Human Capital Investment in Children, the Environment, and Children's Work Burdens in Malawi

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Summary

This paper presents results of research that investigates the relationship between environmental degradation and the education status of children in Malawi. The study specifically investigates how long hours of work spent by children in fuel wood collection and water collection activities[3] are related to the probability that a child aged 6-14 will attend school. Using data from an Integrated Household Survey conducted in Malawi in 1997-98 by the Malawi National Statistics Office, the study finds that children are significantly involved in resource collection work and their probability of attending school decreases with increases in hours spent on fuel wood and/or water collection. The study further shows that girls are disproportionately disadvantaged in that they spend more hours on resource work and are more likely to be going to school while burdened by this work. However, girls are not necessarily less likely to be attending school at all. These results suggest that parents do not discriminate between girls and boys when it comes to school enrollment but that girls have the extra burden of doing domestic work as well. This means that girls may find it difficult to progress well in school. Indeed, a descriptive analysis of the data shows that currently 80% of all 6 to 14 year old Malawian girls and 79% of boys are enrolled in primary schools. However, girls drop out much earlier than boys, resulting in a sex gap at the secondary school level. For example, data from the Population Reference Bureau

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[3] These two tasks will be referred to as resource work or resource collection work throughout the paper.

(PRB 2002) shows that only 12% of Malawian girls and 21% of boys are enrolled in secondary schools[4].

This study also shows that children from the most environmentally degraded districts of central and southern Malawi are less likely to attend school compared to those from the north region districts. There is also an indication that the performance of children in school is affected by environmental degradation because few of the children from central and southern Malawi have progressed to secondary school relative to those from the north.

These results imply that degradation of the environment in Malawi plays a significant role in exacerbating the low education status of children. The need exists, therefore, for innovative ways of integrating environmental programs with development programs to solve these problems.

Background

Malawi has a population of about 10 million people in a space of 94,276 square km, approximately a third of which is Lake Malawi. This makes Malawi one of the most densely populated countries with 105 people per square km. However, there are regional differences in population density. The south has a population density of 146 people per square km, the central region has 114 people per square km, whereas the north has only 46 people per square km. The population grew at an average annual rate of 2.0% between 1987 and 1998 (NSO 2000), and the total fertility rate is 6.3 (NSO 2001). The annual per capita income of Malawi is $170 (World Bank 2002). It is estimated that 65.3% of the people lived below the poverty line in 1997-98 (NEC 2000).

[4] This is a ratio of the number of students enrolled in secondary school to the population in the applicable age group.

Malawi also faces challenges in the education status of her children. Although the enrollment rates are quite high, drop out rates are also high. Despite the high 80% primary school enrollment rate for children aged 6-14 revealed in the data used for this research[5], Lloyd, Kaufman, and Hewett 1999, using data from the Malawi Demographic Health Surveys, showed that less than 20% of 15-19 year old Malawians had completed 4 years of primary education in 1990. A recent article on Malawi (UN IRIN 2002)[6] reported that only about 20% of Malawian children complete the eight years of primary education and that girls face special obstacles due to "burdensome involvement" in household chores. The article further reported that girls start school much later than boys, starting at age 8 instead of 6.

Malawi also faces significant environmental problems. The most significant environmental concern is the high rate of deforestation that was estimated at an annual rate of 2.4% between 1990 and 2000 (UN FAO 2001). This is one of the highest deforestation rates in Africa (10^{th}) and significantly higher than both Africa's average deforestation rate of 0.78%, and the world's average deforestation rate of 0.22%. The causes for this high rate of deforestation include high population growth creating pressure on cultivation land, dependence of the population on fuel wood as a source of cooking energy, and use of wood energy for curing tobacco by tobacco estate farmers (Hudak and Wessman 2000). Data from the Integrated Household Survey showed that 92.6% of households use firewood as their main source of energy for cooking (NEC 2001). Therefore, a rapid depletion of natural resources such as forestland has significant consequences for the quality of people's lives. In terms of fuel wood availability, the south and central regions are the most distressed regions, both experiencing fuel wood shortages (Figure 1).

[5] Similar primary enrollment rates are reported in Lloyd et al. (1999) who report current primary enrollment of 67% from the Malawi Demographic and Health Surveys and a gross primary enrollment rate of 80% from UNICEF's data.
[6] The article was based on a report by the Malawi government and UNICEF.

Deforestation is a fairly recent phenomenon in the northern region. In fact, the only two districts in Malawi with fuel wood surpluses in the year 2000 (i.e., Chitipa and Nkhata-Bay) are located in the north. In terms of water access, Malawi is reported as one of the 11 countries in Africa that will experience a water scarcity crisis by the year 2025 (PRB 2002). That is, Malawi will have less than the critical 1000 cubic meters per person per year of fresh water that is required for basic human nutritional needs. Currently, only 57% of Malawians have access to an improved drinking water source, and only 44% of the rural Malawians have this access.

The deforestation and water scarcity problem affects women and children in specific ways because they are primarily responsible for all domestic-related transport tasks (e.g., fuel wood collection, water collection, going to grinding mills, transporting produce, and accessing social services). In Malawi it is estimated that women and children, especially girls, shoulder greater than 70% of the rural transport burden (PIRTP 1994; Edmonds, Nyanda, and Nankhuni 1995). A large proportion of these tasks such as fuel wood collection and water collection are environmentally related. Therefore, environmental degradation can be expected to cause women and children to travel increasingly longer distances to access fuel wood and water sources.

Study Objectives

This research seeks to investigate how long hours spent on fuel wood collection and water collection affect the education status of children in Malawi. Specifically, this research addresses the following key questions:

1. Does the time that children spend collecting fuel wood and water affect their probability of attending school?

2. What factors determine whether a child combines schooling and resource collection work, attends school without doing these tasks, or does not attend school at all?

These questions are important from a development perspective because increasing deforestation and other resource scarcity issues may well have the potential to limit advances in education.

Theoretical Framework

The analysis is based on the household production/utility model of Becker (1965, 1993). In this model, household consumption and production decisions are simultaneously made. The problem of the household is to maximize their utility subject to a set of constraints:

$$\underset{C_j,n,q,\ell}{\text{Max}}\ U_i = U_i(C_j, n, q, \ell)$$

$$\text{s.t.} \sum_{j=1}^{m} p_j x_j + p_c qn \le F_i(t_f, A) + w_i t_{o-f} + w_i t_i + I_i$$

$$C_j = f_j(x_j, T_j, A; E)$$

$$qn = f_{qn}(x_{qn}, T_{qn}, A; E)$$

$$T_j = t_j C_j$$

$$x_j = b_j C_j$$

$$t_i = \sum_{j=1}^{m} T_j + T_{qn}$$

$$\bar{T} = t_i + t_f + t_{o-f} + \ell$$

where U_i is household i's utility function and C_j is a vector of goods that the household produces at home using their time and market-purchased goods. The n represents the number of children in the household, q represents the level of quality invested in each child, and ℓ the leisure time enjoyed by household members. The household's home production function is $C_j = f_j(x_j, T_j, A; E)$ where x_j and T_j are vectors of market-purchased goods and times spent to produce C_j, A represents the fixed land and other assets of the household, and *E* represents household ability, human capital, social and physical climate, and other environmental variables.

The home production function can also be represented in equivalent forms, $T_j = t_j C_j$ and $x_j = b_j C_j$ where t_j is a vector of input of time per unit of C_j and b_j is a similar vector for market goods. Examples of home-produced goods and services consumed by the household are sanitation, cooked food, and children. However, children are a special commodity, therefore the household home production function for children is represented by $qn = f_{qn}(x_{qn}, T_{qn}, A; E)$.

