WAHARA - Report Series

Farm household agro-socio-economic survey in Ethiopia - analysis report

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Date: 28-04-2015

Mekelle University

MEKELLE - Ethiopia

Report number 26

Series: Scientific Reports

This report was written in the framework of the WAHARA project – www.wahara.eu

WP1 Potential of water harvesting, Task 1.4

Farm household agro-socio-economic survey in Ethiopia;

analysis report

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Introduction

Objective within the project

This document presents an outline of the main agro-socio-economic characteristics of the farm households in the **study site of WAHARA project in Ethiopia**. This outline is based on the outcome of the farm household's survey. The main objective of this survey was to come up with statistical and spatial based analyses of biophysical and socio-economic factors that characterise livelihood strategies, natural resources and land management practices.

Executive summary

Water harvesting and sustainable irrigation development are the focal points of development strategy for reaching out drinking water, agricultural, livestock and industry development goals of the Growth and Transformation Plan (GTP) of the government of Ethiopia. Following the national GTP framework, the GTP of the regional government of Tigray emphasizes integrated watershed management as a principal strategy of not only conserving the environment but also enhancing soil fertility and water availability so as to increase agricultural production and productivity, and hence ensure food security at household levels.
This study assessed the agro-socio-economic characteristics of the farm households in the WAHARA project site in Tigray region of northern Ethiopia. The assessment was done in three selected Tabias using a sample of 300 households to make statistical and spatial based analyses of biophysical and socio-economic factors that characterise livelihood strategies, natural resources and land management practices.

The farm households in the study area depend heavily on agriculture for their livelihood. More than 60% of their income is generated from agriculture. Agriculture, which is mainly rainfed, is highly volatile to rainfall variability. This coupled with small land holding is a big threat to the income of households and hence to their livelihood. For this, the regional government has long time ago designed and implemented conservation based agricultural strategies. Integrated water shed management, and soil and water conservation are the primary focuses to improve soil fertility and water availability. Wide ranges of water harvesting techniques (WHT) have been implemented in Tigray region in general and in the study area in particular.

WHT in the study areas was found to be important both in terms of harvesting enough water needed to meet both the domestic and the irrigation needs. A significant number of farmers in the study areas started to obtain higher yields after they adopted the technologies. According to the farmers assessment, agricultural production has increased by about 77% after introduction of WHT. More than 90 per cent of the sample respondents confirmed that there is gradual improvement in soil fertility and water availability as a result of the continuous work in WHT in the study area.

1. PART I: SAMPLING METHOD AND SURVEY CONDUCTING

1.1. Short introduction to the case study

Ethiopia is the second most populous country in sub-Saharan Africa (SSA) with a population of more than 80 million. Agriculture is the main economic stay which employs 80% of the labour force and accounts for 50% of the GDP. Agriculture is heavily reliant on rainfall and productivity and production are strongly influenced by climatic and hydrological variability that are reflected as dry spells, droughts and floods.

To increase agricultural productivity and production, improving economic incentives and designing conducive organization policy and institutional environment is important. Water harvesting and expansion of irrigation activities is one means by which agricultural production can be increased to meet the growing food demands in Ethiopia. In many drought prone countries, including Ethiopia, there has been an optimistic view regarding water harvesting as a strategy to sustain agricultural production and insure food security. In such countries, the key constraint on further increase in agricultural production is the scarcity of water. Therefore, national and regional planners are strongly attracted to water harvesting as a means of supporting future food strategies.

In line with this, the government of the Federal Democratic Republic of Ethiopian (FDRE) has taken a number of strategic measures to increase agricultural productivity in an effort to fight poverty and enhance food security. In the last decade, small-scale irrigation and water harvesting are central to Ethiopia's new policy and strategy on agricultural and rural development. A separate Ministry of Water, Irrigation and Energy has been established and the government has embarked on wide range of water development efforts throughout the country.

In the subsequent strategies the government gave emphasis to natural resources management, water harvesting and irrigation development. The National Food Security Strategy adopted in 1996 and 2002 envisaged implementation of water harvesting and cost effective irrigation schemes in drought prone and densely populated areas (FDRE, 1996; FDRE 2002). The Ethiopian Interim Poverty Reduction Strategy Paper (2000/01- 2002/03) emphasized the need for agricultural growth in general, and water harvesting and irrigation development as the sub-part of the sector in order to reduce the level of poverty and improve food security situation of the country. As a follow up of the poverty reduction strategy papers, the

ambitious Growth and Transformation Plan (GTP) puts expansion of water harvesting schemes and irrigation high on the agenda and for the subsequent years it is considered the main engine for poverty reduction.

