East African Scholars Multidisciplinary Bulletin
Abbreviated Key Title: East African Scholars Multidiscip Bull
ISSN 2617-4413 (Print) | ISSN 2617-717X (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-7 | Issue-8 | Oct-2024 | DOI: https://doi.org/10.36349/easjmb.2024.v07i08.001

Original Research Article

Assessment, Characterization, Identification and Prioritization of Major Constraints and Potentials of Three Selected Community Watersheds of Agarfa District, Bale Zone, Oromia, Ethiopia

Mulugeta Eshetu[1*], Bayeta Gadissa[2], Regassa Gosa[1], Daniel Abegeja[1], Tesfaye Ketema[1]

[1]Soil Fertility Improvement and SWC, Watershed Management Research Team
[2]Agricultural Extension Research Team

Article History
Received: 02.09.2024
Accepted: 09.10.2024
Published: 11.10.2024

Journal homepage: https://www.easpublisher.com

Quick Response Code

Abstract: The severity of land degradation due to different socioeconomic and biophysical pressures is a key problem encountered in watersheds. In addition, the lack of research-based references to a given community watershed, particularly with regard to socioeconomic and biophysical aspects, leads to the failure of the interventions. This study aimed to assess and characterize the socioeconomic and biophysical conditions of three selected (Oda Chefo, Wabe Seada, and Oda Nagelle) Community Watersheds of the Agarfa District of Bale Zone, Oromia, Ethiopia. Furthermore, it identifies and prioritizes constraints and opportunities for scientists, planners, intervention, impact analysis, and project performance evaluation. Communities' watersheds were selected and delineated, followed by household interviews, focus group discussions, and biophysical characterization to generate data. The study used a random sampling technique and a total of 121 sample sizes for socioeconomic data, watershed delineation, slope classification, soil type, and LULC classification map developed based on the preliminary outlet identified with the help of GPS reading and ArcGIS 10.5 software. The socioeconomic parameters were analyzed using SPSS version 20 software. The result of the baseline survey identified key constraints such as soil erosion, soil fertility decline, deforestation and climate change, feed and fodder shortage, livestock disease, human disease, unemployment, food insecurity, water shortage, lack of credit access, market, road, cooperatives, high input price, pest and disease, yield decline and lack of irrigation access. The results revealed that the availability of the labor force, local market accessibility, transport services, informal farmer cooperatives, livestock clinics, youth and women associations, and informal intuitions are the main opportunities in selected community watersheds. In conclusion, baseline surveying before any watershed management practice intervention plays a vital role in conducting successful activities that improve household livelihoods, and ecosystem balance, and successfully degrading watershed rehabilitation to survive the impacts of climate change. Based on the present study efforts related to awareness, establishment of the multi-disciplinary team and FRG, evaluation, and demonstration/promotion of households' income-generating activities through integrated watershed management technologies should be needed. Integrating biophysical soil and water conservation measures for the reclamation rehabilitation of the expansions of gully's erosion and other forms of soil erosion is recommended.

Keywords: Socioeconomic, Biophysical, Constraints, baseline, Oda Chefo, Wabe Seada and Oda Nagelle Community Watershed.

Copyright © 2024 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution **4.0 International License (CC BY-NC 4.0)** which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

In most developing countries, agriculture is the main source of income for job creation, food security, and nutrition (Anowar *et al.*, 2015). However, due to severe land degradation, rapid urbanization, population growth, and severe climate change, sustainable agricultural productivity and crop production aim to achieve food self-sufficiency for farmers facing many challenges. Land degradation and various socioeconomic pressures are the main problems encountered in watersheds in tropical regions (Firdaus *et al.*, 2014 and Bizuneh *et al.*, 2022). In many parts of the

***Corresponding Author:** Mulugeta Eshetu
Soil Fertility Improvement and SWC, Watershed Management Research Team

world, this situation has led to increasing economic and environmental problems, especially in countries where agriculture is the major source of income.

In Ethiopia, soil degradation is taking place at an alarming rate with serious environmental problems and is constantly turning into a state unsuitable for farming due to a lack of nutrients in the soil and soil degradation especially in highland, densely populated areas (Temesgen, 2012; Abebe *et al*., 2013; Tesfaye and Tripathi, 2015 and Kassa *et al*., 2019 and Birtukan *et al*., 2020). Practicing participatory integrated watershed management is an appropriate strategy to reduce severe land degradation and improve agricultural productivity and production sustainably with the aim of conserving hydrological services. Participatory integrated watershed management programs in a sustainable way for large populations are possible solutions, especially for poverty alleviation and maintaining food, fodder, and energy security (Anantha *et al*., 2009). Watershed development technologies aim not only to conserve natural resources but also to improve the socioeconomic conditions of rural people who depend on watersheds for their livelihood.

Different findings confirm that incentives encouraging people to participate in watershed management activities can help measures bring about positive changes in landscape and livelihood aspects (Adimassu *et al*., 2013 and Daniel, 2020). The success of watershed management measures positively or negatively influenced by socioeconomic constraints and bio-physical conditions such as climate, topography, soil, and drainage system (Daniel, 2020). The constraints related to economic and social status such as gender, youth, age, social status, educational attainment, population growth, property rights, and other conditions, are also present and can affect the effectiveness of watershed management activities (Daniel, 2020).

The success of integrated watershed management facing serious threats due to the complexity of watersheds, uncertainty, and diverse social and biophysical settings needs careful analysis of the socioeconomic to successfully address livelihood and conservation concerns (Agidew and Singh, 2018). In order to understand existing crop production-related conditions, socioeconomic and agro-climatic situations, problems, and potential baseline surveys should be carried out before conducting any farming activities (Anantha *et al*., 2009; Anowar *et al*., 2015 and Taiy *et al*., 2017). The results of baseline characterization help them develop appropriate research programs for reducing land degradation and develop interventions that improve sustainably the livelihoods of the communities and ultimately measure the effectiveness of the project. In addition, constraint and opportunities identification for selected community watersheds is a prerequisite for developing appropriate policy guidelines and designing interventions to enhance productivity and sustainable development.

Due to the continued cultivation and the expansion of agricultural land on sloppy increases soil erosion and soil fertility decline in the watershed community of Agarfa district is the main problem. In integrated watershed management technologies practices related to livelihoods, agricultural production, land productivity, animal feeds, and generally natural resource degradation baseline information on socioeconomic and biophysical conditions are the basic. However, the lack of baseline survey information on the constraints and opportunities related to socioeconomic and biophysical conditions is a main research gap for decision-makers, planners, and other multi-purpose people in the Agarfa community watershed. Therefore, this study aims to identify and document the major biophysical and socioeconomic constraints and potential of three selected community watersheds of Agarfa District.

