being a female is more likely to reduce schooling on average, by 16 percentage points relative to their male counter parts. This shows that there is gender bias in favour of boys in schooling. Jensen and Nielsen (1997) and Assefa (2002) have reported similar findings where being a female child narrows the probability of enrolment significantly. Even though we find evidence that girls are frequently involved in resource collection, the average weekly resource hour in the sample was lower for girls (7 hours) as compared to boys (14 hours). Therefore, gender discrimination in schooling due to the environmental resources collection intensity is not evidenced in this study.

As explained earlier, the descriptive statistics show that girls spend about 29 hours/week on other domestic endeavors. More than 62% of this time was spent on cleaning clothes, house and cooking food stuffs. Therefore, one can conclude that girls' release from resource collection intensity may in turn increase burden by other domestic activities which reduce their likelihood of attending school drastically.

Another issue is to test if children's likelihood of schooling varies negatively or positively with age. The positive and highly statistically significant coefficient for the 'Child age' variable in the probit model for schooling shows that the probability of school enrolment increases by about 45 percentage points as a child's age increases by one year. This works until the child becomes 14 years old, beyond which the possibility of school attendance is

likely to fall. This relationship was confirmed by other studies in Ethiopia (Assefa, 2002 and Weir, 2010). Consistent with some previous studies (Assefa, 2002; Weir, 2010), the variable 'Age squared' has also a negative and statistically significant effect on the probability of school enrolment depicting a non-linear relationship.

Finally, it is worth noting that the being headed by male, monthly income of households, number of dependents, woreda based dummy and father weekly resource hours did not matter much in explaining the likelihood of attending or not attending school among children as revealed by their respective not statistically significant marginal effects.

CHAPTER FIVE

CONCLUSION AND IMPLICATIONS

5.1. Conclusion

Access to and distribution of environmental resources including firewood, water and fodder have a substantial implication in producing tomorrow's intellectual human resources through the time spent on collection. This study examines the relationship between resource scarcity (measured by the weekly hours spent on collection) and the likelihood of schooling (for children in the age category of 7 to 18 years). It also sees if there is any gender bias in schooling due to the resource work hours. Using a multi-stage random sampling technique; 120 rural households, having a total of 316 children, from Enderta and Hintalo Wajerat woredas of the south eastern part of Tigray are incorporated in the analysis.

The descriptive statistics showed that parents are more frequently involved in the collection of resources as compared to their children during the reference period. While children spent about 11 hours, parents spent 25 hours a week on collecting environmental resources. Female children collected resources for about 7 hours/ week, which is about half of the time spent by their male counterparts. Forests were known as the most important source of firewood for most of the households followed by valleys and hills. While village taps were identified as a fundamental source of water, farmlands are the main source of fodder.

The results show that while 69% of the children combined schooling with resource collection; 22% work only on resource collection; 7% only on school and 1% reported as inactive - free from both tasks. 75 children and 29 children were out of school and collection tasks respectively. Children approximately spent about 25 hours a week on other domestic activities. Of this, 44% of the time was allocated to herding and 40% to cleaning and cooking

tasks. While boys spent about 22 hours per week, girls spent 29 hours on all other domestic work.

Since schooling and resource collection are joint activities, we initially estimated the bivariate probit model. The results show that the error terms in the schooling and collection participation equations are not correlated, thus, univariate probit models are used. The endogeneity problem between schooling and collection intensity is solved through the 2SCML technique.

The econometric findings revealed that household heads' ability to read and write have a positive effect on the probability of involvement in resource collection. Children of such families are more likely to enroll at school while still overburdened by resource work hours. This direct relationship between the parental education and collection intensity might be resulted from the involvement of literate religious leaders (other parents) on spiritual (village based government administrative issues) limiting them from fetching resources on the behalf of their children.