The Tigray National Regional State (where the WAHARA project is located) is one of the environmentally vulnerable areas in Ethiopia where poverty and natural resource degradation are intertwined. The predominant livelihood strategy for the majority of the population in Tigray is small-scale mixed rainfed farming system comprising cereal and livestock production. Rainfall is highly variable spatially and temporally in the region. Because of large differences in rainfall distribution between years and within years coupled with short rainy seasons, rainfed agriculture is very susceptible to water shortage. To alleviate the moisture stress and enhance agricultural production, WHT has been one of the core interventions by the government and NGOs in the region. With a technical and financial support from the government and NGOs, and labour contribution by the local community, massive conservation activities have been undertaken in the region for the last 20 or more years. There is a widely held consensus that the continuous integrated watershed management activities and the wide varieties of water harvesting technologies implemented in the region are enhancing soil fertility and water availability, which in turn is increasing agricultural productivity and production.

This document presents the main agro-socio-economic characteristics of the farm households in the WAHARA project area, Tigray region, Ethiopian. This outline is based on the outcome of the farm household's survey conducted from 21-28 August 2012 on three selected Tabias in northern part of Ethiopia in Tigray regional state on a total population of 300 households. The objectives of this task were to come up with statistical and spatial based analyses of biophysical and socio-economic factors that characterise livelihood strategies, natural resources and land management practices.

1.2. Sampling method

The study was conducted in three Tabias[1] of woreda Kilte Awlaelo to represent the three watersheds in the area namely *Genfel, Suluh and Agula.* Accordingly, Tabia *Tsaedanaele* is selected to represent the Suluh Watershed, Tabia *Genfel* is selected to represent the Genfel watershed and Tabia *Mesanu* is selected to represent the *Agula* watershed.

[1] Tabia is the lowest administration unit below woreda in the present day Tigray

After the selection of the Tabias, representative households for the socio-economic and bio-physical survey from each of the three Tabias were selected. Simple random sampling was followed to select a total sample of 300 households. First list of all households in each Tabia was obtained and sample households were selected at some interval from the list with a random start. Since the Tabias were comparable in terms of size of population and other socio-economic and bio-physical characteristics, the total sample 300 was equally distributed to each Tabia. Thus, a sample 100 households was drawn from each Tabia for the survey.

1.3. Survey implementation

Data was collected from a sample of 300 households. A structured questionnaire was used for the data collection. The questionnaire had five parts, namely: (a) household characteristics, (b) livelihood strategies, (c) farming system characteristics and land resources, (d) water harvesting techniques, and (e) resource bases, with each part divided into sub-parts.

Nine qualified enumerators were recruited for the field work. In order to minimize the errors in data collection, training was given to the nine enumerators for 3 days to ensure that the questionnaire was understood by the enumerators. Moreover, pilot survey was conducted in order to test the contents of the questionnaire by taking a sample of target population from a Tabia nearby the city of Mekelle called Romanat. This served as a demonstration to check the interviewers' understanding of the study, and how it is administered. In addition to this, the pilot survey was intended to test whether additional questions were needed, respondents understanding of the questions and check for omission of questions. After the pilot survey, issues that were unclear were discussed with the enumerators.

Field work took place from August 21 – 28, 2012. Close supervision was made during the data collection process. The filled-in questionnaires were checked on the spot and those with significant inconsistencies were returned to be filled again.

1.4. Data base

After the data has been collected, data entry template was prepared and qualified data entry personals were recruited for data entry. Data was entered in STATA and data cleaning was made before the data was used for interpretation.

2. PART II: DATA ANALYSIS

Descriptive statistics mainly average and graphs have been mainly used to analyse the data for the socioeconomic and biophysical survey.

2.1. Households identification

Family size: The average family size of the sample is 5.4 with a maximum of 12 household members in one household. The average family size in the three study *Tabias* is comparable with the highest average family size being in Genfel with an average family size of 5.7 and the lowest being in Tsaedanaele with an average family size of 5.14.

Age of HH head: the average age of household head for the overall sample is 50 with the highest being 90 years and the lowest 19 years. The distribution of average age in the three study sites is comparable in Genfel and Mesanu but the average household head age in Tsaedanaele is slightly higher.

Sex of household head: Out of the total sample of 301 households, 89 households (i.e. nearly 30%) of the households are headed by female and the remaining 212 (i.e. 70%) households are male headed households (Table 1). The distribution of female headed households in the three study *Tabias* is comparable the highest female headed households being observed in Tsaedanaele followed by Genfel and finally Mesanu.

Table 1: Household characteristics by Tabia

HH characteristic		Genfel			Mesanu			Tsaedanaele			Overall sample		
		Average	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.
Family size		5.7	12	1	5.5	12	1	5.14	12	1	5.4	12	1
Age of HH head		49	85	22	49	96	19	52	90	21	50	96	19
Sex of HH head	Male (total)	72			74			66			212		
	Female (total)	29			26			34			89		

Source: Own calculation from survey data.