Utility is maximized subject to an income constraint, where $\sum_{j=1}^{m} p_j x_j$ represent the expenditures on market-purchased goods and $p_c qn$ represents total expenditure on quantity and quality of children. These expenditures cannot exceed the household's income from the household's farm profits, $F_i(t_f,A)$, its wage earnings from off-farm activities, $w_i t_{o\text{-}f}$, the value of the household's home production, $w_i t_i$, and exogenous income, I_i. The price of farm output is normalized to 1. $F_i(t_f,A)$ is the farm production function of the household, where t_f is farm labor input. The household time constraint is represented by $\bar{T} = t_i + t_f + t_{o-f} + \ell$, where t_i is the total time spent on home produced goods, t_f is total household time spent on farming, $t_{o\text{-}f}$ is the total time allocated to off-farm activities, and ℓ is the household's leisure time. Optimal levels of consumption goods, quality of children and quantity of children depend on the shadow prices of these goods as well as on the shadow price of total income. For example, an increase in the cost of rearing children should cause a decrease in the demand for quantity of children, and an increase in the price of quality of children should also decrease the quality of children demanded. Quality of children is measured in several ways. These include: level of investments in their education and/or their health, and their education attainment level and/or health attainment level. Increases in work time spent on fuel wood collection and water collection representing here a measure of

environmental degradation, increase the cost of quality of children because the mother is time constrained and would benefit from the child's immediate help. As a result, there is an incentive to reduce quality in favor of a greater quantity of children[7]. This paper assumes that the above scenario exists in Malawian households and seeks to test how work burdens on children affect their likelihood of attending school.

Data and Methods

Data from the Integrated Household Survey (IHS) of 10,698 households collected in 1997-98 by the National Statistics Office in Malawi were used. The data are intended for poverty-monitoring efforts by the government of Malawi, and are from a comprehensive national survey covering all of the districts in Malawi. The data set contains demographic data as well as socio-economic characteristics of individuals and households, including child and adult levels of education. The data also include time allocation and employment data for Malawian children and adults. The variables summarized in Table 1 are used in the models estimated in this paper. The data are first used to descriptively show the relative contribution of children to domestic work, assessing the average hours that children aged 6-14 spend on different tasks, and the use of child labor relative to the time women aged 15 to 45 spend on the same tasks. Data from the IHS are then used to estimate a series of models to provide a better understanding of the interrelationships between resource scarcity and schooling. First, binary probit models are estimated for participation of children in the sample on fuel wood and/or water collection activities aggregated. That is, discrete choice models are estimated to determine those factors that influence the likelihood that children in the 6 -14 age range participate in work related to

[7] This introduces potential endogeneity problems between school attendance and the household size variables that are used in the models in this paper. These have not been econometrically addressed in the paper due to lack of proper instruments. However, we believe that the endogeneity problem from work hours is more serious and has been corrected for in the school attendance probit models.

Table 1: Description of variables used (see explanation of the variables in Appendix 1).

Variable	Mean	Standard deviation
Age	10.495	2.515
Age squared	116.474	51.442
Female	0.670	0.470
Biological child	0.779	0.415
Child employment	0.030	0.169
High fuel wood median time area	0.348	0.476
High water median time area	0.568	0.495
Resource scarcity area	0.296	0.457
Resource work time	6.424	7.667
District with moderate wood deficits	0.082	0.274
District with severe wood deficits	0.862	0.345
Household poverty	0.700	0.458
Female headship	0.284	0.451
Standard 4 head	0.229	0.420
Standard 8 head	0.355	0.479
Highly educated head	0.151	0.358
Infants	0.405	0.345
Children 1-5 yrs	0.771	0.862
Girls 1-5 yrs	0.397	0.625
Boys 1-5 yrs	0.374	0.628
Children 6-10 yrs	1.356	0.938
Girls 6-10 yrs	0.738	0.751
Boys 6-10 yrs	0.619	0.748
Children 11-14 yrs	1.092	0.832
Girls 11-14 yrs	0.644	0.712
Boys 11-14 yrs	0.448	0.638
Children 15-18 yrs	0.544	0.745
Girls 15-18 yrs	0.241	0.486
Boys 15-18 yrs	0.303	0.568
Young adults 19-24 yrs	0.330	0.644
Young adult girls 19-24 yrs	0.148	0.387
Young adult boys 19-24 yrs	0.182	0.471
Women 25-64 yrs	0.908	0.249
Men 25-64 yrs	0.707	0.532
Old women ≥ 65 yrs	0.065	0.249
Old men ≥ 65 yrs	0.055	0.232
South	0.355	0.479
Central	0.565	0.496
Urban	0.117	0.321

either type of resource collection. Then, regression models of the intensity of work, as measured by hours of work allocated to the particular form of resource-related collection work, are estimated. After the overall resource models are estimated, participation and work intensity models are estimated for fuel wood collection and water collection activities separately. Following estimation of models to better understand those factors that influence resource-related work participation and intensity, models of school attendance are estimated. Specifically, a binary probit model of school attendance by children aged 6-14 is estimated to determine if school attendance is related to hours spent on resource collection work and fuel wood scarcity variables. Because the time spent in resource-related work is likely to be endogenous, the model is tested and corrected for this estimation problem. This is followed by estimation of a multinomial logit model of alternative work-schooling choices: doing resource-related work while attending school, attending school without doing resource work, or not attending school at all. Finally, GIS analysis is used to show the relationship between fuel wood availability in Malawi and secondary school enrollments.

Study Results

Statistics on the average hours spent on different household tasks by children show that children spend a significant amount of time on these tasks. Figure 2 shows the mean hours spent on domestic activities by children aged 6 to 14. Children spend the most hours taking care of other children, followed by water collection, cooking, and fuel wood collection. Figure 3 presents children's mean hours as a percentage of the mean hours that all women aged 15 to 45 spend on