MATERIALS AND METHODS

Description of Study Area

Specifically, study areas are situated in the Agarfa District of Bale Zone 31 Km and 45 km away from Robe and Agarfa town, respectively. Geographically located between 7°19′0″ to 7°21′30″ N latitude and 39°38′45″ to 39°41′15″ E longitude, 7°20′0″ to 7°22′0″ N latitude and 39°46′15″ to 39°47′55″ E longitude for Oda Negelle and Oda Chefo community watershed, respectively. Whereas the Wabe Seada community watershed is geographically located between 7°25′0″ to 7°27′0″ N latitude and 39°42′5″ to 39°43′45″ E longitude. (Figure 1).

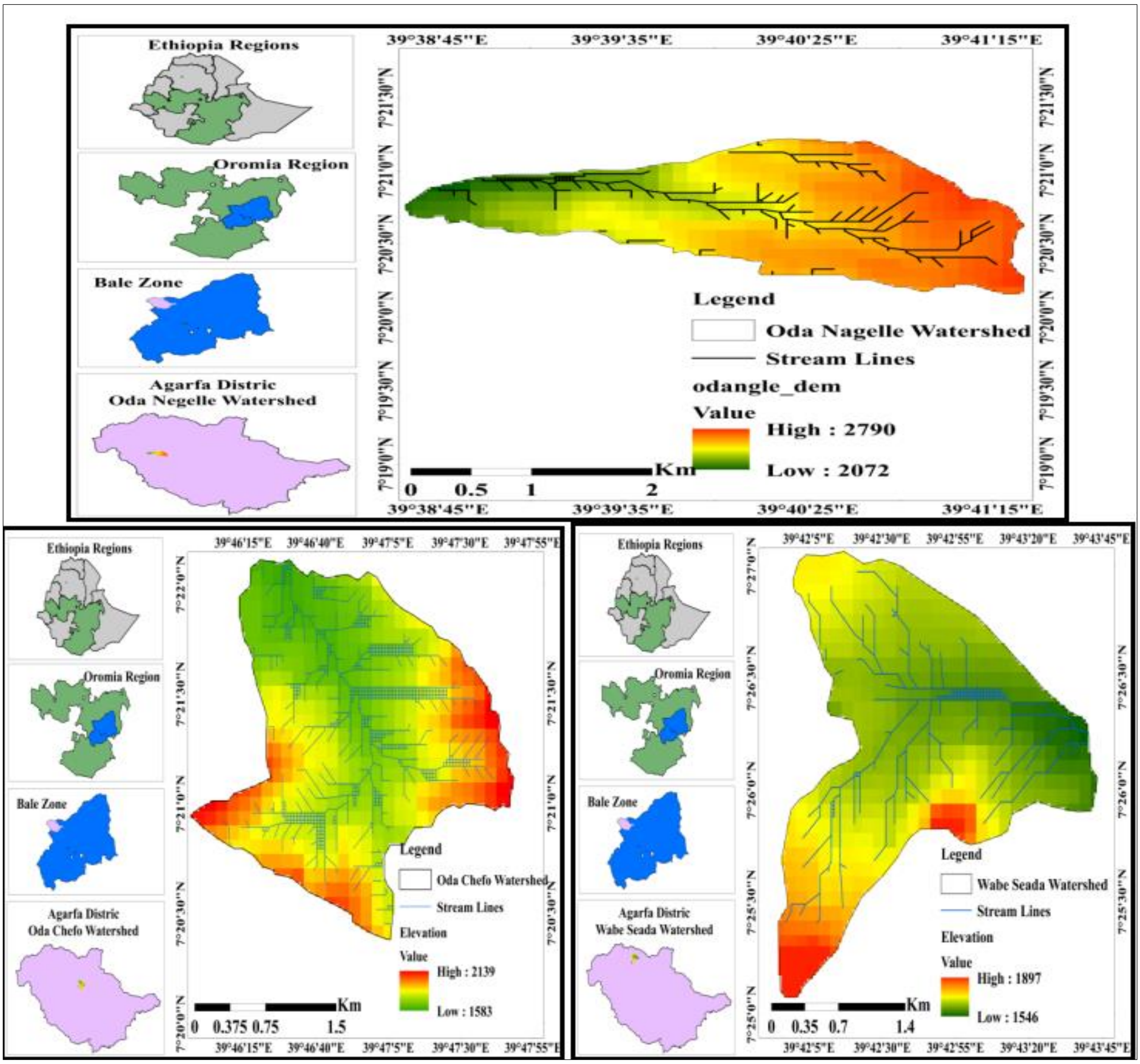

Figure 1: Map of the study area

Climate of the Study Area

The study area has diverse landscapes creating diverse microclimates in the area. The agro-ecosystem of the study area is divided into highland areas and plains with some frost cover around the mountain peaks. The district is divided into frost, highlands, semi-highlands, and lowlands. In the district, rainfall tends to fluctuate due to the change in intensity and distribution. Sometimes this creates an overlap between the seasons, causing unusual weather patterns. The average annual rainfall in the district is 800 mm. However, the annual maximum and minimum rainfall is 1,200 mm and 400 mm, respectively. The average annual temperature in the district is about 17.5°C. In the lowlands around the Wabe Shabele River, temperatures are hot and reach 25°C. In the mountains, the temperature gradually decreases, i.e. below 10°C. Thus, the district's temperature increases gradually from the southwest to the northwest of the district.

There are about 4 different rainy seasons in the district (Table 1).

Table 1: Season and their duration

No.	Season	Duration
1	Autumn/Birraa	September (Fulbaana), October (Onkololeessa), November (Sadaasa)
2	Winter/Bona.	December (Muddee), January (Amajjii), February (Gurraandhala)
3	Spring/Arfaasa	March (Bitooteessa), Appril (Ebla), May (Caamsa)
4	Summer/Ganna	June (Wabajjii), July (Adooleessa), August (Hagayya)

Methods of data Collection and Analysis

Data Sources

In community watershed delineation and slope generation ASTER DEM 30m*30m resolution was used (Table 2). Additionally land uses land cover was generated from an intensive field survey and Google Earth for verification with the support of GPS points and GIS software 10.5 version. The soil map is obtained by clipping the FAO soil map with the study watershed in the GIS software 10.5 version environment (Table 2).