Education of household head: Table 2 below shows the education level of the household head by Tabia and for the overall sample. Most households in the sample (56% of the sample

size) do not have any schooling, close to 20% are primary school incomplete, around 15% have some religious or traditional education, 5% have completed primary school and only less than 5% are in the secondary school and above, the highest level of education being college diploma. The distribution of education of household head by *Tabia* shows the same result. In all the three *Tabias*, the dominant level of education in order of size/percentage of the sample is never any schooling followed by primary schooling incomplete and religious/traditional education.

Table 2: Educational level of household head by *Tabia*

Level of education	Genfel		Mesanu		Tsaedanaele		Overall sample	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Never any schooling	50	49.5	65	65.0	54	54.0	169	56
Religious/Traditional schooling	14	13.9	16	16.0	15	15.0	45	15
Primary school incomplete	21	20.8	14	14.0	24	24.0	59	19.6
Primary school complete	9	8.9	4	4.0	2	2.0	15	5
Secondary school incomplete	5	4.9	1	1.0	2	2.0	8	2.7
Secondary school complete	2	2.0	0	0.0	1	1.0	3	1
College diploma	0	0.0	0	0.0	2	2.0	2	0.7

Source: own calculation from survey data (Freq= Frequency)

Occupation of household head: As expected, the primary occupation of households in the sample is farming which constitutes for close to 87% percent, followed by the head being too old to work (5.7%) (Table 3). For the remaining (less than 10 percent) households in the sample, the primary occupation includes business, employee, pensioner, unemployed, disable/unable to work and housewife. The distribution by Tabia is similar. Farming is the main occupation of households in all study Tabias.

Table 3: Primary occupation of household head by *Tabia*

Primary Occupation	Genfel		Mesanu		Tsaedanaele		Overall sample	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Farming	89	88.1	89	89.0	83	83.0	261	87.0
Business	2	2.0	2	2.0			4	1.3
Employee	1	1.0	1	1.0	2	2.0	4	1.3
Pensioner	2	2.0					2	0.7
Unemployed					1	1.0	1	0.3
Disabled and unable to work			1	1.0	2	2.0	3	1.0
Housewife	5	4.9	1	1.0	3	3.0	9	3.0
Too old to work	2	2.0	6	6.0	9	9.0	17	5.7

Source: own calculation from survey data (Freq= Frequency).

HH head work allocation: Table 4 indicates the work allocation by head of the household between farming and non-farming activities. As expected, the average number of days by a household head allocated for farming stands at 88 days per year and that of non-farming is 36 days for the whole sample. When work days allocation is observed at Tabia level, we still see the same trend – more days are allocated on farming by households in all the three Tabias. However, the number of days allocated on farming and non-farming especially on the latter shows significant variation from Tabia to Tabia. Non-farm activities seem to be frequent in Genfel than the other two Tabias. A household in Genfel spends on average 64 days on non-farm work compared to 27 days and 12 days in Tsaedanaele and Mesanu Tabias respectively.

Table 4: Average number of work days allocation between farming and non-farming by Tabia

Type of work	Genfel	Mesanu	Tsaedanaele	Overall sample
Farming	90	107	66	88
Non-farm	64	12	27	36

Source: own calculation from survey data

2.1. Livelihood strategies

Access to services and ownership of assets play important role in the livelihood of households.

2.1.1. Physical Assets

2.1.1.1. Access to basic services

Access to services such as access to safe drinking water, transportation, health facilities, energy consumption etc are not only direct indicators of welfare of society but also play tremendous role in enhancing productivity.

(a) Access to drinking water:

Table 5 presents source of drinking water by Tabia. The most important sources for the sample as a whole are: public sources which constitute 48%, followed by river constituting close to 25% and public well contributing for nearly 17%. However, the distribution is different when it comes to the Tabia level. Unlike households in Genfel and Mesanu, households in Tsaedanaele do not get their drinking water from rivers. This could be mainly due to the absence of a river close to the Tabia. In Tabias Genfel and Mesanu on the other hand, there are rivers close to the Tabias called Genfel and Agulae respectively that are used for both irrigation and drinking. Thus, rivers serve as source of drinking water to close to 24% and 50% of the sample in Tabias Genfle and Mesanu respectively.

Table 5: Source of drinking water by Tabia

Source of drinking water	Genfel		Mesanu		Tsaedanaele		Overall sample	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Private source	5	4.9	3	3.0	2	2.0	10	3.3
Public source	43	42.6	25	25.0	77	77.0	145	48
Private well	2	2.0	1	1.0	1	1.0	4	1.3
Public well	18	17.8	12	12.0	20	20.0	50	16.6
Tanker	4	4.0	1	1.0			5	1.7
River	24	23.8	50	50.0			74	24.6
Other	5	4.9	8	8.0			13	4.3

Source: own calculation from survey data

Access to drinking water is measured not only by availability but also by the amount of time it takes to travel to fetch water or distance to reach to the water point and whether or not the water is safe for drinking. Survey results indicate that most households (close to 84%) in the sample perceive the water they use for drinking is safe and only 16% said it is not safe for drinking. Survey results further indicate that households in the sample travel on average 1.45 km to fetch water. The distance slightly varies from Tabia to Tabia. Households in Mesanu area travel relatively the longest distance, i.e., 1.8 km followed by households in Genfel (1.3 km) and the least average distance is observed in Tabia Tsaedanaele (1.2 km)

The burden of fetching water as is true in most developing countries heavily lies on women. The table below (Table 6) summarizes the response of sample households to the question of 'who is responsible to fetching water?' The table result clearly indicates that it is adult female followed by female children who are responsible for fetching water in the study area.