Figure 2

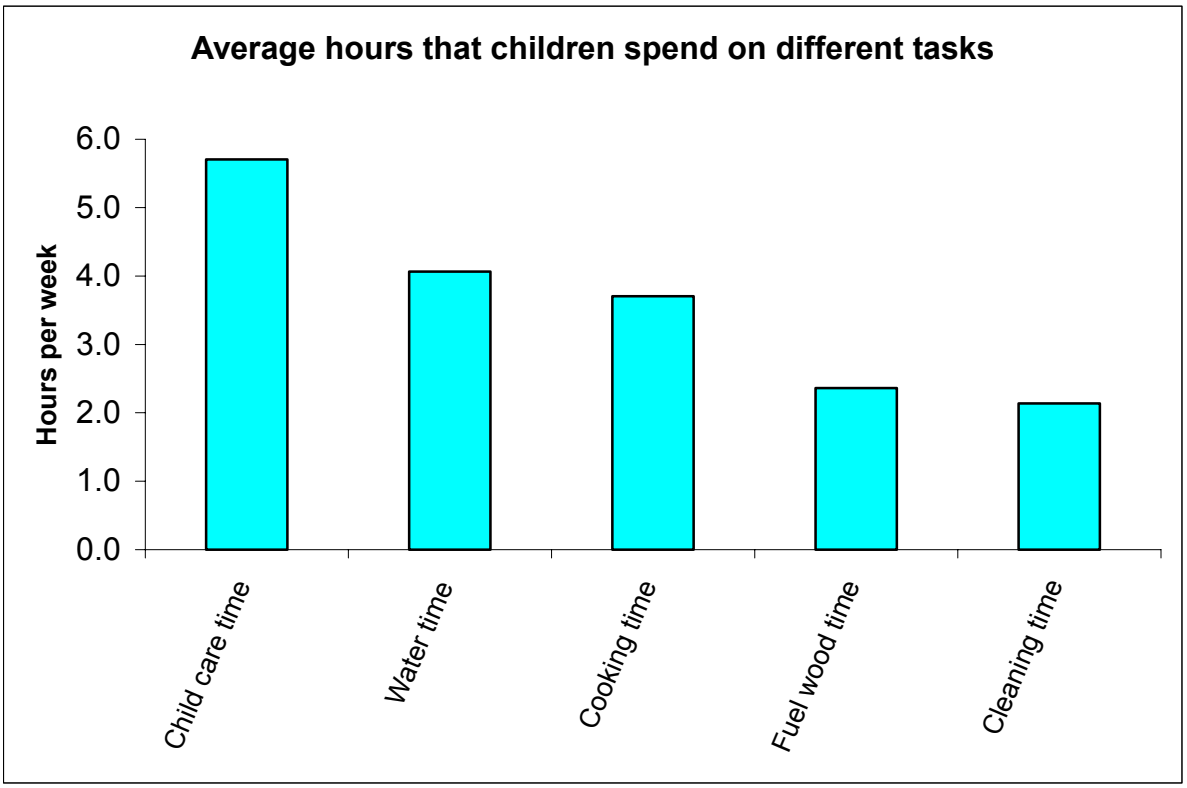
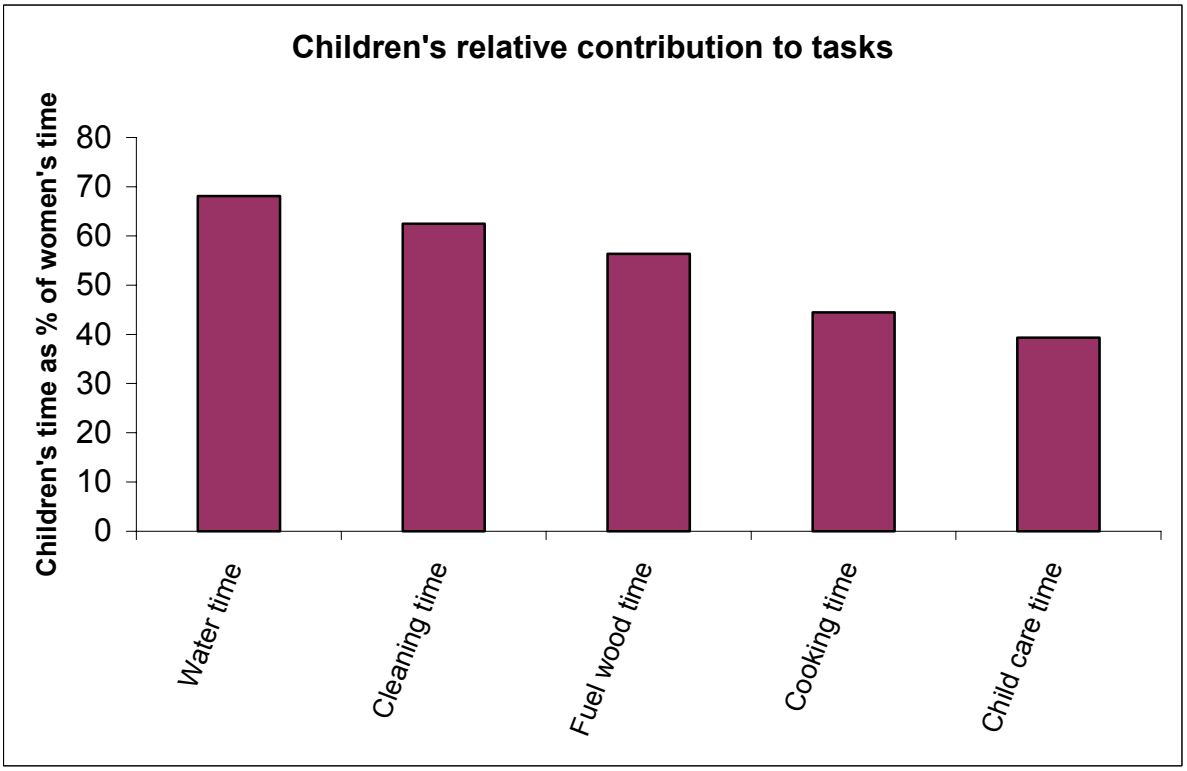


Figure 3



the domestic activities. This is to show the relative contribution of children to domestic work. The figure shows that women rely heavily on children particularly for resource collection activities where, for example, children spend close to 70% of the time their "mothers" spend for water collection.

Determinants of participation in resource work and intensity of work

To identify those factors that contribute to a higher probability that a child aged 6-14 will participate in resource collection work[8], a probit model was estimated. Results of the probit regression are presented in Table 2[9]. Older children are more likely to do resource-related work. Girls are also more likely to do this kind of work, confirming the traditional division of labor typical of all sub-Saharan African countries (Andvig 2000; Barwell 1996; Bryceson and Howe 1993; Malmberg 1994). Analyzing the hours spent on resource-related collection work, Table 3 shows that girls are spending *longer hours* on resource work than boys.

To capture the effect of environmental stress on the probability of a child participating in resource work, we calculated median values of hours spent on fuel wood collection and water collection by all individuals in the sample at an enumeration area level[10]. The median values are used as measures of fuel wood and water scarcity in that enumeration area. Cooke (2000) used a similar approach. If a child lives in an enumeration area that has a median fuel wood collection time value greater than the total sample fuel wood median variable value of 2.0, that child is assigned a "high fuel wood median time area" dummy value equal to one. If the child lives in an

[8] Resource work hours are the addition of hours that the child spent on fuel wood and water collection in the week preceding the interview date. The participation in resource work is a dummy variable equal to 1 if the child is reported to spend positive hours on resource work.
[9] Model 1 has gender-disaggregated household composition variables while model 2 has them aggregated.
[10] There are 136 enumeration areas in the data set. The median values are calculated from the whole IHS sample of 46,128 individuals. Each child was assigned the median value from the enumeration area where they come from.

enumeration area with median water collection time greater than the total sample water median value of 3.0, the child is also assigned a "high water median time area" dummy value equal to one. The high fuel wood and water median time area variable coefficients are both positive and significant showing that a child who lives in a fuel wood or water distressed area has a higher probability of being involved in fuel wood and/or water collection. As expected, children who live in the high fuel wood and water median time areas also spend more hours on resource work (Table 3). To see if the effects of wood and water scarcity on hours of work are extenuated if a child lives in an area that is both fuel wood and water scarce, we interacted a water scarcity dummy variable and a fuel wood scarcity dummy variable. The resource scarcity area variable is an interaction term of the water scarcity and fuel wood scarcity dummies. The interaction variable coefficient is negative in the resource work participation equation but is not statistically significant in the resource work-hours regression,[11] implying that the effects of simultaneous wood scarcity and water scarcity on hours that a child spends on resource work are not necessarily extenuated if a child lives in an area where both fuel wood and water are scarce. Another way of capturing environmental degradation is through the fuel wood stock variable. This is done by constructing fuel wood scarcity district dummies that are constructed from the fuel wood availability map in Figure 1[12]. We find that children in these districts spend more hours on resource work than those in the fuel wood surplus districts but they are not necessarily more likely to participate in this work.

[11] The model that included this variable is not reported here because we decided to remove this variable from our set of instruments for resource hours.

[12] All the districts in Malawi were coded into three dummies according to availability/non-availability of fuel wood resources. Using the map presented in Figure 1 the two districts with fuel wood surpluses in 2000 were labeled wood surplus districts, those that had fuel wood surpluses in 1985 but had deficits in 2000 were coded as districts with moderate fuel wood deficits, while those that had deficits in both 1985 and 2000 were coded as districts with severe fuel wood shortages. The districts with fuel wood surpluses are, therefore, used as the base category in the regressions.

Household characteristics and household composition variables also affect the likelihood of a child doing resource work. A child who lives in a household that is below the poverty line in Malawi[13] is more likely to participate in resource work but is not necessarily more likely to spend more hours on this work than a child from a richer household. A child who lives in a household whose head is highly educated (that is, the head completed secondary or higher education) has a lower likelihood of being involved in resource work and also spends less hours of work on this work. This may be due to the ability of such household heads to buy fuel wood or drill a water-well near the home. Presence of infants (aged below one year) and children aged 1-5 years also decrease the likelihood that a child aged 6-14 is involved in resource work. This may imply that young children impose childcare responsibilities on other children, and as a result the other children become more involved in helping their mothers with this work rather than doing the harder fuel wood or water collection work[14]. Presence of more boys aged 11-14 and young adult girls (aged 19-24) also decrease the likelihood that a child aged 6-14 is involved in resource work. In terms of intensity of work, the presence of more children aged 1-5 years old, more boys aged 11-14, young adult girls aged 19-24, and women aged 25-64 decrease the hours of work that a child aged 6-14 spends on resource work. This suggests that presence of women and a larger number of household members in the non-school age range[15] help to relieve the work burden on school-age children.