Table 2: Source, description and purpose of the data used in the study

No.	Types of data	Source	Description	Purpose
1	DEM	USGS	30 m x 30 m resolution	Watershed delineation and slope generation
2	Digital Soil map	FAO	FAO (1986)	generate soil map
3	Household Survey	Survey	Socioeconomic survey	Problem and opportunity ranking and prioritization

Software and Tools Used for the Study

During the selection, classification, delineation, and mapping of the selected community watershed of the Agarfa district, different software and tools were used. Accordingly, the types of software, tools, and purposes are described in the table (Table 3).

Table 3: Software and purpose of used in the study

No.	Software and Material	Purpose
1	ArcGIS10.5	Analyzing, Displaying and viewing Spatial data
2	Arc Hydro extension	Community watersheds delineation
3	Garmin GPS(GPS)	To take ground truth points for different purpose
4	Clinometer	Additional slope validation and classification

Selection and Delineation of Community Watershed

Based on the degradation levels, intervention requirements, constraints, and opportunities, the selection of the watershed for conducting the baseline socioeconomic and biophysical survey was determined. The delineation of the study area was accomplished using the automatic delineation option within the ArcGIS 10.5 software, utilizing the Arc Hydro Extension. To carry out this process, the Aster 30m*30m resolution DEM was used to generate Fill, Flow direction, and flow accumulation data sets.

Subsequently, the "Flow Accumulation" tool was applied to the flow direction grid in order to create a grid indicating the accumulated flow to each cell from all other cells. The initial delineated boundaries were then verified in the field using GPS technology to establish reference benchmarks for future operations. Finally, a map of the watershed was produced, incorporating additional information such as elevation ranges, area, slopes, and the geo-referenced and digitized delineated watershed.

Topography

The topography of the study site was characterized based on the elevation and slope topographic parameters. The slope is one of the major geo-morphometric parameters and refers to a surface's degree of incline, which was calculated as the highest rate of change in elevation between that site and its surroundings. The Aster DEM 30m*30m resolution was used to generate the slope maps of the study watershed using Arc GIS 10.5 version software and Google Earth Engine (GEE). The slopes were calculated in percentage of slope, and six slope classes (0-3%, 3-8%, 8-15%, 15-30%, 30-50%, and >50%) were designated for the selected watershed based on the standard slope classification system (MoA, 2016; Hurni *et al*., 2016). Flat or almost flat (0-3%), gently sloping (3-8%), sloping (8-15%), moderately steep (15-30%), steep (30-50%), and very steep (>50%) as the standard rate of classification suggested by (Yalgaw, 2013 and Ahmed *et al*., 2022).

Socioeconomic Data Collections

Study Design and Sampling Technique and Sample Size

This study uses a cross-sectional research method considering both quantitative and qualitative factors. The cross-design was relatively affordable and consumed less time to complete as it involved collecting data once a time. A multi-stage sampling technique was used in this study. Three community watersheds, Oda Chefo, Wabe Seada, and Oda Nagelle were randomly selected from the watershed in the Agarfa district. Finally, a total of 121 respondents were selected using a simple random sampling technique for the final survey.

Type and Source of Data

To achieve the objective of the study primary and secondary data both quantitative and qualitative data were collected. Primary data were collected from a sample of respondents in watersheds. Secondary data was collected from various sources such as office records, journals, and other publications.

Method of Data Collection

Interview schedules were used to collect data. A questionnaire was used to collect primary data from sample households via face-to-face personal interviews (interview schedule). Both open-ended and closed-ended question types were used. Secondary data was collected by the document analysis method.

Method of Data Analysis

Data collected from primary and secondary sources were analyzed, summarized, and presented through quantitative and qualitative methods. Quantitative data was analyzed using descriptive and inferential statistics. Descriptive statistics include percentage, frequency, mean, standard deviation, and cross-tabulation. Finally, all the collected data were compiled and analyzed using SPSS computer software version 20 and STATA version 11 software.

RESULT AND DISCUSSIONS

Biophysical Characteristics of the Community Watersheds

Topography

The results of slope classification and maps show flat or almost flat (0-3%) and very steep (50 – 193.33%) both have equal percent coverage (27%) followed by both moderately steep (15-30%) and steep (30-50%) slope categories 17% for Oda Negelle community watershed (Table 4 and Figure 2). Similarly, flat or almost flat (0-3%) cover 33.56% followed by sloping (8-15%) having 25.92%, and very steep (50 – 213.57%) cover 33.93 % followed by flat or almost flat (0-3%) having 26.23% slope area coverage for Wabe Seada and Oda Chefo community watershed, respectively (Table 4 and Figure 2). Farmers who have land subjected to slope to steep slope areas were more likely to adopt integrated watershed management technologies than those on gentle or level sloping fields (Alufah *et al*., 2012 and Birtukan *et al*., 2020).

Thus, farmers cultivating at steep slopes perceived the problem of soil nutrient loss more than farmers who cultivate at gentle or level-sloping fields. The slope classes of the watershed affect the adoption decision of farmers on land management practices positively and significantly (Wossen *et al.*, 2015 and Agidew and Singh, 2018). This means farmers whose farmland is located on steep slopes are more concerned to participate in watershed management practices. The slope positively influences the adoption, decisions, and practices of watershed management technologies since households farming steep land are more likely to adopt conservation structures than less steep land (Abebe, 2022 and Ahsanuzzaman, 2015).

Table 4: Slope class and area coverage for Community Watershed of the Agarfa District

Oda Nagelle Community Watershed			**Wabe Seada Community Watershed**			**Oda Chefo Community Watershed**		
Slope Class (%)	**Area (ha)**	**Area (%)**	**Slope Class (%)**	**Area (ha)**	**Area (%)**	**Slope Class (%)**	**Area (ha)**	**Area (%)**
0 - 3	154.87	27.17	**0-3**	198.83	33.56	**0-3**	154.07	26.23
3 - 8	24.89	4.37	**3-8**	110.30	18.62	**3 - 8**	19.35	3.29
8 - 15	34.85	6.11	**8-15**	153.57	25.92	**8 -15**	34.49	5.87
15 - 30	98.10	17.21	**15-30**	92.90	15.68	**15 -30**	77.12	13.13
30 - 50	102.30	17.94	**30-50**	23.27	3.93	**30 - 50**	103.09	17.55
50 - 193.33	155.08	27.20	**50- 136.7**	13.65	2.30	**50 - 213.57**	199.28	33.93

Major Soil Type and Its Characteristics

According to FAO World Soils Classification (2012), standard the selected community watershed of Agarfa District of Bale Zone is covered by two major soil types which are chromic luvisols, and Lithosols. According to the soil type map, a large area is covered by lithosols whereas less area was covered by chromic luvisols soil type contradicting this large area covered by chromic luvisols for the Oda Chefo community watershed. The Wabe Seada community watershed consists solely of lithosols soil type, as indicated in Figure 3.

