

The effect of Water Fetching and Firewood Collection on Rural Non-agricultural Employment of Ethiopia

Abdulaziz Abdulsemed Mosa

Agricultural and Food Policy Group (420a), Universität Hohenheim, PO box 70593 Stuttgart Germany

E-mail: Abdulaziz.Mosa@uni-hohenheim.de

Abstract

Water fetching and firewood collection activities are part of the daily routine of many households in rural Ethiopia. The majority of Ethiopian households have no access to drinking water and household energy infrastructure. Households travel long distances and spent large amounts of time every day to collect water and firewood. Furthermore, water fetchers and firewood collectors are usually agricultural and non-agricultural laborers in Ethiopia. This would affect the labor hours allocated to agricultural and non-agricultural activities and hence the production and productivity of these activities are enormously affected. The objective of this study is to investigate the impact of water fetching and firewood collection on non-agricultural participation of rural households of Ethiopia. The main dataset for this study is sourced from Ethiopian rural socio-economic survey (ERSS). ERSS was conducted in 2011-2012 by Ethiopian Central Statistical Agency (CSA) in collaboration with the World Bank. The survey covers 3,969 sampled households living in rural and small towns of the country. The study find out that rural household of Ethiopia allocated large amount of labor hours for water fetching and firewood collection. On average rural households spent 0.64 hours and 0.58 hours per day for water fetching and firewood collection respectively. On the other hand, urban household spent 0.15 hours and 0.1 hours for water fetching and firewood collection respectively. Female members of the household spent larger amount time for both water fetching and firewood collection relative to male. The study also find out that labor spent for water fetching and firewood collection activity is negatively and significantly affects non-agricultural employment. Households who spent more labor hours for water fetching have 19.8% less likely to engage into non-agricultural activities relative to other household who spent less time for water fetching. On the other hand, households who spent more labor hours for firewood collection have 13.9% less likely to engage into non-agricultural activities relative to household who spent less time for the same activities.

1. Introduction

Household activity incorporates all goods and services produced and consumed within the household. These commodities produced mainly for satisfying households own consumption and can be partly provided to the market. According to the 1993 and 2008 the international standard system of national accounts, household activities can be categorized into: 1) domestic and personal services and 2) productive activities. Domestic and personal services include cleaning, decoration and maintenance of household dwelling, servicing and repair of household durables or other goods, preparing and serving meals, care of children, sick and elderly people. Enormous amount of labor is devoted to domestic and personal services. However, these services are excluded from production boundaries by the system of national accounts and hence these household activities also not counted in the calculation of Gross Domestic Product (GDP) (System of National Accounts, 1993, 2008).

On the other hand, a broad range of household productive activities include a) agricultural activities (such as cultivation of crops), firewood collection, forestry, hunting and fishing, b) the production of other primary products such as mining, salt and water fetching c) the processing of agricultural products such as grain milling, preservation of fruits by drying, the production of dairy products, production of mat or basket d) other processing activities such as weaving cloth, dress making and tailoring, footwear making and the production of pottery. All these household activities are included in the production boundary irrespective of whether the commodities are consumed at home or supplied to the market (System of National Accounts, 1993,2008). Empirical literature interchangeably makes use of the following terminologies to describe household activities. These terminologies include non-market activities, household reproduction, social reproduction, reproduction sector, unpaid work and home activities and domestic work (Chadeau,1992; Fontana & Wood, 2000; Fontana,2001,2002, 2004; Latigo & Neijwa,2005;Fofana, Cockburn, & Decaluwé, 2005; Fofana et al., 2006).