The number of cattle owned by the household increases the likelihood of collection participation significantly. Though weak, it has in turn escalated the resource gathering hours perhaps due to the high demand for fodder resource as cattle size increases. Rural households are likely to send their children to school while their livestock size is kept on increasing, probably due to the anticipation that such educated children will support their family in the future as schooling can bring higher wages. The results revealed that large size of land significantly reduces the resources collection participation and intensity of hours, perhaps through the provision of access to crop-residues that can be used alternative to firewood and

fodder resources. However, large sizes of farm results in lower schooling likelihood through high labor demand for farming, sowing, weeding and harvesting activities.

Girls are more frequently involved on collection. However, they spent shorter resource gathering time as compared to boys. This less time spent on collection can open a room for girls work on other domestic issues. Thus, there is no evidence about the lower probability of girls' schooling due to resource work intensity. Older children are likely to spend longer hours on environmental resources collection.

Father hours of work aggravates the resource work burden probably through more labor demand in collection. While being an own child of the household head has a greater likelihood of attending school, greater number of children in the household reduces investment in child schooling may be due to extra educational costs. The results, however, show no evidence concerning the impact of male headed households, income, the number of dependents and location on the probability of collecting resources, collection intensity and school enrolment. The paper, finally, concludes that resource work intensity adversely affects the process of human capital formation.

5.2. Implications

To enhance the likelihood of schooling and reduce the resource collection intensity among children, we forward the following policy implications based on the findings.

1. The significant positive effect of the literate households on collection and resource intensity conveys the message that though such individuals can be busy with religious and public administrative affairs, they can minimize children's collection intensity by

purchasing resources especially firewood, charcoal and fodder. The fact that educated households promote child schooling calls for the provision of functional adult literacy programs or basic education to develop literacy and numeracy among the rural households.

2. since large sizes of cultivated land significantly reduces the resource collection participation and resource work hours, the proper collection of farm-based fodder resources including the straws and stalks can relieve children from frequent collection of fodder resources and spending longer hours of resource work during the critical feed shortage months. Crop-residues obtained from farm lands can be used as a substitute to firewood. Purposively planting fodder-rich tree species for animal feeding will ease children's resource collection intensity and improve the probability of attending school. The negative impact of large farm sizes on school enrolment can at least be minimized through the moral economy of peasants in which farmers perform their agricultural tasks on a round basis, called "wofera" in the local language.
3. Results show that not being an own offspring of the household head adversely affects schooling relative to own children. One possible policy implication is the need to introduce a flexible academic calendar that matches with the peak seasons in farming if parents deliberately keep them out of schooling for farm work purposes. This would at least enable them to combine schooling and agricultural tasks.
4. The inverse association between intensity of resource collection work and being a girl provides no support for gender bias in education due to resource intensity. The

discrimination, rather, might have resulted from girls' substantial involvement on other domestic tasks including herding of animals, caring of young siblings and the elderly as well as cooking and cleaning. In this regard, creating awareness among the mass to fairly share the routine domestic endeavors might be an important policy option.

5. Above all, that resource work hours have adversely affected the likelihood of enrolment at school indicates the importance of reducing the resource collection intensity by children. In this regard, repairing the already constructed but currently non-functioning water sources is a key policy instrument since it minimizes at least the waiting time at water sources. The annual remuneration free soil and water conservation activity across the region has to be continued in a very organized manner to reduce the degree of resource degradation in the region at large.
6. Due to financial and time constraints, the scope of this study was limited. Therefore, the resource scarcity and schooling interactions can be traced with larger data sets to come up with policy relevant empirical evidence both at the regional and country level. Examination of the link between the intensity of environmental resources work and the extent of class absence and presence among students and their academic achievement for those who are already enrolled at school could also be an important future research agenda.

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Annex-4: Heteroskedasticity test for resource collection intensity

Breusch-Pagan/Cook-Weisberg test for Heteroskedasticity using the fitted values of Ln (collection time)

Ho: Constant variance

$$\text{chi2 (1)} = 19.67$$

$$\text{Prob} > \text{chi2} = 0.0000$$

Decision: The 0.00 P-value suggests that the null hypothesis of constant variance is rejected in all conventional level of significances. Therefore, there exists evidence for heteroskedastic model errors. This problem is addressed through the Huber-white sandwich technique.