Table 6: Household member in charge of water fetching by Tabia.

HH member in charge of water fetching	Genfel		Mesanu		Tsaedanaele		Overall sample	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Adult female	63	65	63	63.6	61	63.5	187	64.0
Adult female and female children	15	15.5	10	10.1	7	7.3	32	11.0
Adult female and male children	1	1.0	2	2.0	1	1.0	4	1.4
Adult male	3	3.1	5	5.1	7	7.3	15	5.1
Adult male and adult female	1	1.0	2	2.0	3	3.1	6	2.1
Adult male and female, & children			1	1.0			1	0.3
Adult male and male children	1	1.0					1	0.3
Female children	11	11.3	4	4.0	5	5.2	20	6.9
Male and female children	2	2.1	3	3.0	8	8.3	13	4.5
Male children			9	9.1	4.2		13	4.5

Source: own calculation from survey data

(b) Energy source:

The main energy source for cooking in the area is cow dung (50.8%) followed by firewood (41.2%) (Table 7). The other sources of energy for cooking in their order of importance include Charcoal and Kerosene. The distribution of energy source at Tabia level also follows the same suit. In all Tabias, the primary source of energy for cooking is cow dung followed by firewood. Kerosene as a source of energy for cooking, however, is used only in Tsaedanaele Tabia only.

Table 7: Energy source by Tabia

Source of energy	Genfel		Mesanu		Tsaedanaele		Overall sample	
	Freq	%	Freq	%	Freq	%	Freq	%
Firewood	41	41.0	43	43.4	39	39.0	123	41.2
Charcoal	3	3.0	5	5.1	9	9.0	17	5.7
Kerosene					6	6.0	6	2.0
Cow dung	56	56.0	51	51.5	46	46.0	153	51.1

Source: own calculation from survey data

(c) Access to health:

Access to health is another indicator of welfare and also part of the Millennium Development Goals which Ethiopia at large and the regional government of Tigray in particular is committed to achieve it. Although difficult to measure access to health, respondents were asked about type of health facilities they visit when sick and how far they live from the nearest clinic and health center. Survey results indicate that almost all respondents in the sample (more than 98%) said they visit government clinic or hospital for their treatment. Only less than 2% said they often go to traditional or home pathetic healer and private clinic. Although in a country like Ethiopia, where alternative modern health facilities are limited especially in the rural area where the government is the sole modern health facility provider, the high percentage of households visiting government health facility should not come as a surprise, the figures seem to be slightly higher than many studies.

Respondents were also asked how far they live from the nearest health clinic or hospital. Results indicate that most of the respondents (more than 93%) live within the range of 0 to 10 km distance from the nearest health clinic or hospital and only few (less than 7%) live in the range of 10 to 20 km distance from the nearest health clinic or hospital.

(d) Physical assets:

Farming is the main economic stay in the study area as is true in all rural areas of Ethiopia. For this type of livelihood system, besides natural assets such as land and human capital, farming equipment play important role.

Farming is still performed traditionally. The basic tools used are the traditional ploughing tools that are pulled by a pair of oxen. Other farming tools such as tractors, trucks, greenhouse, water tanks etc are non-existence. Only a few households (12%) own some irrigation equipment including motor pumps.

2.1.1.2. Financial Assets

Table 8 below shows the income structure of households in the sample. As expected, the major contributing sector to income of households is farming. A farmer in the sample gets on

average an annual income of ETB[2] 4433 followed by other sources with an average income of 1547, followed by income from livestock 471, own business income 337, wage/salary income (220), migration income (194) and finally transfer income (190) in the form of remittance from household members living in other places.

Table 8: Average income by source of income and by Tabia

Income source	Genfel	Mesanu	Tsaedanaele	Overall sample
Agricultural income	4785	4960	3550	4433
Income from livestock and livestock products	481	581	352	471
Own business income	286	689	38	337
Wage/salary income	465	24	170	220
Transfer income	208	360	3	190
Income from migration	201	214	168	194
Other income	1570	698	2371	1547
Average income of all sources	8016	7526	6651	7400

Source: own calculation from survey data.

Note: Average income from each source is calculated for all households whether a household earns income from the specified source or not. If average income were to be calculated only for those who earn income from a specified income source, the average income from each source would have been much higher than the figures indicated in the above table.