There are regional differences in resource work participation as well as in intensity of work among children. Children who live in the central and southern regions of Malawi have a lower

[13] The poverty dummies were provided with the data and were constructed by the International Food Policy Research Institute (IFPRI), Washington D.C., and The National Economic Council (NEC), Malawi, who worked on the IHS data set for poverty monitoring reports in Malawi. Details of how these were constructed are in NEC (2000).
[14] Presence of more 1-5 year olds decreasing the hours of work on 6-14 year olds may also imply that there is significant help provided by the 4-5 year olds.
[15] Except for boys aged 11-14.

likelihood of participating in resource-related activities and spend less time on this work as well. This is the case for both fuel wood and water collection work. Finally, children who live in rural areas, as expected, are more likely to participate in resource work and also to spend more hours on this work than urban children. The IHS data show that 27.1% of urban households used electricity as the main source of cooking fuel as opposed to only 0.2% of rural households using it. Similarly, 81.4% of urban households had access to tap water as opposed to only 21.4% in rural areas[16].

Fuel wood collection versus water collection

To determine if there are any significant differences in the nature of fuel wood collection and water collection, separate probit regressions of participation in fuel wood collection and water collection were estimated. The model results are presented in Table 4. Most of the variables that affect the likelihood of participation in fuel wood collection also affect the likelihood of water collection participation. The difference comes with respect to biological children who are less likely to collect water but significantly more likely to collect fuel wood. We do not have a good explanation why this should be the case. Overall, a biological child is less likely to do resource collection work as the resource work participation equation in Table 2 revealed. Table 5 presents the actual fuel wood hours and water hours' regressions. Appendices 2 and 3 present similar results but with gender disaggregated household composition variables. These results show that children who come from a household whose head is highly educated spend less time collecting fuel wood but the coefficient is not significant in the water collection time regression.

[16] The figures are much lower for own tap access (42.5% in urban areas and 1% in rural areas).

Effects of resource work on school attendance

To determine if the work burdens significantly influence school attendance, probit models of school attendance were estimated correcting for endogeneity of resource-work hours following a method developed by Rivers and Vuong (1988) and as explained by Wooldridge (2002). This involves estimating an OLS regression of resource hours and retaining the residuals, which are included as one of the explanatory variables in the probit equation for school attendance, with the resource hours also included as an explanatory variable. This acts as a test as well as a correction for the endogeneity problem. If the t-statistic for the estimated error term is statistically significant, this indicates that hours are endogenous in the school attendance regression. The results of our analyses using this approach are presented in Table 6. The error term is statistically significant, indicating presence of endogeneity in school attendance and hours spent on resource-related work.[17]

The results show that older children are more likely to attend school up to the age of about 12 years, beyond which the likelihood of school attendance starts to decline. Although girls are more likely to collect fuel wood and water, these results show that they are not necessarily less likely to attend school. The female dummy variable coefficient is insignificant (see Table 6). These results suggest that parents do not discriminate between girls and boys when it comes to school enrollment but that girls have the extra burden of doing domestic work as well[18]. Consequently, the girls may find it difficult to progress well in school.

[17] We believe that a child who spends more time on resource work (or any other work) would most likely be the one who is already not attending school, therefore the decision to attend school or not may depend on whether a child is involved in this kind of work. It is also possible that a child who attends school and is heavily involved in resource work may end up dropping out and, hence, not attending school. As a result, the causal effect is both ways and the decisions are non-recursive in nature.

[18] These results are supported by multinomial logit regressions presented in Table 7.

The hours of work that children spend on resource work reduce the likelihood of a child attending school, supporting our hypothesis. Child employment[19] also decreases this likelihood. If a child lives in a district with severe fuel wood deficits, they are also less likely to attend school. It is also interesting to note that when the district fuel wood deficit dummy variables are excluded from the models, the south and central districts have statistically significant negative marginal effects on school attendance. Adding the fuel wood deficit district variables removes the apparent regional differences, implying that environmental degradation contributes to the low school attendance observed in south and central regions relative to the north region. This means that children from environmentally-degraded regions are less likely to attend school. Figure 4 is a mapping of boys' and girls' secondary school enrollment level and the fuel wood scarcity index[20] at a regional level. The figure shows that children in the least degraded northern region are one and a half times more likely to proceed to secondary school than those in the south and central regions of Malawi. This suggests that it is not only primary school enrollment that is related to environmental degradation but primary school performance and, hence, secondary school enrollment as well.

Poverty is another constraint on the education of children. If a child lives in a household that is below the poverty line, their likelihood of attending school is reduced. Other variables explaining school attendance include education of the household head that increases attendance if the head has completed up to 4 years of primary school education or more relative to a head who did not

[19] The child employment dummy variable is equal to 1 if the child is reported as an employee, family business worker, or house worker. A house worker is someone employed as a housekeeper or full-time baby sitter in somebody's house.

[20] Districts with fuel wood surpluses are given an index value of 10, those with moderate fuel wood deficits are given an index value of 20 and those with severe fuel wood deficits are given an index value of 30. The index of fuel wood scarcity at a regional level is the average value of the district indices.

attend school. The effects become stronger with increases in levels of higher education of the household head. Household composition variables also affect the probability of school attendance. The presence of more young girls (6-10 years old) and women in all age categories in a household increase the likelihood of children aged 6-14 attending school. This likely suggests that it is the female members of the household that are mostly involved in household responsibilities thereby reducing the burden of household work from school-age children. For example, young adult girls (19-24 years old) are consistently[21] having the effect of reducing the likelihood of children's involvement in work as well as reducing the intensity of work for children aged 6-14 (Tables 2 and 3, and Appendices 2 and 3). This pattern continues for women aged (25-64) who consistently reduce the intensity of work for children (Tables 3 and 5, and Appendix 3).[22] Presence of infants in a household also decreases the likelihood that a child aged 6-14 attends school. This is likely due to the increased financial demands that infants place on households.

Residing in an urban area does not necessarily increase the likelihood that a child attends school. This shows that Malawi is almost at universal primary school enrollment rates. However, rural/urban differences are more likely to exist with regard to performance indicators such as early start, dropout rates, and progress to higher education levels (NEC 2000 and 2001).

Robustness of results

Results of multinomial logit model of alternative work-schooling choices: doing resource-related work while attending school, attending school without doing resource work, or not attending school at all are reported in Table 7. The results confirm most of the results from the probit

[21] With one exception in the wood participation equation where the coefficient is insignificant

regressions. Older children are more likely to attend school but at about age 12 the probability of school non-attendance starts to increase, as was found earlier. The results also show that girls are more likely to be attending school and collecting fuel wood and/or water but *are less likely to be attending school without doing these tasks*. However, girls are not necessarily less likely to be attending school at all. Child employment increases the likelihood of school non-attendance. Children who live in districts with severe or moderate fuel wood deficits are more likely not to attend school. In fact, the statistically significant negative marginal effect of severe fuel wood deficits on the likelihood of combining schooling with resource work seems to suggest that children who live in these areas are not even able to combine work with schooling but are much more likely not to attend school at all. Household head education variables are as expected. The presence of more young women (aged 19-24) and women of working age (aged 25-64) increases the likelihood that a child goes to school and does not do resource collection work and decreases the likelihood that a child does not attend school. This finding is consistent with the earlier result that major resource collection responsibilities being borne by women may be the driving force for this result**.** The presence of infants and young children (aged 1-5) reduce the resource work burden and increases the likelihood that a child aged 6-14 attends school without doing resource work. This is probably due to the presence of the young children increasing other work responsibilities of childcare, cooking, and cleaning on children aged 6-14. However, it is only the presence of infants that increases the likelihood of school non-attendance for children aged 6-14.