Annex-5: Specification test for the resource collection intensity

Ramsey RESET test using powers of the fitted values of Ln (collection time)

Ho: model has no omitted variables

$$F(3, 298) = 1.69$$

$$\text{Prob} > F = 0.1684$$

Decision: The 16.84% P-value suggests that the null hypothesis of “model has no omitted variables” would not be rejected at any conventional level of significances. Hence, there exists no evidence for problems due to the omitted variables.

Annex-6: Bivariate probit model for school enrolment and environmental resources collection participation

(Observations=316)

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
schooling						
maleheadship	.3250455	.2541433	1.28	0.201	-.1730662	.8231572
literatehead	.5680042	.2052064	2.77	0.006	.165807	.9702014
nochildren	-.1677584	.1003422	-1.67	0.095	-.3644255	.0289087
lnincome	.331544	.2667077	1.24	0.214	-.1911935	.8542816
nocattle	.0153842	.0470747	0.33	0.744	-.0768805	.107649
farmsize	-.0927131	.0500226	-1.85	0.064	-.1907557	.0053294
dependents	-.2195514	.0945517	-2.32	0.020	-.4048694	-.0342334
ownchild	.6950614	.2780398	2.50	0.012	.1501135	1.240009
hintalodummy	.1145905	.2226828	0.51	0.607	-.3218596	.5510407
childsex	-.1123292	.1782435	-0.63	0.529	-.4616799	.2370216
childage	.8062288	.2264787	3.56	0.000	.3623387	1.250119
agesquared	-.0357577	.0085445	-4.18	0.000	-.0525046	-.0190108
fatherhours	.0003577	.0093801	0.04	0.970	-.0180269	.0187423
_cons	-4.918914	2.271073	-2.17	0.030	-9.370135	-.4676931
collection						
maleheadship	-.4088487	.3744655	-1.09	0.275	-1.142788	.3250902
literatehead	1.222193	.357671	3.42	0.001	.5211713	1.923216
nochildren	-.127123	.1412616	-0.90	0.368	-.4039907	.1497447
lnincome	-.5756665	.3581534	-1.61	0.108	-1.277634	.1263012
nocattle	.193854	.0704527	2.75	0.006	.0557693	.3319388
farmsize	-.2504383	.0736228	-3.40	0.001	-.3947363	-.1061404
dependents	.0146439	.1288201	0.11	0.909	-.2378388	.2671266
ownchild	.4273003	.426871	1.00	0.317	-.4093515	1.263952
hintalodummy	.0874036	.2927212	0.30	0.765	-.4863194	.6611267
childsex	.5443722	.2657013	2.05	0.040	.0236072	1.065137
childage	.9809746	.2886298	3.40	0.001	.4152705	1.546679
agesquared	-.0314585	.0112035	-2.81	0.005	-.053417	-.0094999
fatherhours	.0168719	.0133655	1.26	0.207	-.0093239	.0430677
_cons	-1.823291	2.890591	-0.63	0.528	-7.488745	3.842163
/athrho	-.1193285	.1852495	-0.64	0.519	-.4824109	.2437539
rho	-.1187653	.1826365			-.4481724	.2390383
Likelihood-ratio test of rho=0: chi2(1) = .419993 Prob > chi2 = 0.5169						

Summary statistics of the Model:

Fitting comparison equation 1: Iterations completed	4
Fitting comparison equation 2: Iterations completed	5
Comparison: log likelihood	-199.97
Fitting full model: Iterations completed	3
Number of observations	316
Wald chi2 (26)	104.55
Prob > chi2	0.00
Log likelihood	-199.76

Decision: The null hypothesis of the correlation coefficient (rho) is zero is tested against the alternative that it is statistically different from zero. The result shows that we fail to reject the null hypothesis, and thus, univariate probit models are relevant.