The share/contribution of each income source in the overall household income of the sample households is shown in the pie chart below (Figure 1). As expected, around 60% of income of the households in the sample is generated from agriculture and related activities followed by other sources such safety net program and others contributing for 21% of household income. The next income source that contributes nearly 6% of the total income is income from livestock and livestock products, followed by own business (4%) and the remaining three sources, i.e., income from migration, transfer income in the form of remittance living in other places, wage/salary income, each contributing 3% of the overall income.

[2] ETB is Ethiopian Birr, the legal currency of Ethiopia. One US $ is approximately equal to 19.3 ETB (April 2014)

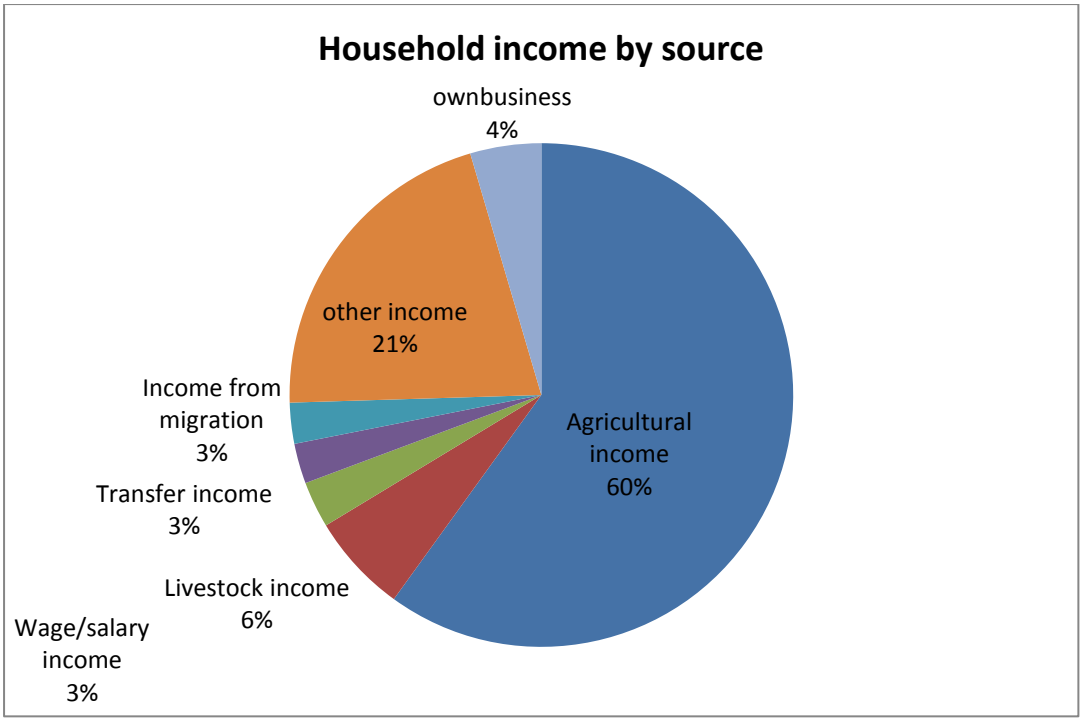

Figure 1. Household income by source in the study area (Source: Survey data).

2.2. Natural Assets

2.2.1. Land holding size and harvest in rural areas

2.2.1.1. (a) Number of plots owned:

Land as well as all natural resources are under public ownership in Ethiopia. The Ethiopian Constitution (Article 40) provides land use rights but not ownership rights. Selling and mortgaging of land are prohibited. Land happens to be one of the three most important resources at the possession of rural households in Tigray; the others being labour and livestock. Out of the total sample of 300 households, only 12 households do not own land. This means that 4% of the rural households are landless.

Farming plots owned by rural households are generally small and found in different locations. While this pattern may negatively affect land productivity in view of difficulties for investment, it, on the other hand, ensures some sort of equity by staggering land ownership among different areas of soil fertility within the particular village. Taking only those households possessing land, the average number of plots per household is 2.39 (Table 9). Thus, on average, every household possesses slightly more than two plots of land.

Table 9: Average number of plots per household by *Tabia*

Tabia	N	Mean	Standard deviation
Genfel	95	2.98	1.33
Mesanu	99	2.72	1.89
Tsaedanaele	95	1.46	0.63
Overall sample	289	2.39	1.28

Source: own calculation from survey data.

However, if we consider all households in the sample; i.e., including those who do not own land, the average number of plots per household becomes slightly smaller and stands at 2.3 plots per household.

(b) Average land holding size:

Perhaps more important than the number of plots is the size of holdings. Keeping other factors constant, one can safely imagine that the larger the size of land a household owns, the more output it generates. However, land holding size in Tigray has remained small because of the fact that relative to the size of rural population arable land in the region is quite small. One needs to note, in the meantime, one can attain higher levels of land productivity by introducing appropriate technologies and reap higher levels of harvest even if land remains of small size.