Households allocate time to market activities, non-market activities and personal care. Market sectors include all income generating activities such as agriculture, manufacturing and services. Non-market sectors include home activities (such as cooking and cleaning, care of children and elderly, fetching water and collecting firewood) and leisure. The focus of this study is water fetching and firewood collection activities from among many household activities which are considered as productive by the system of national accounts. Water fetching and firewood collections activities are the routine task of households in developing countries. Access to water and household energy are among the development challenges of developing countries. The majority of Ethiopian households are unable to access drinking water in their neighborhood. It is only 12% of Ethiopian populations have access to piped water (WHO and UNICEF, 2015). Households often spend several hours on a daily basis for collecting drinking water from the remote sources. For instance, 16% and 34% of urban and rural household respectively on average travel between 1 to 2 hours per trip for water fetching (Central Statistical Agency of Ethiopia, 2014)

The majority of Ethiopia populations have also limited access to electricity. More than 75% of Ethiopian populations live without access to electricity. Nearly all rural households and 80% of urban households of Ethiopia depend on biomass fuel for cooking (OECD/IEA, 2014). Most households use less energy efficient traditional cooking stove. Additionally, due to underdeveloped road infrastructure and deforestation, households spend several hours for firewood collection. For example, 22% and 36% of urban and rural households spend more than 2 hours per trip to collect firewood respectively (Central Statistical Agency of Ethiopia, 2014). Furthermore, water fetchers and firewood collectors are usually agricultural and non-agricultural laborers in Ethiopia. This would affect production and productivity of the agricultural and non-agricultural activities. The main objective of this study is to investigate the effect of water fetching and firewood collection on non-agricultural participation of rural household of Ethiopia. This study also provides the general review of time spent for water fetching and firewood collection in developing countries and explores time use pattern for these activities in Ethiopia.

2. An overview of water fetching and firewood collection in developing countries

2.1 Access to drinking water supply and water fetching time

One of the targets of the United Nation Millennium Development Goal (UNMDG) was to halve the proportion of people without sustainable access to improved drinking-water by 2015 using 1990 as the base period. Specifically, the MDG target was to attain 88% coverage by 2015 and it was already achieved in 2010. Currently, global coverage of improved water supply rose from 76% in 1990 to 91% in 2015. In other words, nowadays 91 percent of the world population is able to access improved drinking water supply. However, large numbers of people remain without access to basic levels of drinking water supply. These populations are located in Sub-Saharan Africa, Northern Africa, Caucasus, Oceania and Central Asia (see **Figure 1**). Furthermore, disparities persist in the distribution of improved drinking water supply between rural and urban areas. For instance, 96% of the world's urban population has access to improved drinking water supply as compared to 84% of rural global population (WHO and UNICEF, 2015).

The main sources of drinking water for the majority of populations in developing countries are river, well/spring, lakes and irrigation canal (WHO and UNICEF, 2015). However, these sources of water are located far from the household. Therefore, household walks a long distance or spent a large amount of time daily to access water. Empirical evidence shows that women and children on average spent 200 million hours per day for the purpose of collecting water globally. Children and girls on average walk six kilometers every day for water fetching in Asia and Africa. Access to water is a serious challenge for most Sub-Saharan African countries. It is estimated that annually 40 billion working hours are spent for water fetching activities in Sub-Saharan Africa. Therefore, large amount of potential working time that can potentially be used for income generating activities is lost to water fetching activities (Wilbur, Lamb, Willenborg, & Sridharan, 2016). A large proportion of population in several African countries spent significant amount of time per day for water collection from the distant source (See **Figure 2**). More than a quarter of the population in several African countries spent more than 30 minutes per round trip for collecting water from the distant source.