Annex-7: Goodness of fit measure for the collection participation model

Classified	True		Total
	D	~D	
+	282	21	303
-	5	8	13
Total	287	29	316

Classified + if predicted $\Pr(D) \geq .5$
 True D defined as collection != 0

Sensitivity	$\Pr(+ D)$	98.26%
Specificity	$\Pr(- \sim D)$	27.59%
Positive predictive value	$\Pr(D +)$	93.07%
Negative predictive value	$\Pr(\sim D -)$	61.54%
False + rate for true ~D	$\Pr(+ \sim D)$	72.41%
False - rate for true D	$\Pr(- D)$	1.74%
False + rate for classified +	$\Pr(\sim D +)$	6.93%
False - rate for classified -	$\Pr(D -)$	38.46%
Correctly classified		91.77%

Decision: 21 observations are misclassified as 1 when the correct classification is 0. Similarly, 5 observations are misclassified as 0 while the actual is 1. 282 and 8 observations are correctly classified by the model.

Annex-8: Goodness of fit measure for the school enrolment model

Classified	True		Total
	D	~D	
+	222	43	265
-	19	32	51
Total	241	75	316

Classified + if predicted $\Pr(D) \geq .5$
 True D defined as schooling != 0

Sensitivity	$\Pr(+ D)$	92.12%
Specificity	$\Pr(- \sim D)$	42.67%
Positive predictive value	$\Pr(D +)$	83.77%
Negative predictive value	$\Pr(\sim D -)$	62.75%
False + rate for true ~D	$\Pr(+ \sim D)$	57.33%
False - rate for true D	$\Pr(- D)$	7.88%
False + rate for classified +	$\Pr(\sim D +)$	16.23%
False - rate for classified -	$\Pr(D -)$	37.25%
Correctly classified		80.38%

Decision: 43 observations are misclassified as 1 when the correct classification is 0. Similarly, 19 observations are misclassified as 0 while the actual is 1. The model correctly classifies 222 and 32 observations.

Annex-9: Survey Questionnaire

Environmental Resources Collection Versus Children's Schooling: Evidence from Tigray,
Northern Ethiopia

Enumerator's Name: _____ 'Tabia' Name: _____
Woreda Name: _____ Questionnaire No: _____
Date: _____ Village Name: _____

[Enumerator]: My name is _____, a field worker on a survey about environmental resources collection - child schooling interaction in the South Eastern part of Tigray. The study is to be carried out in partial fulfillment of the requirements for the degree of Master of Science in Economics from Addis Ababa University, School of Economics. The findings of the study will help policy makers in formulating sound educational and resource management policies.

We need to examine how households feel about the impact of environmental resources (firewood, water and fodder) scarcity on children's schooling (aged 7 to 18 years). So, household heads are requested to give information about time allocation patterns on three environmental resources. If you wish to stop the interview at any time or jump a specific question, it is entirely up to you and that your answers will be confidential. I appreciate your collaboration in advance.

N.B: Depending on respondents' answer, the enumerator should put an (X) mark on the space provided whenever necessary.

Part-I: Household's socio-economic characteristics

1. Household head:

A. Male _____ B. Female _____

2. Marital status of the household head:

A. Both parents' alive _____ C. Widowed _____

B. Divorced _____ D. Others (specify) _____

3. The age of the household head is _____ years.

4. Household head's education level:

A. Illiterate _____ C. Primary education _____

B. Informal education _____ D. Secondary education _____

5. The total size of your household is _____ in number (including yourself).

No	Category	No. of	
		M	F
1	Infants(<1 year)		
2	Members aged 1-6 years		
3	Children aged 7-18 years		
4	Adults(19-24 years)		
5	Those 25-60 years		
6	Elderly(>60 years)		

6. Main occupation of the of the household head is

- A. Agriculture_____ C. Daily labor_____
- B. Petty trading_____ D. Others(specify)_____

7. Other income generating activities the household(head and other members) engaged:

- A. Agriculture_____ C. Daily labor_____
- B. Petty trading_____ D. Others(specify)_____

8. On average, the household's monthly income(in ETB) from

- A. Agriculture _____ C. Food aid _____
- B. Daily labor_____ D. Remittance_____
- E. Resources selling_____ F. Petty trading_____
- G. Others (specify) _____

Part-II: Children's Schooling and Resource Collection Work

9. Within your household, how many are involved in the collection of fire wood, water and fodder?

A. Children <7 years_____

B. Members >18 years_____

10. How many children [aged 7-18 years] are currently involved in schooling and how many of them were engaged on environmental goods collection before one week?