Alike to previous studies, this survey shows that average land holding size remains below one hectare per household. In precise terms, and excluding landless households, the average land holding size is reckoned as 3.01 *tsimad* (or 0.75 hectares) per household (Table 10). This figure is lower than the average land holding for the Tigray region at large which stands at 0.9 hectares (Fredu et al. 2011). There exists variation in terms of Tabia distribution of land holding sizes as shown in the table below. While land holding size in Tabias Genfel and Mesanu is comparable, the land holding size in Tsaedanaele is almost half of the land holding size in the other two Tabias.

Table 10: Average land holding size by Tabia.

Tabia	Number of observations	Average land holding in tsimad*	Standard deviation
Genfel	95	3.47	2.67
Mesanu	99	3.68	2.0
Tsaedanaele	95	1.84	0.89
Overall sample	289	3.01	2.15

*Tsimad is an area of land that can be ploughed by a pair of oxen and is equivalent to one-fourth of a hectare.

As farming communities, the land in the sample household is mainly used to grow crops. The following pie chart shows the share of use of land (Figure 2). More than 93% of the land is used for growing crops.

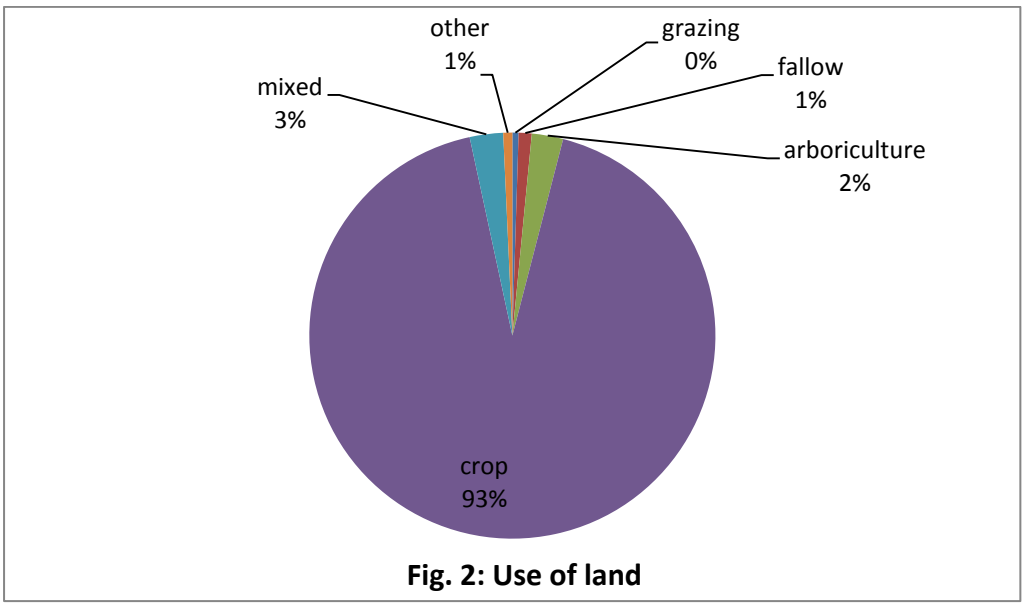

Figure 2. Share us of land in the study area.

(c) Renting and sharecropping arrangements:

Farmers in Ethiopia have only use rights but not ownership of land. They cannot sale or buy land. Thus when a farmer is not able to cultivate his own land or when a farmer wants to cultivate more land than his own, the available option is to enter into renting and/or sharecropping arrangements. Sharecropping is the commonest form of arrangement in the rural areas of Tigray. The table below (Table 11) shows percentage of farm households in the sample who sharecropped out their land.

Table 11: Households who rented out their land by Tabia.

Tabia	Households who sharecropped out their land		Average land size sharecropped out
	No.	Percentage	
Genfel	24	25	2.09
Mesanu	35	35	2.08
Tsaedanaele	17	18	1.65
Overall sample	76	26	1.99

Source: own calculation from survey data.

As can be noted from Table 11, slightly more than one-fourth of the sample households who own land entered in sharecropping arrangement, i.e., these households sharecropped out on average close to 2 *timad* of land to other households.

Farmers could sharecrop out land for a number of reasons. The following table (Table 12) summarizes the reasons households in the sample sharecrop out their land. The frequently cited reason for sharecropping out land is lack of oxen. This should not come as a surprise as farming in the area is mainly done using oxen power. Besides land, the two critical inputs for farming in the area oxen and labour. Thus, following lack of oxen, the next frequently cited reason for sharecropping out land among the sample households is lack of labour. Households with labour constraint are most likely not able to farm their land by themselves. Sometimes, however, labour constrained households, if they can afford to pay, can hire labour for farming. Following the aforementioned critical inputs, the third major reason for sharecropping out land is lack of money.

Table 12: Reasons for sharecropping out land.

Reason for sharecrop out land	Frequency	Percentage
Plot too far from the house	6	4.9
Land of poor quality	2	1.6
Not profitable to cultivate	2	1.6
Cannot get necessary inputs	4	3.3
Lack of oxen	42	34.4
Not enough money	27	22.1
Not enough manpower	39	32.0

Source: own calculation from survey data.