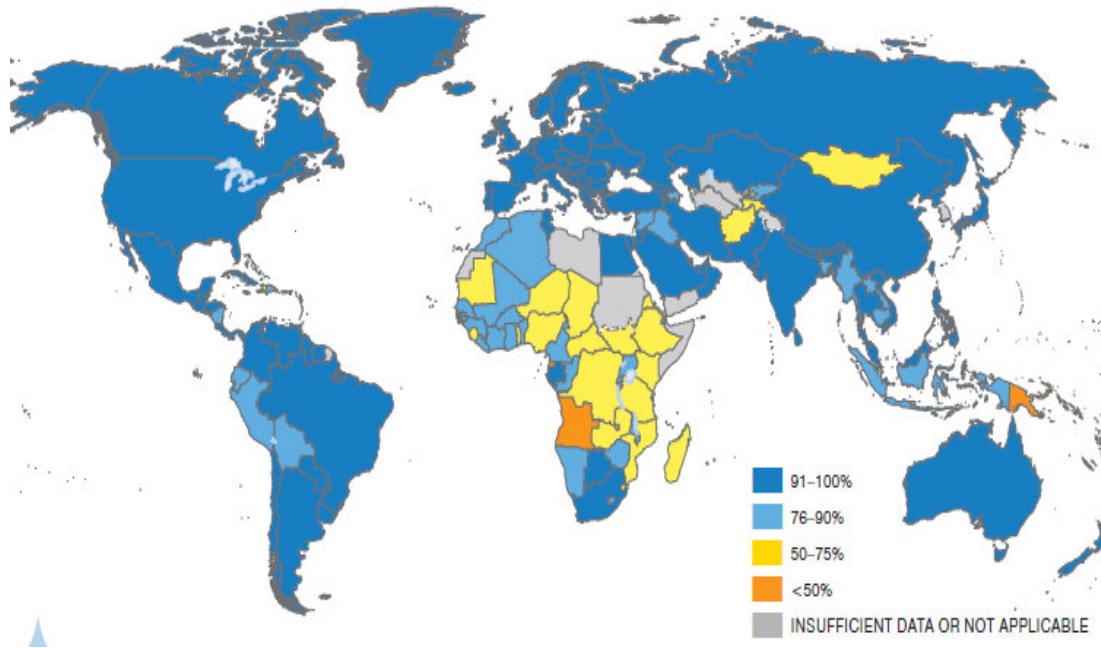


Figure 1: Proportion of population with access to improved drinking water supply

Source: WHO and UNICEF (2015)

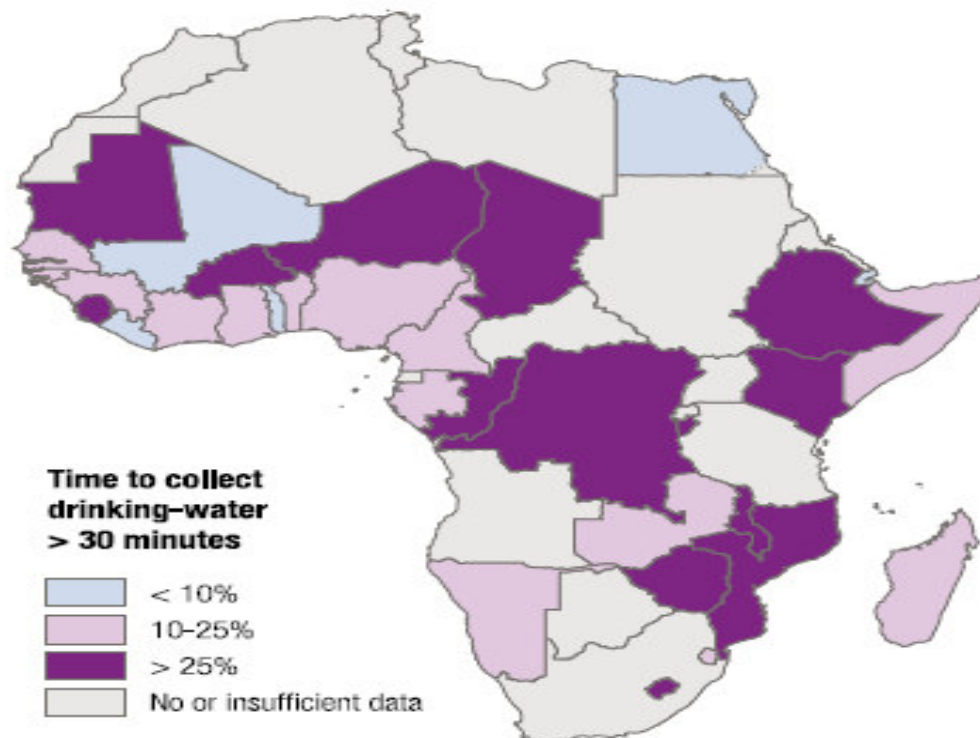


Figure 2 : Proportions of population that spent more than 30 minutes per round trip of water fetching