Chromic Luvisols is the tropical soil most used by small farmers because of its ease of cultivation and no great impediments. These chronic luvisols are characterized by having a percent base saturation >50% and they are greatly affected by water erosion and low levels of soil fertility. The chromic luvisols soil in the selected watershed is dominantly observed in undulating terrain in the studied area. Lithosols are typically characterized by low organic matter; found in areas with complex geology, including areas with steep slopes and rocky outcrops. Lithosols are often referred to as rock outcrop soils which are characterized by their shallow depth, low nutrient content, and poor water-holding capacity, the thickness of lithosols is often limited to a few centimeters. The Lithosols are susceptible to erosion and land degradation due to their shallow depth, these soils are particularly. Despite these challenges, lithosols support a diverse range of vegetation and have a range of uses, including grazing land, forestry, wildlife habitats, and horticulture. Generally, the soil type significantly influences the soil erosion status because soil erodibility, water holding, and infiltration capacity vary for different soil types.

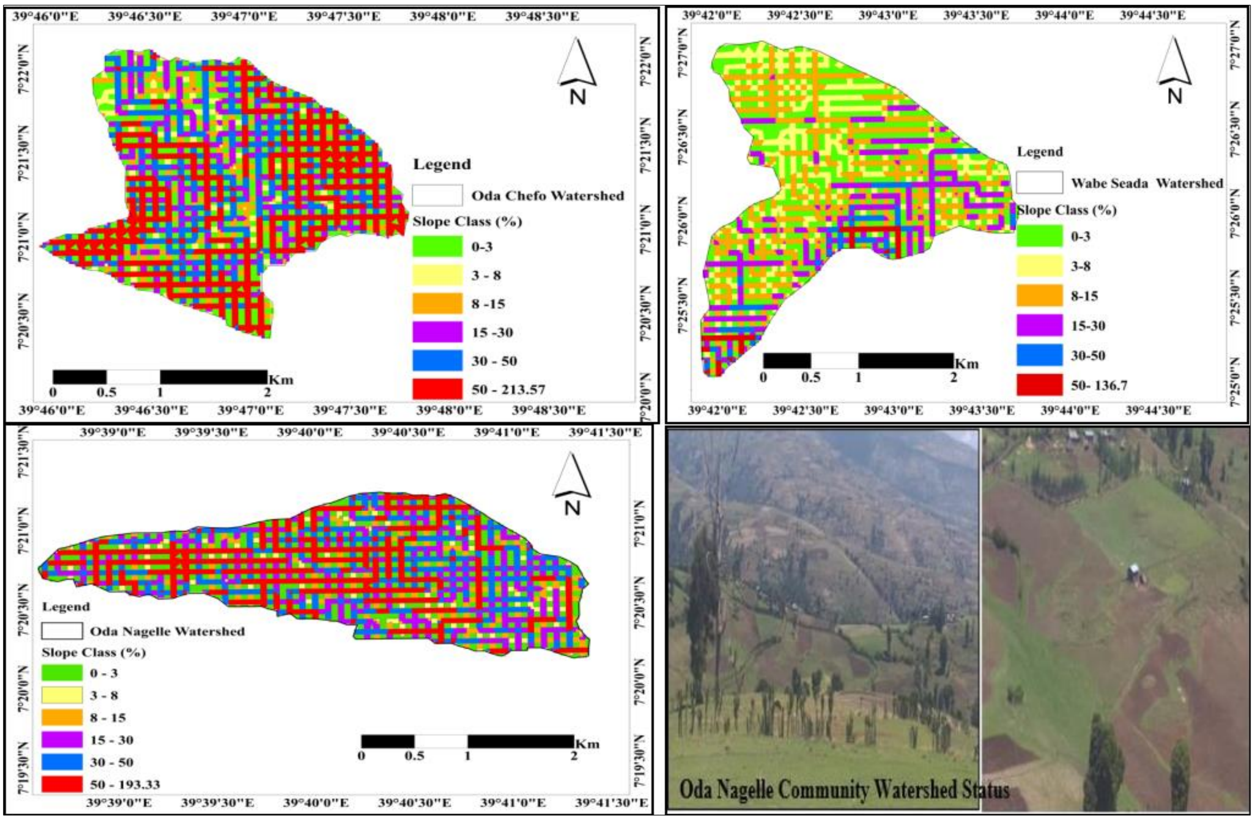

Figure 2: Slope class map Oda Chefo, Wabe Seada and Oda Nagelle Community Watershed *of the Agarfa District*