2.3. Social Assets

Social capital, which can be understood as the norms and networks that enable people to act collectively (Woolcock and Narayan, 2000), is increasingly getting attention as a mechanisms for understanding socioeconomic phenomena. It has been used to explain a range of phenomenon ranging from voting patterns (DiPasquale and Glaeser, 1999) to health (Kennedy et al., 1998) to judicial efficiency (LaPorta et al., 1997) and to household welfare analysis (Putnam, 2000). In this part, the focus is more on social capital related to natural resource management.

The Tigray regional state follows an Agricultural Development Lead Industrialization (ADLI) strategy based on resource conservation. Accordingly, main emphasis is given to water as the region has limited water sources. This has motivated the regional government to build all possible water harvesting mechanisms including integrated watershed management. Besides government programs such as the public work program in which the rural communities engage in public work mainly in natural resource conservation activities against payment, farmers in Tigray contribute upto 40 days of free labour to work on natural resource conservation activities through the locally operating natural resource management institutions.

Respondents were asked whether or not they are engaged with natural resource management institutions and the reason for their engagement. More than 72% of the respondents said that at least one member of the household is a member of natural resource management institution. Moreover, except very few (only close to 13%) who considered their involvement solely as government obligation, all respondents justified their involvement in implementing watershed management activities in order to improve their livelihood through enhancing productivity by conserving soil and water.

The local natural resource management institutions in the study area and elsewhere in rural Tigray are well organized with their own structures or grouping and have many years of experience. Respondents were asked whether or not watershed communities are capable of continuing/maintaining watershed management activities on their own. Most respondents (more than 80%) have the confidence that the local institutions are capable of undertaking watershed management activities by their own. Even more than the local institutions, almost all the respondents (more than 96%) have expressed their satisfaction on the regional government's policies on water resources.

2.4. Farming characteristics and practices with and without WHT

2.4.1. Farming characteristics and land resource

Farming is the main economic stay of the local community. As indicated in section 2.2 above, more than 60% of the income of the sample households is generated from agriculture. Moreover, as indicated in section 2.3, more than 93% of the land owned by sample households is used to grow crops. Thus, the livelihood system in the rural communities is subsistence farming highly dependent on growing crops.

In this sub-section, we discuss on some farming characteristics that designate the farming practice in the study sites.

(a) Crop calendar:

One important consideration in farming is crop calendar, i.e., the date of planting. Farmers in the sample were asked about their crop calendar – the basis to determine the date of planting of crops. Results indicate that there is no fixed date of planting. Most farmers indicate that the date of planting depends on the nature of the rain and the type of crop. But most argue that they start planting after the first rain, although a few have said they plant after the first two or three rains. Because planting date depends on the nature of the rain and since there is variability on the rain from year to year, close to 85% of the respondents indicated significant variation of planting dates from year to year.

The amount and distribution of rains matters not only for the cropping calendar but it also affects crop yield. Most farmers (more than 72%) indicated that rainfall is the major factor influencing variability in yield from year to year. Other factors indicated also include application of fertilizer, conservation and preparation of soil, improved seed etc.

(b) Product storage:

Respondents were asked if they store their products before they are sold or consumed, and where and for how long they store their produce. More than 93% of the respondents said that they store their produce before consumed or sold in the market. Almost all farmers store their produce at home in sucks and other traditional storages mainly made of mud and wood.

(c) Product marketing:

Although farming in the study area, as is true in most rural parts of Ethiopia, is subsistence, i.e., farmers primarily produce for self consumption, they also sale part of their produce to buy non-agricultural products and to meet other demands and obligations. Agricultural products are often sold in local markets. The average time it takes to reach the market in the study area is 56 minutes. This, however, is different from village to village. The village with the smallest distance to market is Gefel with approximately 50 minutes walk and the longest distance is in Tabia Mesanu with a distance of approximately 66 minutes walk. In all the study villages, the mode of transportation to reach the market is on foot. Other modern means of transportation are absent.

2.4.2. Water harvesting

Tigray is one of the moisture stressed regions in Ethiopia. Following this fact, the regional government has given due place to water harvesting in its strategies. The government and the people have invested intensively on water harvesting mechanisms for more than two decades. It is widely believed and argued in the region that this effort has started to pay in terms of increasing productivity through improvements in soil fertility and water availability for productive purposes.

Sample households in the study areas were asked if they benefit from water harvesting techniques applied in their area, what type of water harvesting techniques have been implemented, who implements these techniques etc.