Source: WHO and UNICEF (2015)

2.2 Firewood collection

More than half of the populations of developing countries depend on traditional biomass for satisfying their energy demand. Furthermore, 68% of the African population relies on traditional biomass energy for cooking. Traditional biomass includes wood, tree leaves, charcoal, animal dung and crop residues (OECD/IEA, 2015). Firewood is the main source of fuel for the majority of households in developing countries. However, households travel long distances or spent large amounts of time per day to collect firewood. **Figure 3** depicts the average time spent for firewood collection per household per day in selected African countries. The average daily time spent per household for firewood collection ranges from 0.8 hours to 5 hours in Zimbabwe and Serra Leone respectively. On the other hand, household time spent for firewood collection on regional average is 2.1 hours.

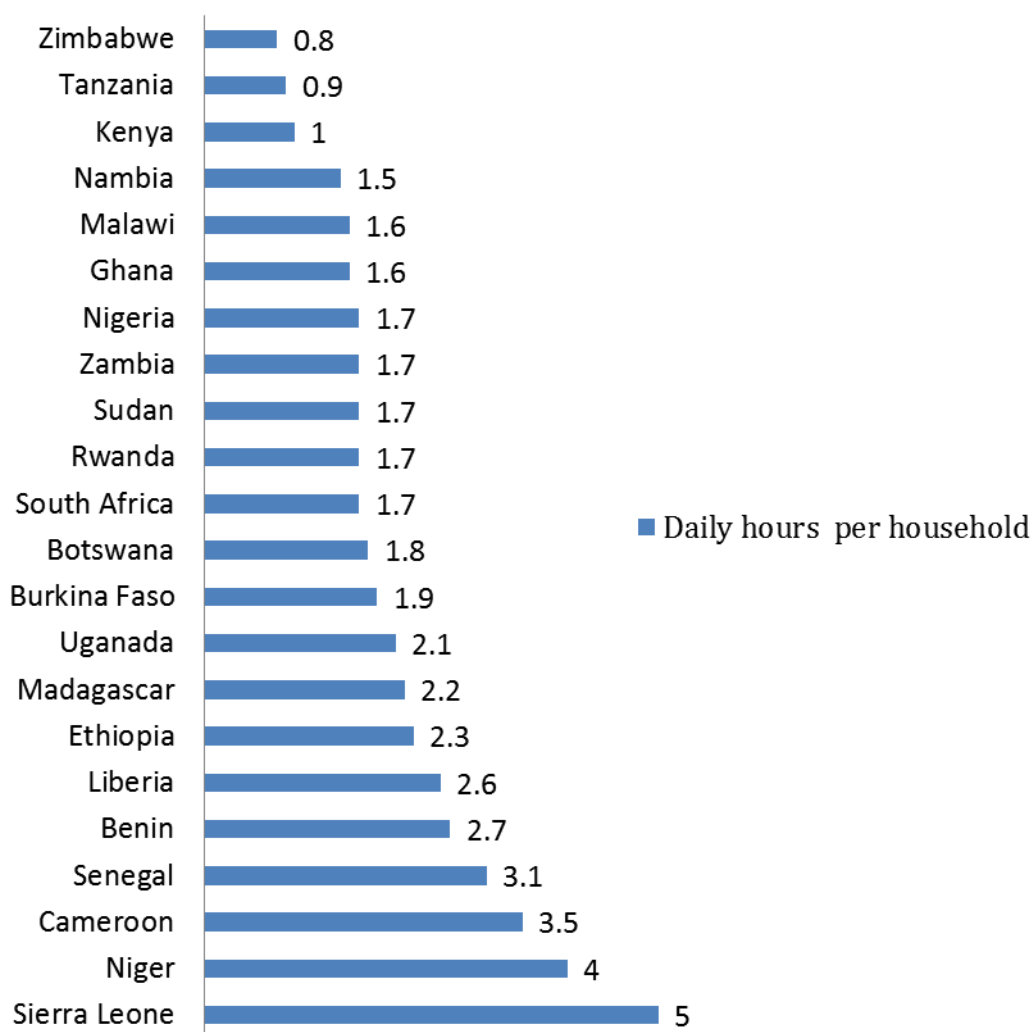


Figure 3: Time spent for firewood collection in selected African countries

Source: World Bank (2014)

3. Household time use pattern, water fetching and firewood collection activities in Ethiopia

3.1 Household time use pattern in Ethiopia

Ethiopian household allocated their time across a range of different activities on a daily basis. The major activities include: System of National Account (SNA) activities (e.g. agricultural activities, trade), non-SNA activities (e.g. cooking, child caring), learning and non-productive activities. As can be observed in Table 1, there is a significant differences between males and females in the time allocated to SNA and non-SNA activities

which indicates gender division of labor in Ethiopia. Males on average spent larger amount of time (5 hours) on SNA activities than female (3.3 hours). On the other hand, female spent a bigger time on non-SNA activities (4.85 hours) than male counterparts (2.08 hours). This indicates female allocates most of their time for non-income generating activities. Some activities can be done simultaneously. For instance, women can take care of children while doing some other household activities but Table 1 indicates household daily time allocation by assuming that in a given time an individual exclusively spent on certain activities. Therefore, average daily time allocated to different activities add up to 24 hours.