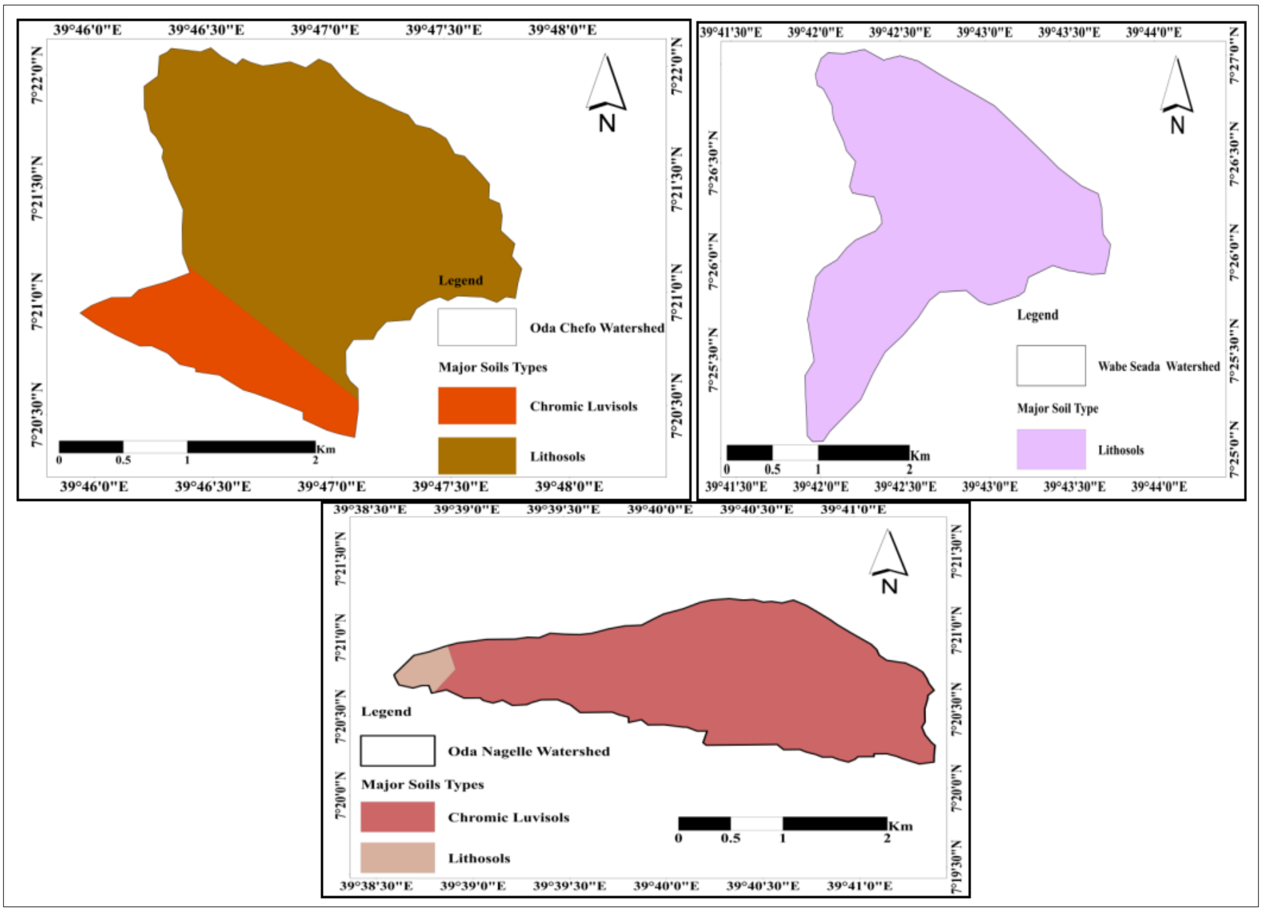

Figure 3: Major Soil types *Oda* **Chefo, Wabe Seada and Oda Nagelle Community Watershed** *of the Agarfa District*

Land Use Land Cover

The results of LULC indicate that the highest percentage (68.58 %) and the lowest (2.17 %) cover cultivated and bare land, respectively (Figure 4 and Table 5). The highest percentage of land use type subjected under cultivated land. This indicates potential causes for deforestation and a limited availability of grazing land. This result shows that agricultural practices main sources of livelihood that need great attention on their sustainability.

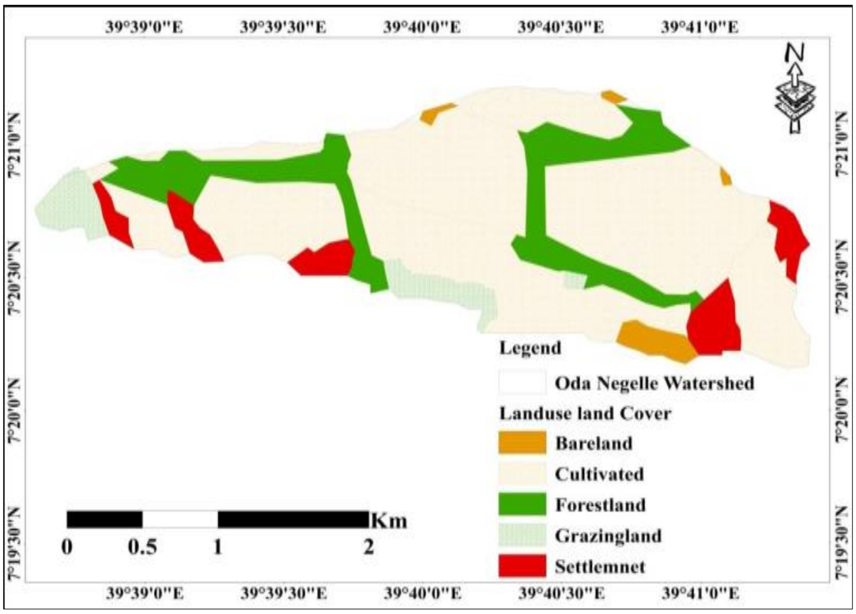

Figure 4: LULC map of Oda Negelle Community watershed selected for innervations.

Table 5: LULC types and area coverage Oda Negelle Community watershed

No	Types	Area (ha)	Area (%)
1	Bare land	12.41	2.17
2	Cultivated	392.98	68.58
3	Forestland	94.03	16.41
4	Grazing land	30.42	5.31
5	Settlement	43.21	7.54

Socioeconomic Characteristics Community Watersheds

Technology adoption, active participation in community development planning, and strategy formulation, especially in watershed management, are influenced by various socioeconomic characteristics such as education, family size, farm size, and age of the household (Mulugeta *et al*., 2017). These factors play a vital role in determining people's participation and decision-making in community development.

Demographic Characteristics

The demographic characteristics of farmers such as respondents' distribution across the watersheds, religion, marital status, sex, education level, age, and family size of respondents are presented below.

Respondents' Distribution across Watersheds

According to the data presented in Figure 5, a total of 121 respondents participated in this study. Among them, 62.8% (76) of the surveyed respondents were from the Oda Nagelle watershed. About 19% (23) of the respondents were from the Wabe Seada watershed, while 18.2% (22) of the respondents were from the Oda Chefo watershed.

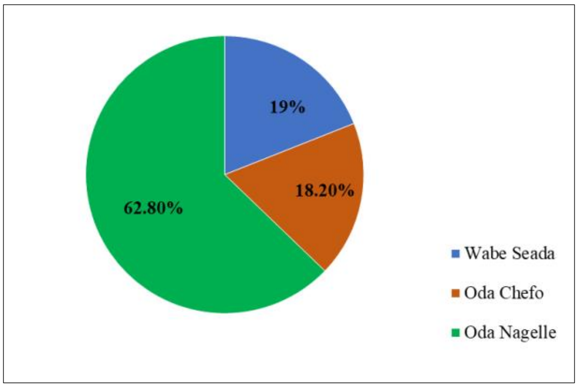

Figure 5: Respondent's Distribution across Watersheds

Marital Status of the Respondents

Regarding marital status, out of the total respondents 97.5% were married while, 0.8% and 1.7% were widowed/divorced and single, respectively. Different studies confirmed that marital status determines participation of individual characteristics in watershed development activities (Dolisca *et al*., 2006; Faham *et al*., 2008; Agidew and Singh, 2018).