These results also support the non-significance of urban residence in determining school attendance but here, the school with work or schooling without work dis-aggregation shows that

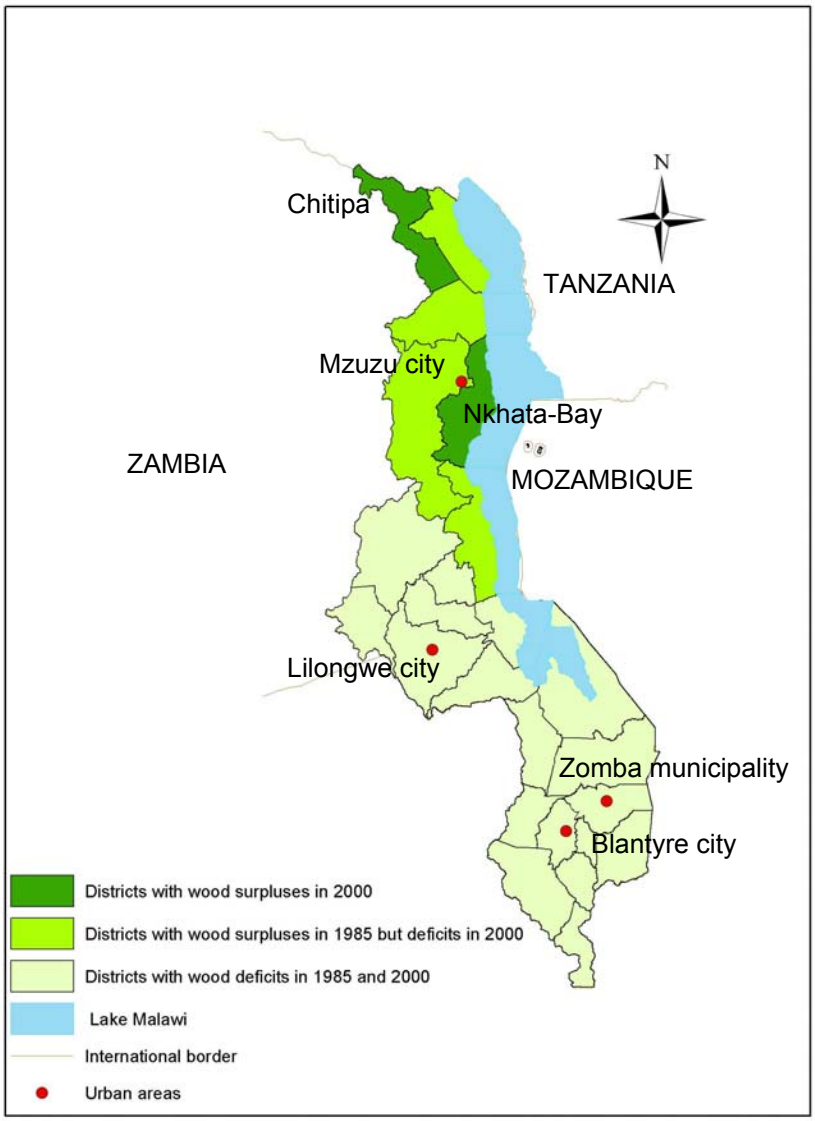
[22] This is not necessarily the case in the participation equations, where their increased presence mostly reduces participation in work but the coefficients are not statistically significant.

it is rural children who are burdened with resource work while going to school while urban children are more likely to attend school without doing any resource work.

Conclusions

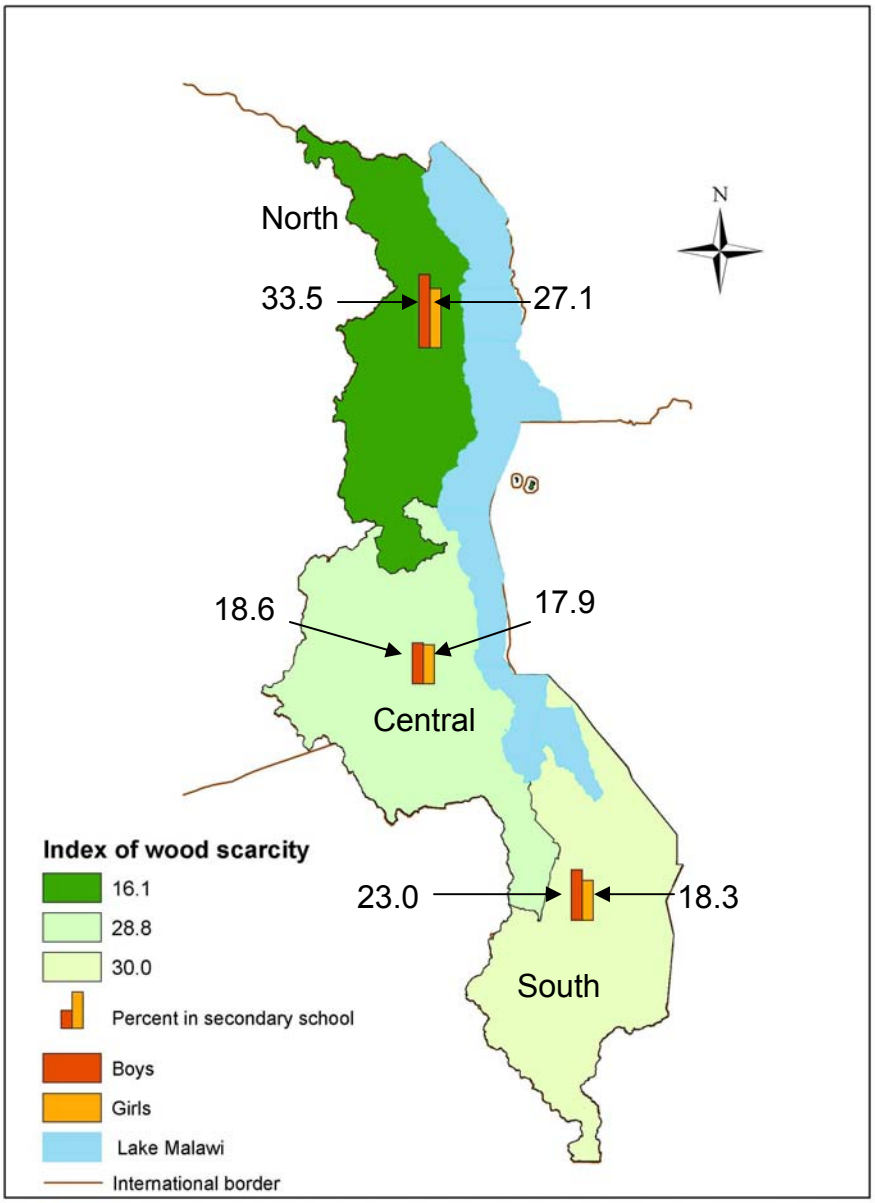
Results of this analysis support the hypothesis of a negative relationship between environmental degradation and the education status of children. This means that by increasing work burden of children, environmental degradation may well contribute to the low education status of children in Malawi. The lower likelihood of school attendance with increased hours of work shows that parents trade-off investment in children's education in favor of using children for labor. The presence of more women decreases the burden of work on children and increases attendance of children at school while that of men does not, implying that education of children can be enhanced even through "non-monetary" adjustments such as a change in cultural attitudes towards encouraging men's involvement in domestic work. On the other hand, the relationships between the environment and schooling of children suggest that there exist opportunities to integrate environment programs with development initiatives in the fields of education, health, and family planning. For example, an environmental program to reforest the degraded areas in Malawi can also be combined with a primary-school scholarship program to help ameliorate the negative effects of deforestation on education.