Table 1: Average time per day per person (in hours) spent across activities

Daily activities	Male	Female
1) SNA activities/ work related activities	5	3.33
Work for establishment	0.88	0.4
Work for primary production	2.97	1.92
Work for household non-primary production	0.15	0.42
Work for construction activities	0.3	0.05
Work for household providing service for income	0.7	0.55
2) Non-SNA activities	2.08	4.85
Provide unpaid service for domestic use	1.45	3.85
Provide unpaid care giving service	0.13	0.78
Unpaid community service	0.5	0.22
3) Learning	1.17	0.97
4) Non-productive activities	15.75	14.85
Leisure	2.33	1.65
Personal care and maintenance including sleeping	13.42	13.2
Total	24	24

Source: Central Statistical Agency of Ethiopia (2014)

3.2 Leisure activities in Ethiopia

The main leisure activities of Ethiopian household include; socialization and community participation, attending/visiting cultural entertainment and sport events/venue, hobbies /games, indoor and outdoor sports and mass media. The average time spent per day for the different leisure activities are depicted on

Table 2. The average time allocated to all leisure activities by persons residing urban and rural areas are 2.57 hours and 1.82 hours per day per person in rural and urban areas of the country respectively. In rural areas, socialization and culture are the usual leisure activities (69.4% of leisure time) where as for urban residents, mass media absorbs most of their leisure time (42 % of leisure time).

Table 2: Average time per day per person (in hours) spent for different leisure activities

Leisure activities	Rural	Urban
Socialization and culture	1.25	0.9
Attending/visiting cultural places/events	0.02	0.12
Hobbies /games	0.38	0.33
Indoor and outdoor sports	0.07	0.12
Mass media	0.1	1.1
Total leisure time	1.82	2.57

Source: Central Statistical Agency of Ethiopia (2014)

3.3 Water fetching activity in Ethiopia

Most rural households of Ethiopia have inadequate access to drinking water facility. Water fetching activity is usually done by youths such as boys and girls or adult women. Usually rural household collect water for own consumption but in urban area water can also be sold in the market.