Child No.	Sex (M/F)	Age	Child's involvement			Child relationship to household head		Grade level
			School	Collect	Neither	Own	Not	
1								
2								
3								
4								
5								

11. If a child in this household is currently out of school, what are the possible reasons?

A. He/she is required for other domestic work (taking care of siblings, the sick and the elderly, cooking, cleaning, etc)_____

B. Being too young for schooling_____

C. Desire to participate in non-formal literacy and life-skill education_____

D. Being responsible for resource collection_____

E. Others(specify)_____

12. If a child has attended school, did he/she ever repeat any class and dropout of school?

Child No.	Child sex	Any class repeated		Any time he/she dropout of school	
		Yes	No	Yes	No
1					
2					
3					
4					
5					

13. If any, what do you think are the possible causes of grade repetition?

- A. Lacking study time due to involvement in resource collection work_____
- B. Engagement in routine household chores(child care, cooking, etc)_____
- C. More time spent on home-school travelling _____
- D. Others(please specify)_____

14. If he/she was engaged in the collection of environmental resources, how much time is spent on the collection of firewood, water and fodder before seven days and private studies? [*F*=frequency of resource collection per week, *Trv*=two way travel time and *Coll*=time spent on resource collection, everywhere]

Child No.	Sex	Time spent (minutes) on									Study time (hrs/day)
		Firewood			Water			Fodder			
		F	Trv	Coll	F	Trv	Coll	F	Trv	Coll	
1											
2											
3											
4											
5											

14.1. What do you think is the possible effect of involvement on resource collection?

HH child No.	Child sex (M/F)	Participation in resource collection causes			Child's previous semester	
		Class absence	Dropout	Lower performance	Rank	Average
1						
2						
3						
4						
5						

15. Did parents help their children in the collection of environmental goods?

A. Yes_____ B. No_____

16. .If the answer is yes, would you kindly fill the following table concerning the time you spent (minutes) collecting these resources?

Groups	Minutes spent on the collection of								
	Firewood			Water			Fodder		
	F	Trv	Coll	F	Trv	Coll	F	Trv	Coll
Father									
Mother									

17. What was the relative contribution of children [7-18 years], men and women [≥ 19 years] towards domestic work in hours per week during the reference period?

	Child		Herding	Caring children & elderly	Cooking & cleaning
	No	Sex			
Children	1				
	2				
	3				
	4				
	5				
Men					
Women					

18. If your household collects firewood, water and fodder, indicate the sources in rank?

Resource type	Sources	Rank	Time spent(min)		Other alternatives	Quantity used/mth	Expenditure/mth, ETB
			Trv	Coll			
Fire wood	Hills & valleys				Dung, Kg		
	Forest				Crop residues, head		
	Market				Charcoal, Kg		
	Others				Oil lamp, liter		
Fodder	Hills & valleys				Cactus, Kg		
	Own farmland						
	Others						
Water	River						
	Village tap						
	Water well						
	Streams						

19. If you buy fire wood, amount spend per month is _____ETB.
20. Do you use pack animals (camel, donkey, horse and mule) to gather resource easily?
- A. Yes _____ B. No _____
- 20.1. If your answer above is yes, how many pack animals do you have? _____
21. How many cattle do you have (other than pack animals)? _____
22. The amount of land holding being operated by your household is _____'tsimdi''.
23. This year, your household has collected _____donkey-load straws, stalks, etc from your farmland.
24. If you face fodder shortage, did (will) you incur budget to buy straw, stalks, etc from the fodder-rich areas?
- A. Yes _____ B. No _____
25. If your answer is yes, how much birr did (will) you spend this year? _____

Thank You!