A wide variety of both traditional and introduced water harvesting and watershed management techniques have been implemented in the study area. Some of the common techniques include:

- application of organic and chemical fertilizers, Contour ploughing;
- Contour soil and stone bunds;
- Stone faced soil bunds;
- Stone/soil/stone faced soil bund with trenches, Stone faced deep trenches;
- Semi-circular bunds;
- Construction of demarcation bunds (Armo) between farm holdings or within a farm to reduce slope length and gradient;
- Application of manure to farms;

- Fallowing of farm lands;
- Crop rotation between cereals and legumes;
- Construction of diversion channels to protect farm lands from damage from upstream runoff and drainage channels to safely remove excess runoff from the farm lands;
- Construction of hand-dug wells for household and irrigation purposes;

Most of the aforementioned water harvesting technologies are implemented by the government, the community and individual farmers themselves. The government provides financial, material and technical support, and the community contributes labour.

2.4.3. Benefits of WHT: Assessment by farmers

Respondents were asked if WHT applied on their plots have brought any changes in productivity. Although difficult to measure the changes in productivity due to WHT without a closely observed data, a rough approximation that could indicate the productivity impact of WHT was collected through recall.

Farmers were asked for the plots on which WHT have been implemented to recall average production before and after WHT implementation. Famers were asked to recall production in this way for up to two plots. Results of the farmers' assessment on average productivity before and after WHT is summarized below (Table 13).

Table 13: Farmers' assessment of average productivity per plot before and after WHT.

Tabia	Plot	Average yield per household before WHT	Average yield per household after WHT	Percentage change
Genfel	Plot1	168	369	120%
	Plot2	145	245	69%
	Overall	203	427	110%
Mesanu	Plot1	241	382	59%
	Plot2	215	326	52%
	Overall	307	482	57%
Tsaedanaele	Plot1	167	297	78%
	Plot2	71	125	76%
	Overall	174	308	77%

Overall sample	Plot1	192	347	81%
	Plot2	167	265	59%
	Overall	227	401	77%

Source: Own calculation from survey data

Table 13 indicates that in all the study villages, WHT has a significant impact on productivity. In all the villages, average productivity has increased after WHT significantly. Although these observed changes may not have been solely attributed to WHT, it clearly indicated that WHT enhances agricultural production.

The sample households were further asked if they observe gradual improvements in soil fertility and water availability due to the WHT. More than 90 per cent of the sample respondents confirmed that there is gradual improvement in soil fertility and water availability as a result of the continuous work in WHT in the study area.

3. Conclusion

Water as a natural asset forms part of the asset range available to households and improved access to water supply plays critical role in the sustainable livelihoods of households. One way in which access to this natural resource can be increased is by increasing its availability through harvesting this natural asset. For this, wide ranges of water harvesting techniques have been used to harvest water for both drinking and productive purposes.

The government of Ethiopia has emphasized on water harvesting and sustainable irrigation development as focal point of development strategy for reaching its drinking water, agricultural, livestock and industry development goals of its Growth and Transformation Plan (GTP). Following the national GTP framework, the GTP of the regional government of Tigray emphasizes integrated watershed management as a principal strategy of not only conserving the environment but also enhancing soil fertility and water availability so as to increase agricultural production and productivity.

This study assessed the agro-socio-economic characteristics of the farm households in Tigray region of northern Ethiopia. The assessment was done in three selected Tabias using a sample of 300 households to make statistical and spatial based analyses of biophysical and socio-economic factors that characterise livelihood strategies, natural resources and land management practices.

The farm households in the study area depend heavily on agriculture for their livelihood. More than 60% of their income is generated from agriculture which is mainly rainfed. Land, and amount and distribution of rainfall are two of the basic inputs that determine agricultural productivity and production. Land in Ethiopia is publicly owned. Farmers have a user right that includes all but sale of land. They cannot accumulate or decumulate land through purchase and sale. But use rights can be inherited, rented or sharecropped for some time.

Land holding in the area is small, approximately three quarters of a hectare to a family with average family size of five. This is small even when compared to the average land holding for Tigray as a whole which is close to one hectare per household. The small land holding coupled with deteriorating soil fertility and highly variable/erratic rainfall is a major challenge to the income of households and hence to their livelihood. For this, the regional government has long time ago designed and implemented conservation based agricultural

strategy. Integrated watershed management (soil and water conservation, area closures, etc), coupled with water harvesting are the primary focuses to boost agricultural production and productivity. Wide ranges of water harvesting techniques have been implemented in the Tigray region in general and in study area in particular.

WHT in the study areas was found to be important both in terms of harvesting enough water needed to meet both the domestic and the irrigation needs. A significant number of farmers in the study areas started to obtain higher yields after they adopted the technologies. According to the farmers assessment, agricultural production has increased by about 77% after introduction of WHT. More than 90 per cent of the sample respondents confirmed that there is gradual improvement in soil fertility and water availability as a result of the continuous work in WHT in the study area.

Results in this study are useful to understand agro-socio-economic characteristics of the farm households in northern Ethiopia with focus on WHT. However, the paper has limitations in the sense that it does not provide ground for selective WHT as necessary elements in poverty reduction strategies. Moreover, the paper also does not address the cost benefit analysis of WHTs.

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