3.3.1 Source of drinking water supply

The main sources of drinking water supply are tap, protected or unprotected well/spring, river/lake/pond and rain water during rainy seasons. Table 3 depicts the proportion of household by the source of drinking water supply in rural and small town. For example, the main source of drinking water for rural household are protected well/spring (30.2%), river/lake/pond (23.7%) and unprotected well/spring (23.01%). On the other hand, the main sources of drinking water for household in small town are taps such as private tap, shared tap and communal tap (48.5%) and water from kiosk/retailers (29%).

Table 3: Proportion of household by source of drinking water supply (% of household)

Source of drinking water	Rural	Small town
Tap inside the house	0.26	2.66
Private tap in the compound	0.56	14.52
Shared tap in compound	1.23	14.52
Communal tap outside compound	8.82	16.77
Water from kiosk/retailer	8.12	29.24
Protected well / spring	30.21	9.81
Unprotected well / spring	23.05	4.29
River / lake / pond	23.69	5.32
Rain water	1.99	1.64
Other	2.07	1.23
Total	100	100

Source: Computed based on CSA and WB (2013)

3.3.2 Water fetching time

In most parts of the country, water sources are not located in the nearest vicinity of the household. Households spent large amount of time per day for collecting water. For instance, in rural area male on average spent 0.12 hours and female spent 0.52 hours per day for water fetching (see Table 4). Gender disparity persists for

collecting water in rural part of Ethiopia; female spent bigger time than male. On the other hand, in urban location on average male spent 0.05 hours and female spent 0.1 hours for water fetching activity.

Table 4: Average time spent per day (in hours) for water fetching activities

Location	Male	Female	Total
Rural	0.12	0.52	0.64
Urban	0.05	0.1	0.15

Source: Central Statistical Agency of Ethiopia(2014)

3.4 Firewood collection activities in Ethiopia

Firewood collection is a common practice in Ethiopia; it is one of the daily routine activities of rural households in the country. Firewood is used for cooking food and lighting for the household. In addition to firewood, households also use charcoal, electricity, animal dung cakes and crop residues for satisfying energy demand. Firewood can be collect by the member of the households or it can be bought from the market. Most of the firewood collected is used for own consumption. However, firewood can be sold in the market both in rural and urban areas of Ethiopia.

3.4.1 Source of cooking fuel

The main sources of cooking fuel are firewood, charcoal, dung/manure, kerosene, butane/gas, electricity and solar energy. Table 5 describes the main source of cooking fuel. Collected or purchased firewood is the main source of fuel for household in rural (88.8%) as well as small town (79.6 %).

Table 5: Source of cooking fuel (% of household)

Source of cooking fuel	Rural	Small town
Collecting firewood	84.48	27.2
Purchase firewood	4.36	52.35
Charcoal	0.44	11.45
Crop residue / leaves	3.37	1.43
Dung / manure	5.42	1.43
Other(electricity, solar energy, kerosene, Butane/gas)	1.94	6.13
Total	100	100

Source: Computed based on CSA and WB (2013)

3.4.2 Firewood collection time

Firewood is predominantly sold by poor women and girls; they carry firewood with their back and transport it to small rural towns and/or big urban market. It can also be transported by pack animals such as donkey, camels and horse. It is a norm to collect firewood from nearby forest areas. However, forest areas are not easily accessible in the nearest vicinity of the household due to deforestation. Members of the household are forced to spent large amount of time for collecting firewood. For example, male on average spent 0.2 hours and female spent 0.38 hours per day for firewood collection in rural Ethiopia. On the other hand, in urban areas both male and female on average spent 0.05 hours per day for fire wood collection activities (see Table 6).

Table 6: Average time spent per day (in hours) for firewood collection

Location	Male	Female	Total
Rural	0.2	0.38	0.58
Urban	0.05	0.05	0.1

Source: Central Statistical Agency of Ethiopia (2014)

4. The effect of water fetching and firewood collection on non-agricultural employment of Ethiopia

4.1 Introduction

Water fetching and firewood collection activities are among the household activities that are part of the daily routine of many households in rural Ethiopia. The majority of Ethiopian households have limited access to drinking water and household energy infrastructure. Ethiopian household spent large amount of time for collecting water and firewood. Furthermore, water fetchers and firewood collectors are regularly agricultural and non-agricultural laborers in Ethiopia. Water fetching and firewood collection affect production and productivity of marketed sectors including agricultural activities and non-agricultural activities. In this study, the effect of water fetching and firewood collection on non-agricultural employment of rural household of Ethiopia is estimated using household survey collected from rural and small towns of Ethiopia.