Figure 1: Fuel wood availability in Malawi



Source: National Physical Development Plan Study, OPC, Town and Country Planning Department, Lilongwe, Malawi

Figure 4: Fuel wood scarcity and secondary school enrollment in regions of Malawi



Data source: OPC (Figure1) and survey data (IHS 1997-98)

Table 2: Resource work participation probit regression, N=4210[1] (88.4% participated).

Variable	Model 1	Model 2	Mean
Constant	0.024	0.010	-
Age	0.033***	0.035***	10.495
Age squared	-0.001*	-0.001*	116.474
Female	0.092***	0.098***	0.670
Biological child	-0.018*	-0.017	0.779
Child employment	0.021	0.023	0.029
High fuel wood median time area	0.120***	0.120***	0.348
High water median time area	0.030***	0.030***	0.568
Resource scarcity area	-0.095***	-0.095***	0.296
District with moderate wood deficits	-0.001	0.002	0.082
District with severe wood deficits	0.013	0.013	0.862
Household poverty	0.030***	0.030***	0.700
Female headship	0.022	0.017	0.284
Standard 4 head	0.017	0.017	0.229
Standard 8 head	0.021*	0.019*	0.355
Highly educated head	-0.026*	-0.030**	0.151
Infants	-0.017*	-0.022**	0.122
Girls 1-5 yrs	-0.028***	-	0.397
Boys 1-5 yrs	-0.037***	-	0.374
Children 1-5 yrs	-	-0.034***	0.771
Girls 6-10 yrs	0.005	-	0.738
Boys 6-10 yrs	-0.001	-	0.619
Children 6-10 yrs	-	0.002	1.356
Girls 11-14 yrs	-0.010	-	0.644
Boys 11-14 yrs	-0.014**	-	0.448
Children 11-14 yrs	-	-0.012*	1.092
Girls 15-18 yrs	-0.002	-	0.241
Boys 15-18 yrs	0.008	-	0.303
Children 15-18 yrs	-	0.004	0.543
Young adult girls 19-24 yrs	-0.043***	-	0.148
Young adult boys 19-24 yrs	-0.001	-	0.182
Young adults 19-24 yrs	-	-0.019***	0.330
Women 25-64 yrs	-0.011	-0.003	0.908
Men 25-64 yrs	0.006	0.003	0.707
Old women ≥ 65 yrs	0.023	0.026	0.065
Old men ≥ 65 yrs	0.024	0.020	0.055
South	-0.115***	-0.116***	0.355
Central	-0.115***	-0.116***	0.565
Urban	-0.127***	-0.126***	0.117

1 The sample of 4210 children includes only those children that had non-missing information on hours of work.
***The variable coefficient is significant at 1% level of significance.
** The variable coefficient is significant at 5% level of significance.
*The variable coefficient is significant at 10% level of significance.

Table 3 Resource hours regression, N=4210.

Variable	Model 1	Model 2
Constant	8.348***	7.750***
Age	-0.472	-0.435
Age squared	0.038**	0.036**
Female	2.338***	2.720***
Biological child	0.342	0.408
Child employment	-0.452	-0.370
High median fuel wood time area	1.991***	1.997***
High median water time area	1.197***	1.171***
District with moderate wood deficits	3.787***	3.859***
District with severe wood deficits	5.147***	5.083***
Household poverty	0.347	0.320
Female headship	0.672	0.554
Standard 4 head	-0.241	-0.260
Standard 8 head	-0.284	-0.313
Highly educated head	-0.823**	-0.962**
Infants	0.438	0.326
Girls 1-5 yrs	-0.494***	-
Boys 1-5 yrs	-0.412**	-
Children 1-5 yrs	-	-0.507***
Girls 6-10 yrs	0.155	-
Boys 6-10 yrs	-0.105	-
Children 6-10 yrs	-	0.027
Girls 11-14 yrs	0.026	-
Boys 11-14 yrs	-0.505***	-
Children 11-14 yrs	-	-0.209
Girls 15-18 yrs	-0.128	-
Boys 15-18 yrs	-0.188	-
Children 15-18 yrs	-	-0.168
Young adult girls 19-24 yrs	-1.302***	-
Young adult boys 19-24 yrs	0.237	-
Young adults 19-24 yrs	-	-0.358**
Women 25-64 yrs	-0.981***	-0.746***
Men 25-64 yrs	0.232	0.120
Old women ≥ 65 yrs	-0.493	-0.297
Old men ≥ 65 yrs	0.138	0.029
South	-6.802***	-6.688***
Central	-9.483***	-9.373***
Urban	-1.943***	-1.920***

***The variable coefficient is significant at 1% level of significance.
** The variable coefficient is significant at 5% level of significance.
*The variable coefficient is significant at 10% level of significance.

Table 4: Fuel wood and water collection participation equations, N=4210.

	Fuel wood collection (52.9%)[a]	Water collection (85.7%)[a]
Variable	**Marginal effects**	**Marginal effects**
Constant	-0.268***	-0.048
Age	0.023***	0.050***
Age squared	-	-0.002***
Female	0.151***	0.145***
Biological child	0.046**	-0.023*
Child employment	0.051	0.025
High fuel wood median time area	0.182***	-
High water median time area	-	0.036***
District with moderate wood deficits	0.253***	-
District with severe wood deficits	0.104	-
Household poverty	0.051***	0.032***
Female headship	-0.013	0.022
Standard 4 head	0.004	0.021
Standard 8 head	0.067***	0.017
Highly educated head	-0.082***	-0.045***
Infants	0.005	-0.023*
Children 1-5 yrs	-0.064***	-0.036***
Children 6-10 yrs	0.016*	0.004
Children 11-14 yrs	-0.024**	-0.011*
Children 15-18 yrs	-0.032***	-0.003
Young adults 19-24 yrs	-0.023*	-0.016**
Women 25-64 yrs	0.001	-0.005
Men 25-64 yrs	-0.015	0.005
Old women ≥ 65 yrs	-0.022	0.046*
Old men ≥ 65 yrs	-0.010	-0.009
South region	-0.134**	-0.080***
Central region	-0.254***	-0.106***
Urban	-0.121***	-0.156***

[a] Percent of children who participated in activity.

***The variable coefficient is significant at 1% level of significance.

** The variable coefficient is significant at 5% level of significance.

*The variable coefficient is significant at 10% level of significance.

Table 5: Fuel wood collection time and water collection time OLS regressions.

	Fuel wood collection time (hrs)	Water collection time (hrs)
Variable	**Coefficient**	**Coefficient**
Constant	4.226***	2.847***
Age	-0.479**	0.155***
Age squared	0.031***	-
Female	0.824***	1.910***
Biological child	0.429**	0.040
High fuel wood median time area	1.490***	-
High water median time area	-	1.192***
District with moderate wood deficits	5.555***	-
District with severe wood deficits	5.463***	-
Household poverty	0.317**	0.011
Female headship	0.084	0.399
Standard 4 head	-0.271	-0.006
Standard 8 head	-0.080	-0.243
Highly educated head	-0.556**	-0.422
Infants	0.124	0.201
Children 1-5 yrs	-0.286***	-0.216**
Children 6-10 yrs	-0.042	0.094
Children 11-14 yrs	-0.076	-0.141
Children 15-18 yrs	-0.152*	-0.046
Young adults 19-24 yrs	-0.143	-0.221*
Women 25-64 yrs	-0.285*	-0.469***
Men 25-64 yrs	0.013	0.011
Old women ≥65 yrs	-0.328	0.082
Old men ≥65 yrs	-0.372	0.389
South	-6.069***	-0.670**
Central	-7.288***	-2.319***
Urban	-0.479**	-1.393***

***The variable coefficient is significant at 1% level of significance.
** The variable coefficient is significant at 5% level of significance.
*The variable coefficient is significant at 10% level of significance.

Table 6: Probit regression: Determinants of school attendance for children aged 6-14 in Malawi, N=4210 of which 86.1% attended school.