Sex of the Respondents

The results show 91.7% and 8.3% were male and female respondents, respectively (Table 6). This showed that male farmers have more access to contact with external bodies than females due to the sociocultural factors and multiple responsibilities of women in the household. Like other demographic factors, gender determines the participation of individual characteristics in watershed development activities (Dolisca *et al*., 2006; Faham *et al*., 2008; Agidew and Singh, 2018). Male farmers associated better with their decision to be involved in watershed management programs than women (Agidew and Singh, 2018). This might be due to male farmers being more capable of resources such as land than their women counterparts this does not mean the contribution of women in watershed management is lower.

Achieve a 20% increase in agricultural productivity in sub-Saharan Africa it is necessary to ensure that women have equal access to land, seeds, and fertilizers (FAO, 2009). Male-headed households have better access to land and water conservation technologies; have more authority to make adoption decisions than female-headed households (Ahsanuzzaman, 2015; Agidew and Singh, 2018 and Abebe, 2022). The argument is that male-headed households often get more new information and better risk-takers about technologies than female-headed households. The number of Male-headed households is higher in watershed management than female households because the life of rural farm households mainly depends on agriculture which requires more labor for various activities like land preparation, planting, weeding, cultivation, harvesting, threshing, and other practices (Mulugeta *et al*., 2017).

Table 6: Demographic Characteristics of respondents

Categories	Frequency	Percent
Religion		
Muslim	116	95.9
Orthodox	5	4.1
Total	121	100
Marital status		
Married	118	97.5
Divorced/widowed	1	0.8
Single	2	1.7
Total	121	100
Sex		
Male	111	91.7
Female	10	8.3
Total	121	100
Descriptive	**Age of household head**	**Total family size**
Minimum	18	1
Maximum	80	23
Mean	41.74	9
Standard deviation	12.86	4.27

Source: own computation from survey data, 2022

Age of the Household Heads'

Household age is necessary for watershed management because it enables careful design of the activities related to the age. Accordingly, the result demonstrated that the average age of a sample respondent was 41.74 years, with a minimum of 18 years and a maximum of 80 years (Table 6). This showed that most of them are in active age. Among demographic factors, the age of the household determines participation individual characteristics in watershed development activities (Dolisca *et al*., 2006; Faham *et al*., 2008; Agidew and Singh, 2018). Age positively influences adoption of watershed management practices since older farmers have a relatively good experience of watershed constraints compared with younger farmers (Abebe, 2022). This means that interventions incorporated into watershed management technologies influenced by household age that correlated with farmers' awareness, participation, and adoption. In contradiction, age negatively influences farmers' attitude toward watershed management program since older farmers lack the labor required to maintain and practices soil and water conservation (Belete, 2017; Daniel and Mulugeta, 2017).

Younger farmers tend to exhibit higher levels of technical efficiency than older farmers, primarily due to their ability to readily adopt new technologies and thereby enhance their efficiency (Battese and Coelli, 1995). The middle group (16-60 years) is ideally the most productive age group in farming compared to other age categories, especially in agricultural activities, SWC measures, and general watershed management (Mulugeta *et al*., 2017).

Family size of Respondents

Family size also affects household participation in soil and water conservation. Household family size is one of the demographic factors that determine participation individual characteristics in watershed development activities (Dolisca *et al*., 2006; Faham *et al*., 2008; Agidew and Singh, 2018). The family member is the main source of labor supply for agriculture and natural resource conservation in most developing countries including Ethiopia. According to the survey, the average family size of the sample respondents was found to be 8.52 persons, with minimum and maximum of 1 and 23 family sizes, respectively (Table 6). This finding revealed that there may not be a labor shortage for natural resource conservation in the area. In order to ensure successful and fruitful integrated watershed management programs to improve the livelihood of the community sufficient agricultural labor force is required (Agidew and Singh, 2018). Thus, a lack of interest in soil and water conservation measures occurred due to a shortage of labor, to undertake farm activities and correlated with the farmers' decision to participate in watershed management programs.

Family size is negatively related to the adoption and practices of watershed management technologies due to households with larger family sizes are likely to face food scarcity to maximize short-term benefits less interested in soil conservation measures whose benefits can be obtained in the long term (Abebe, 2022). However, contrary to this study large family size was positively related to the adoption and practices of watershed management technologies hence, due to large family size is favorable to supplying more labor in conservation work which needs more labor force (Chavai *et al*., 2012; Daniel and Mulugeta, 2017 and Belete, 2017). Household size and characteristics are directly related to supply, and demand and also influence adopting integrated watershed management (Mulugeta *et al*., 2017).

Education Level of Respondents

The result revealed that 73.6% (89) of respondents had a primary (1-8) education level. About 12.4% (15) of the surveyed farmers were uneducated. About 10.5% (13) and 2.5% (3) had secondary (9-10) and preparatory education levels, respectively while only 0.8% (1) of sample respondents had college level (Figure 6). The finding showed that education access is better in the area since a large portion of respondents (87.6%) were educated (Figure 6). According to Agidew and Singh (2018) and Azizi and Zamani (2009) educated households have a better understanding and participation in developmental projects than uneducated colleagues.

Hence, it is evident that participation is positively linked to farmers' decision to engage in watershed management programs. This can be attributed to the bottom-up approach, which allows farmers to engage in comprehensive discussions regarding the significance and long-term advantages of such programs. Highly educated farmers have a greater understanding and acceptance of developmental projects. Household level of education also affects the ability to comprehend, make decisions, and adopt new farming technologies (Faham *et al*., 2008 and Mulugeta *et al*., 2017).