4.2 Description of the dataset

The dataset for estimating the effect of water fetching and firewood collection on non-agricultural employment of Ethiopia was sourced from Ethiopian Rural Socio-Economic Survey (ERSS). ERSS was conducted in 2011-2012 by Ethiopian Central Statistical Agency (CSA) in collaboration with World Bank. This survey covers 3,969 households living in rural and small towns of the country. All regions of Ethiopia are covered by this survey and hence these sampled household are represent rural and small town of Ethiopia. The dataset incorporates household's socio-economic characteristic including education, health status, asset ownership, time allocation, food security, non-agricultural employment, etc (CSA and WB, 2013).

4.3 Model specification and estimation

4.3.1 Econometric model specification

The bivariate probit model for the household's non-agricultural labor supply decision specified as follows:

$$P_r (P_i=1) = P_r (W_m > W_r) = X_i B + \epsilon$$

Where P_r is the probability to diversify into non-agricultural activities, P_i is household participation decisions, $P_i=1$ if the household diversify into non-agricultural activities and $P_i=0$ if the household is not diversified into non-agricultural activities. W_m is the wage from non-agricultural activities, W_r is the reservation wage. ϵ is the random disturbance term of the model. X is a vector of exogenous variables that affect household non-agricultural participation decisions. The summary statistics of the main variables are depicted in Table 7.

Table 7: Summary statistics of some of the main variables

Variables	Mean	Standard deviation	Minimum	Maximum
Time spent on non-agricultural employment in hours	5.07	11.46	0	98
The share of income from non-agricultural enterprise	2.6	1.06	1	5
Time spent on agricultural activities in hours	11.3	15.29	0	98
Time spent on water fetching activities in hours	0.39	0.99	0	40
Time spent on firewood collection in hours	0.41	1.12	0	50
Household size	4.7	2.41	1	15
Age of the household head	47.5	16.84	15	100

Source: Own computation from CSA and WB (2013)

4.3.2 Estimation of econometric model

The binary probit model specified above is estimated. The dependent variable is the probability of non-agricultural participation decision of rural household which attains the value of '1' if the household diversifies into non-agricultural activities and '0' otherwise. The independent variables are factors that influence non-agricultural participation decision of rural households. In this study, the following determinants of rural non-agricultural activities of Ethiopia are analyzed and discussed. These factors include time spent on agricultural activities, time spent on water fetching activities, time spent on firewood collection, access to credit and

possession of non-agricultural equipment (such as sewing machine, weaving equipment, hand drawn cart and animal drawn cart). The quantitatively estimated empirical results are reported in Table 8.

Table 8: Determinants of non-agricultural employment

Variables	Coefficients	P>/z/	Marginal effect
Water fetching time	-0.1981619**	0.000	-0.0680578
Firewood collection time	-0.1395381**	0.000	-0.0479237
Time spent for agricultural activities	-0.0236753**	0.000	-0.0081312
Access to credit	0.2403448**	0.000	0.0825453
Region	0.0700481**	0.000	0.0240577
Ownership of non-agricultural asset	0.0229349**	0.029	0.0078769

*Pseudo R2 = 0.1191

**statistically significant at 5 % level

Source: Own computation based on CSA and WB (2013)

4.3.3 Discussion of results

The discussions of empirical results are presented in the following paragraphs:

A. Time spent for water fetching

Rural household of Ethiopia usually spent enormous amount of labor hours in water fetching activities. In order to investigate the effect of water fetching time on household's non-agricultural participation, the daily labor hours spent on this activity is incorporated. The labor hours spent for water fetching as expected is negatively and significantly affect non-agricultural employment. Households who spent more labor hours in water fetching activity have less probability to diversify into non-agricultural activities. In other words, households who spent more labor hours in water fetching have 19.8% less likely to engage into non-agricultural activities relative to household who spent less time for fetching water.