Variable	Marginal effects	P-value
Constant	-0.776***	0.000
Age	0.181***	0.000
Age squared	-0.008***	0.000
Female	0.021	0.161
Biological child	0.006	0.637
Child employment	-0.440***	0.000
Resource work time	-0.007**	0.043
Residuals	0.006*	0.091
District with moderate wood deficits	-0.044	0.307
District with severe wood deficits	-0.122***	0.011
Household poverty	-0.024**	0.034
Female headship	0.023	0.249
Standard 4 head	0.022*	0.073
Standard 8 head	0.080***	0.000
Highly educated head	0.088***	0.000
Infants	-0.025*	0.055
Girls 1-5 yrs	-0.006	0.462
Boys 1-5 yrs	0.008	0.322
Girls 6-10 yrs	0.015*	0.053
Boys 6-10 yrs	0.005	0.449
Girls 11-14 yrs	0.006	0.514
Boys 11-14 yrs	0.002	0.787
Girls 15-18 yrs	0.003	0.778
Boys 15-18 yrs	-0.002	0.824
Young adult girls 19-24 yrs	0.035**	0.025
Young adult boys 19-24 yrs	0.015	0.187
Women 25-64 yrs	0.047***	0.001
Men 25-64 yrs	0.014	0.401
Old women ≥ 65 yrs	0.046**	0.034
Old men ≥ 65 yrs	0.019	0.442
South	0.020	0.650
Central	0.006	0.910
Urban	0.028	0.169

***The variable coefficient is significant at 1% level of significance.
** The variable coefficient is significant at 5% level of significance.
*The variable coefficient is significant at 10% level of significance.

Table 7: Multinomial logit regression showing the marginal effects of variables on probability, N=4210.

Variable	Combining resource work and schooling (76.3%)	Schooling without involving in resource work (9.8%)	No schooling (13.9%)
Constant	-0.654***	-0.171***	0.825***
Age	0.174***	-0.003	-0.17***
Age squared	-0.007***	0.000	0.007***
Female	0.081***	-0.071***	-0.010
Biological child	-0.015	0.014	0.001
Child employment	-0.299***	-0.093*	0.392***
District with moderate wood deficits	-0.075	0.003	0.072***
District with severe wood deficits	-0.139**	-0.009	0.148**
Household poverty	0.005	-0.031***	0.026**
Female headship	0.022	-0.003	-0.019
Standard 4 head	0.033**	-0.010	-0.024**
Standard 8 head	0.090***	-0.010	-0.080***
Highly educated head	0.049***	0.033***	-0.082***
Infants	-0.042**	0.013*	0.028**
Girls 1-5 yrs	-0.019***	0.018***	0.001
Boys 1-5 yrs	-0.025*	0.032***	-0.007
Girls 6-10 yrs	0.016*	-0.003	-0.013*
Boys 6-10 yrs	0.006	0.000	-0.006
Girls 11-14 yrs	-0.005	0.008	-0.002
Boys 11-14 yrs	-0.002	0.006	-0.004
Girls 15-18 yrs	0.004	-0.001	-0.004
Boys 15-18 yrs	0.008	-0.007	-0.001
Young adult girls 19-24 yrs	0.009	0.032***	-0.042***
Young adult boys 19-24 yrs	0.008	0.005	-0.013
Women 25-64 yrs	0.037***	0.015*	-0.052***
Men 25-64 yrs	0.008	0.008	-0.015
Old women ≥ 65 yrs	0.062**	-0.021	-0.042**
Old men ≥ 65 yrs	0.037	-0.019	-0.017
South	-0.021	0.089***	-0.068*
Central	-0.026	0.098***	-0.072**
Urban	-0.074***	0.099***	-0.025

***The variable coefficient is significant at 1% level of significance.
** The variable coefficient is significant at 5% level of significance.
*The variable coefficient is significant at 10% level of significance.

Appendix 1: Description of the variables used in the models.

Variable	Description
Age	Age of the child
Age squared	Age squared
Female	Dummy equal to 1 for all female children
Biological child	Dummy equal to 1 for a child who is reported to be a biological child of the household head
Child employment	Dummy equal to 1 if the child is reported to be an employee, a family business worker or a house worker
Fuel wood collection time	Hours that a child spent on fuel wood collection the week preceding interviews
Water collection time	Hours that a child spent on water collection the week preceding interviews
Resource work time	Total hours that a child spent on fuel wood collection and water collection the week preceding interviews
High fuel wood median time area	Dummy equal to 1 if child lives in an enumeration area where the fuel wood median time > the total "population" median time of 2.0.
High water median time area	Dummy equal to 1 if child lives in an enumeration area where the water median time > the total "population" median time of 3.0
Resource scarcity area	An interaction of the fuel wood scarcity dummy (water median area) and the water scarcity dummy (high fuel wood median area)
District with moderate wood deficits	Dummy equal to 1 if child lives in a district that had fuel wood surpluses in 1985 but fuel wood deficits in 2000
District with severe wood deficits	Dummy equal to 1 if child lives in a district that had fuel wood deficits both in 1985 and 2000
Household poverty	Dummy equal to 1 if child lives in a household that is below the poverty line
Female headship	Dummy equal to 1 for a child who lives in a household whose head is reported to be female
Standard 4 head	Dummy equal to 1 for a child who lives in a household whose head completed up to first four years of primary school education
Standard 8 head	Dummy equal to 1 for a child who lives in a household whose head completed up to eight years of primary school education
Highly educated head	Dummy equal to 1 for a child who lives in a household whose head completed any level of secondary, high school, and university education
Infants	Total number of children below age one who live in the child's household
Child 1-5 yrs	Total number of children age 1 to 5 who live in the child's household
Girls 1-5 yrs	Total number of girls age 1 to 5 who live in the child's household
Boys 1-5 yrs	Total number of boys age 1 to 5 who live in the child's household
Child 6-10 yrs	Total number of children age 6 to 10 who live in the child's household
Girls 6-10 yrs	Total number of girls age 6 to 10 who live in the child's household
Boys 6-10 yrs	Total number of boys age 1 to 5 who live in the child's household
Child 11-14 yrs	Total number of children age 11 to 14 who live in the child's household
Girls 11-14 yrs	Total number of girls age 11 to 14 who live in the child's household
Boys 11-14 yrs	Total number of boys age 11 to 14 who live in the child's household
Child 15-18 yrs	Total number of children age 15 to 18 who live in the child's household
Girls 15-18 yrs	Total number of girls age 15 to 18 who live in the child's household

Variable	Description
Boys 15-18 yrs	Total number of girls age 15 to 18 who live in the child's household
Young adults 19-24 yrs	Total number of young adults age 19 to 24 who live in the child's household
Young adult girls 19-24 yrs	Total number of young women age 19 to 24 who live in the child's household
Young adult boys 19-24 yrs	Total number of young men age 19 to 24 who live in the child's household
Women 25-64 yrs	Total number of women age 25 to 64 who live in the child's household
Men 25-64 yrs	Total number of men age 25 to 64 who live in the child's household
Old women ≥ 65 yrs	Total number of old women age 65 and above who live in the child's household
Old men ≥ 65 yrs	Total number of old men age 65 and above who live in the child's household
South	Dummy equal to 1 for a child who lives in the southern region of Malawi
Central	Dummy equal to 1 for a child who lives in the central region of Malawi
Urban	Dummy equal to 1 for a child who lives in urban areas of Malawi (Blantyre city, Lilongwe city, Mzuzu city, and Municipality of Zomba)

Appendix 2: Fuel wood participation and water participation probit regressions with gender disaggregated household size variables.