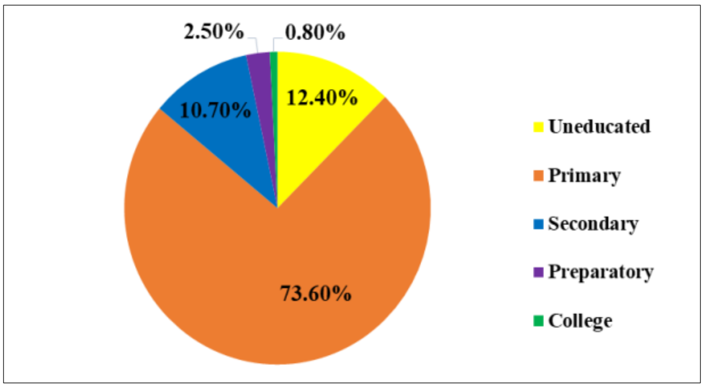

Figure 6: Education level of respondents

Land Ownership, Means of Land Access and Land Holding Size

Land ownership also affects the efficient use of land and influences soil and water conservation practices. Among the respondents included in the survey, 96.7% and 3.3% of them have land and haven't, respectively. Out Of about 117 farmers who have land, the majority of them (69.23%) accessed it through inheritance from their parents (Table 7). Similarly, 21.37% of them accessed through the government while 9.4% of them rented (Table 7). The presence of land ownership among the majority of the respondents presents a favorable opportunity for implementing soil and water conservation (SWC) practices in the area. The farmer's decision to participate in watershed management programs depends on land ownership to conduct a long-term investment in their farmland (Agidew and Singh, 2018). The finding also showed that the average land size owned by a household was 1.07 hectares with a maximum and a minimum of 0.083 and

4.1 hectares, respectively with a standard deviation of 0.83 (Table 7).

This result implied that there is a great variation in land holding. Land ownership is crucial for the overall development of society in the context of a watershed that determines the participation of the community in watershed management activities to conserve, manage, and use natural resources (Anantha *et al*., 2009). This confirms that land ownership builds a strong base for the utilization and management of resources for production purposes in a given watershed. The integrated watershed management adoption depends on farm size, and farmers who hold large farms are more likely to more invest in soil and water conservation measures than less farms size (Aklilu, 2006 and Birtukan *et al*., 2020).

Different studies conducted by Zarafshani *et al.*, (2008), Sharma and Sisodia (2008), and Agidew and Singh (2018) land holding size is strongly associated with farmers' participation because it plays a central role in producing crops, livestock rearing, and positively related existence of conservation measures on farmland. This means farmers with large farm sizes could decide to participate in watershed management programs to increase their agricultural productivity. This result is also in line with the findings of Arun *et al.,* (2012) who reported that the participation of farmers increases as farm size increases. The size of farmland was found to be negatively associated with the adoption and practices of watershed management technologies due to households' larger holdings having a higher probability of applying the labor-intensive nature of constructing soil conservation structures to the fact that conservation structures need lots of labor compared to those with relatively lower farm size (Abebe, 2022). However, opposed to this study Agidew and Singh (2018) stated that farmers who have larger farms are more likely to invest in the adoption and practices of watershed management technologies.

Table 7: Land ownership and means of land access

Land holding			**Frequency**	**Percent (%)**
Yes			117	96.7
No			3	3.3
Total			121	100
Means of access				
Inherited from the parents			81	69.23
Government			25	21.37
Rented in			11	9.4
Total			117	100
Land size owned (ha)				
Minimum	Maximum	Mean	Std. deviation	
0.083	4.1	1.07	0.83	

Source: own computation from survey data, 2022

Crop Production and Its Production Patterns

In the Oda Negelle community watershed, two cropping patterns crop rotation (76.4%) and mono-cropping (23.6%) were adopted (Table 8). Similarly, in the Wabe Seada communities watershed 22.7%, 4.5%, 22.7%, and 50% practiced mono-cropping, double cropping, inter-cropping, and crop rotation, respectively (Table 8). In the Oda Chefo watershed, 20%, 25%, 45%, and 10% practiced inter-cropping, crop rotation, mono-cropping, and double-cropping, respectively (Table 8). Integrated watershed management reduced soil erosion and increased crop yields specifically, whereby crop yield has increased by (22%) on some farms within one year of bund construction and more than 50% after three years with similar farming practices (Abay, 2011). Similarly, different authors Tesfaye (2011); Gerbe-Mariam *et al.*, (2015); Meaza (2015), and Birtukan *et al.*, (2020) stated that watershed management has a positive and significant impact on crop production due to improved soil fertility by reducing soil erosion.

Table 8: Cropping patterns in the Watersheds

Watershed	**Descriptive**	**Intercropping**	**Rotation**	**Mono cropping**	**Double cropping**
Wabe Seada	Frequency	5	11	5	1
	%	22.7	50.0	22.7	4.5
Oda Chefo	Frequency	4	5	9	2
	%	20.0	25.0	45.0	10.0
Oda Negelle	Frequency	0	55	17	0
	%	0.0	76.4	23.6	0.0
Total	Frequency	9	71	31	3
	%	7.9	62.3	27.2	2.6

Source: own computation from survey data, 2022

Participation in SWC Practice and Existing Type of SWC on Farm Land

The result shows that 62.8% of the respondents practiced soil and water conservation measures on their farmland (Table 9). Soil and water conservation measures of 65.2%, 72.7%, and 59.2% were practiced by respondents on their land in Wabe Seada, Oda Chefo, and Oda Nagelle watersheds, respectively. Based on types of SWC measures, 69.7% of them practiced Physical SWC measures, and 23.3% practiced both Physical and biological SWC measures. Among respondents from the Wabe Seada watershed, 20% practiced Physical SWC measures, and 80% practiced both Physical and biological SWC measures.

About 75% of respondents from the Oda Chefo watershed practiced SWC measures, and 25% practiced physical and biological SWC measures. Similarly, 69.7% and 30.3% of respondents from the Oda Nagelle watershed practiced Physical and biological SWC measures, respectively (Table 9). Soil and water conservation measures implemented in various watersheds through mobilization or campaigns, but most have not been sustainable in soil erosion control as they have collapsed due to different factors (Mulugeta *et al*., 2017). Similarly, in the studied watershed, soil and water conservation measures constructed were not removed, due to limited farmer awareness creations, less attention to the technical standard of biophysical SWC measures such as recommended structures, vertical and horizontal distance, missing much with slope, lack of integrated with biological measures, and some of them removed by farmers after constructed because of unpaid farmer expected incentive.