B. Time spent for firewood collection

Rural households also spent large amount of labor time for collecting firewood. Labor hours spent on firewood collection has negatively and significantly influencing non-agricultural employment. Households that spent larger share of their labor hours for collecting firewood would have less probability to engage into non-agricultural activities. In other words, households who spent more labor hours for firewood collection have 13.9% less likely to engage into non-agricultural activities relative to household who spent less time for collecting firewood.

C. Time spent for agricultural activities

Rural households usually spent a larger proportion of labor hours for agricultural activities which is the main stay of the rural household of Ethiopia. If households spent too much labor time in agricultural activities, there would be less labor that can be employed in non-agricultural activity. The estimation results indicate labor hours allocated to agricultural activities are negatively and significantly affect non-agricultural employment. In other words, households who spent more labor hours for agricultural activities have 2.4% less likely to engage into non-agricultural activities relative to household who spent less time on agriculture.

D. Access to credit

Diversification into rural non-agricultural activities is also constrained by credit facility. Access to credit service is the dummy variable which attains the value of '1' if the household has access to credit facility and '0' otherwise. The estimation results indicate that access to credit is positively and significantly affect the household's non-agricultural employment. Households with access to credit facilities are 24% more likely to

engage into non-agricultural activities as compared to household with no access to credit facility. In other words, financial capital is a critical bottleneck which inhibits rural household of Ethiopia to diversify into non-agricultural activities.

E. Ownership of non-agricultural asset

Non-agricultural assets are equipment that enable rural household to work in non-agricultural activity. Some of the non-agricultural assets are hand driven carts, animal driven cart, weaving and sewing machine. The dummy variable is generated to capture non-agricultural equipment in the model. Specifically, if the household has any of these asset it is assigned a value of "1" and "0" otherwise. The estimation results indicate that household who owns non-agricultural equipment has 2.24% more likely to engage into non-agricultural activity relative to households who do not own these equipments and it is also statistically significant.

5. Summary and conclusion

Household walks a long distance or spent a large amount of time per day for accessing drinking water and firewood in most developing regions of the world such as Asia and Sub-Saharan African countries. For instance, more than a quarter of the population in several African countries spent more than 30 minutes for collecting water from the distant source. Furthermore, the African average time spent for firewood collection is 2.1 hours per household per day. Similarly, water sources are not located in the nearest vicinity of the household in most parts of Ethiopia. Households spent large amount of time per day for collecting water. For instance, in rural area male on average spent 0.12 hours and female spent 0.52 hours per day for water fetching. Ethiopian household also spent large amount of time for collecting firewood. For example, male on average spent 0.2 hours and female spent 0.38 hours per day for firewood collection in rural Ethiopia.

The effect of water fetching and firewood collection time on non-agricultural employment is estimated using household survey collected from rural and small town of Ethiopia. Non-agricultural employment is also influenced by other factors such as time spent on agricultural activities, household size and access to credit. The estimation result indicates that, the labor hours spent for water fetching activity is negatively and significantly affects non-agricultural employment. Households who spent more labor hours in water fetching activity have less probability to diversify into non-agricultural activities. Furthermore, labor hours spent for firewood collection has also negatively and significantly influencing non-agricultural employment. Households that spent larger share of their labor for collecting firewood would have less probability to engage into non-agricultural activities. Therefore, non-agricultural employment can be promoted by reducing time spent for water fetching and firewood collection. Improved access to drinking water supply and household energy saving technology (for example, improved stove) is potentially reduce water fetching and firewood collection time. Studying the effect of improved access to water supply and household energy saving technology on rural non-agricultural employment is an interesting research topic to explore in the future.

6. Reference

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