	Fuel wood collection	Water collection
Variable	**Marginal effects**	**Marginal effects**
Constant	-0.258***	-0.037
Age	0.022***	0.048***
Age squared	-	-0.002***
Female	0.147***	0.138***
Biological child	0.045**	-0.024*
Child employment	0.049	0.131
High fuel wood median time area	0.183***	-
High water median time area	-	0.036***
District with moderate wood deficits	0.254***	-
District with severe wood deficits	0.108	-
Household poverty	0.051***	0.033***
Female headship	-0.016	0.026
Standard 4 head	0.005	0.021
Standard 8 head	0.068***	0.019
Highly educated head	-0.080***	-0.039**
Infants	0.006	-0.017
Girls 1-5 yrs	-0.071***	-0.027***
Boys 1-5 yrs	-0.058***	-0.040***
Girls 6-10 yrs	0.007	0.005
Boys 6-10 yrs	0.025**	0.002
Girls 11-14 yrs	-0.014	-0.006
Boys 11-14 yrs	-0.037***	-0.016**
Girls 15-18 yrs	-0.037**	-0.015
Boys 15-18 yrs	-0.026*	0.005
Young adult girls 19-24 yrs	-0.026	-0.044***
Young adult boys 19-24 yrs	-0.021	0.005
Women 25-64 yrs	0.001	-0.015
Men 25-64 yrs	-0.016	0.008
Old women ≥ 65 yrs	-0.018	0.045*
Old men ≥ 65 yrs	-0.012	-0.006
South region	-0.133**	-0.078***
Central region	-0.253***	-0.103***
Urban	-0.119***	-0.156***

***The variable coefficient is significant at 1% level of significance.
** The variable coefficient is significant at 5% level of significance.
*The variable coefficient is significant at 10% level of significance.

Appendix 3: Fuel wood and water collection hours' regression with gender disaggregated household size variables.

	Fuel wood collection hours	Water collection hours
Variable	**Coefficient**	**Coefficient**
Constant	4.582***	3.526***
Age	-0.503**	0.045
Age squared	0.032***	0.005
Female	0.590***	1.780***
Biological child	0.387**	0.024
High fuel wood median time area	1.497***	0.429
High water median time area	-	1.190***
District with moderate wood deficits	5.527***	-
District with severe wood deficits	5.528***	-
Poverty dummy	0.331**	0.021
Female headship	0.154	0.440
Standard 4 head	-0.247	-0.013
Standard 8 head	-0.067	-0.226
Highly educated head	-0.484**	-0.364
Infants	0.187	0.243
Girls 1-5 yrs	-0.402***	-0.070
Boys 1-5 yrs	-0.111	-0.317***
Girls 6-10 yrs	0.044	0.143
Boys 6-10 yrs	-0.133	0.057
Girls 11-14 yrs	0.055	-0.053
Boys 11-14 yrs	-0.252**	-0.241*
Girls 15-18 yrs	-0.153	-0.005
Boys 15-18 yrs	-0.131	-0.084
Young adult girls 19-24 yrs	-0.640***	-0.623***
Young adult boys 19-24 yrs	0.165	0.036
Women 25-64 yrs	-0.397**	-0.579***
Men 25-64 yrs	0.078	0.048
Old women ≥ 65 yrs	-0.433	0.001
Old men ≥ 65 yrs	-0.306	-
South region	-6.170***	-0.680**
Central region	-7.380***	-2.340***
Urban	-0.477**	-1.421***

***The variable coefficient is significant at 1% level of significance.
** The variable coefficient is significant at 5% level of significance.
*The variable coefficient is significant at 10% level of significance.

References

1. Andvig, J.C. "Family-controlled Child Labor in sub-Saharan Africa – A Survey of Research." Norwegian Institute of International Affairs Working Paper, no. 612. Norway, December 2000.
2. Barwell, I. "Transport and the Village: Findings from African Village Level Travel and Transport Surveys and Related Studies." World Bank Discussion Paper, no. 344. The World Bank, Washington, D.C., 1996.
3. Becker, G.S. "Theory of Allocation of Time." *Economic Journal* 75 (1965):493-517.
4. Becker, G.S. *A Treatise on the Family*. Cambridge, USA: Harvard University Press, 1993.
5. Bryceson, D.F., and J. Howe. "Rural Household Transport in Africa: Reducing the Burden on Women." *World Development* 21, no. 11 (1993):1715-28.
6. Cooke, P.A. "Changes in Intrahousehold Labor Allocation to Environmental Goods Collection: A Case Study from Rural Nepal, 1982 and 1997." Food Consumption and Nutrition Division Discussion (FCND) Paper, no. 87. International Food Policy Research Institute, Washington, D.C., 2000.
7. Edmonds, G.A., M. Nyanda, and F. Nankhuni. "Pilot Integrated Rural Transport Project: Thematic Review." International Labour Organization (ILO), IT Transport Ltd, and Ministry of Local Government, Lilongwe, Malawi, October, 1995.
8. Hudak, A., and C.A. Wessman. "Deforestation in Mwanza District, Malawi from 1981 to 1992, as Determined from Landsat MSS Imagery." *Applied Geography* 20 (2000):155-175.
9. Lloyd, B.C., C.E. Kaufman, and P. Hewett. "The Spread of Primary Schooling in sub-Saharan Africa: Implications for Fertility Change." Policy Research Division Working Paper, no. 127, Population Council, New York, 1999.
10. Malmberg, C. C. "Case Study on the role of Women in Rural transport: Access of Women to Domestic Facilities." Sub-Saharan Africa Transport Program (SSATP) Working Paper, no. 11. Environmentally Sustainable Development Division, The World Bank, Washington, D.C., 1994.
11. Pilot Integrated Rural Transport Project (PIRTP). "Consolidated Pilot Areas Data Report." Ministry of Local Government, Lilongwe, Malawi, 1994.

12. Rivers, D., and Q.H. Vuong. "Limited Information Estimators and Exogeneity Tests for Simultaneous Probit Models." *Journal of Econometrics*, 39 (1988):347-86.
13. National Economic Council (NEC). "Poverty Profile of the Malawi Integrated Household Survey, 1997-98." Capital City, Lilongwe, Malawi, 2000. (Also available on the Malawi National Statistics Office web-page *www.nso.malawi.net*).
14. National Economic Council (NEC). "Relative Poverty Profile of the Malawi Integrated Household Survey, 1997-98." Capital City, Lilongwe, Malawi, 2001. (Also available on the Malawi National Statistics Office web-page *www.nso.malawi.net*) .
15. National Statistics Office (NSO). "1998 Population and Housing Census". NSO, Zomba, Malawi. December 2000. Accessed on *www.nso.malawi.net* on July 18, 2002.
16. National Statistics Office (NSO). "2000 Demographic and Health Survey." NSO, Zomba, Malawi. September 2001. Accessed on *www.nso.malawi.net* on November 13, 2001.
17. Population Reference Bureau (PRB). "2002 Women of Our World Data Sheet on Education." PRB, Washington D.C., 2002. Accessed on *http://www.prb.org/Template.cfm?Section=PRB&template=/Content/ContentGroups/Datasheets/Women_2002_Education_Africa.htm* on April 10, 2002.
18. Population Reference Bureau (PRB). "Making the Link: Population Health Environment Wall Chart" prepared by Nash, G. N. and R. De Souza. PRB, Washington D.C., 2002.
19. United Nations Integrated Regional Information Networks (UN IRIN). "Girls Face Obstacles to Education." News article posted on allAfrica.com on July 9 2002. Accessed on *http://www.irinnews.org/report.asp?ReportID=28723&SelectRegion=Southern_Africa&SelectCountry=MALAWI* on August 8, 2002.
20. United Nations, Food and Agriculture Organization (FAO). "Forest Resources Assessment 2000 Global Tables: Changes in Forest Cover 1990-2000 Table." accessed on web page *http://www.fao.org/forestry/fo/fra/index tables* on November 13, 2001.
21. Wooldridge, J.M. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, USA: The MIT Press, 2002.
22. World Bank. "World Bank Development Indicators 2002" accessed on web-page *http://www.worldbank.org/data/wdi2002/tables/table1-1.pdf* on August 12, 2002.