Table 9: Participation in SWC and existing type of SWC

Watershed	Descriptive	SWC Practices		Type of SWC practiced	
		Yes	No	Physical	Both physical and biological
Wabe Saeda	Frequency	15	8	3	12
	%	65.2	34.8	20.0	80.0
Oda Chefo	Frequency	16	6	12	4
	%	72.7	27.3	75.0	25.0
Oda Negelle	Frequency	45	31	38	7
	%	59.2	40.8	84.4	15.6
Total	Frequency	76	45	53	23
	%	62.8	37.2	69.7	30.3

Source: own computation from survey data, 2022

Household Primary and Secondary Occupation

In this study, agriculture is the primary occupation held by about 95.9% of the respondents. The remaining 3.3% and 0.8% are trading and others, respectively (Table 10). Similarly, 73.6% of the respondents have no secondary occupation. Agriculture is the secondary occupation for 3.3%. Trading, government employment, and other occupations are the secondary occupations for 14.9%, 1.7%, and 6.6% respectively (Table 10). The finding revealed that agriculture (crop production and livestock rearing) is the main means of living and source of job opportunities in the watersheds. Farmers' participation in off-farm income-generating activities is positively correlated with farmers' decisions to participate in watershed management programs (Agidew and Singh, 2018).

Table 10: Household primary and secondary occupation of respondents

Household primary occupation			Household secondary occupation		
Activities	**Frequency**	**Percent (%)**	Activities	**Frequency**	**Percent (%)**
Agriculture	116	95.9	Agriculture	4	3.3
Trading	4	3.3	Trading	18	14.9
other	1	0.8	Government Employer	2	1.7
Total	121	100	Other	8	6.6
			none	89	73.6
			Total	121	100

Source: own computation from survey data, 2022

Household Sources of Incomes in the Watershed

Rain-fed crop income was the main source of household annual income for both the downstream and upstream beneficiaries such as crop production, animal production, natural resource use, employed earnings by salary, vegetable production, and off-farm activities (Table 11- Table 13). Household sources of income are one of the demographic factors that determine participation individual characteristics in watershed development activities (Dolisca *et al.*, 2006; Faham *et al*., 2008; Agidew and Singh, 2018). Household incomes were affected based on, watershed management practices (Birtukan *et al*., 2020).

Table 11: Household Primary Income Source Table

Watersheds	Descriptive	Primary income sources								Total
		Crops	Fruits	Vegetables	Livestock	Petty trade	Handcraft	Employment	Fattening	
Wabe Seada	Frequency	1	7	4	11	0	0	0	0	23
	%	4.3	30.4	17.4	47.8	0	0	0	0	100
Oda Chefo	Frequency	5	4	8	4	0	1	0	0	22
	%	22.7	18.2	36.4	18.2		4.5			100
Oda Negelle	Frequency	51	1	2	14	3	0	1	2	76
	%	698	1.4	2.7	18.9	4.1		1.4	2.7	100
Total	Frequency	57	12	14	29	3	1	1	2	121
	%	47.9	10.1	1.8	24.4	2.5	0.8	0.8	1.7	100

Source: own computation from survey data, 2022

Table 12: Household Secondary Income Source Table

Watersheds	Descriptive	Secondary income sources										Total
		Crops	Fruits	Vegetables	Livestock	Trade	Handcraft	Employment	Fattening	Beehives	None	
Wabe Seada	Frequency	8	2	3	6	1	0	0	1	2	0	23
	%	34.8	8.7	13	26.1	4.3	0.0	0.0	4.3	8.7	0.0	100
Oda Chefo	Frequency	1	1	7	10	0	1	0	0	0	1	21
	%	4.8	4.8	33.3	47.6	0.0	4.8	0.0	0.0	0.0	4.8	100
Oda Negelle	Frequency	17	1	3	45	2	1	1	0	0	0	70
	%	24.3	1.4	4.3	64.5	2.9	1.4	1.4	0.0	0.0	0.0	100
Total	Frequency	26	4	13	61	3	2	1	1	2	1	114
	%	22.8	3.5	11.4	53.5	2.6	1.8	0.9	0.9	1.8	0.9	100

Source: own computation from survey data, 2022

Table 13: Household Tertiary Income Source Table

Watersheds	Descriptive	Tertiary income sources										Total
		Crops	Fruits	Vegetables	Livestock	Tree	Trade	Handcraft	Employment	Fattening	Beehives	
Wabe Seada	Frequency	3	0	6	5	1	0	0	0	1	4	20
	%	15	0.0	30	25	5	0.0	0.0	0.0	5	20	100
Oda Chefo	Frequency	3	3	0	1	0	2	0	1	0	0	11
	%	27.3	27.3	0.0	9.1	0.0	18.2	0.0	9.1	0.0	0.0	100
Oda Negelle	Frequency	3	1	0	8	0	2	2	1	4	9	30
	%	10	3.3	0.0	26.7	0.0	6.7	6.7	3.3	13.3	30	100
Total	Frequency	9	4	6	14	1	4	2	2	5	13	61
	%	14.8	6.6	9.8	23	1.6	6.6	3.3	3.3	8.2	21.3	100

Source: own computation from survey data, 2022

Major Crops Produced in the Watersheds

Major Cereal Crops

The major cereal crops produced in the area were bread wheat, food barley, emmer wheat, teff, sorghum, and maize (Table 14). Food barley was produced by 27% while emmer wheat was produced by 31.4%. Sorghum and teff were the minor cereal crops produced by small farmers that account for only 11.6% and 6.6% of the respondents, respectively (Table 14).

Table 14: Cereal crops produced in the watersheds

Cereal crops	Descriptive	Wabe Seada		Oda Chefo		Oda Negelle		Total	
		Yes	No	Yes	No	Yes	No	Yes	No
Bread wheat	Frequency	1	22	0	22	65	11	66	55
	%	4.3	95.7		100	85.5	14.5	54.5	45.5
Food barely	Frequency	0	23	0	22	33	43	33	88
	%		100		100	43..4	56.6	27.3	72.7
Emmer wheat	Frequency	0	23	0	22	38	38	38	83
	%	0	100		100	50.0	50.0	31.4	68.6
Teff	Frequency	0	23	5	17	3	73	8	113
	%		100	22.7	77.3	3.9	96.1	6.6	93.4
Sorghum	Frequency	2	21	1	21	12	64	14	107
	%	8.7	91.3	4.5	95.5	15.8	84.2	11.6	88.4
Maize	Frequency	14	9	3	19	55	21	72	49
	%	60.9	39.1	13.6	86.4	72.4	27.6	59.5	40.5

Source: own computation from survey data, 2022

Major Pulse and Oil Crops

Common bean, faba bean, field pea, lentil, and linseed were the major pulse and oil crops produced in the area. According to the result, except for the Oda Nagelle watershed, none of these crops were produced in the Wabe Seada and Oda Chefo watersheds (Table 15).

As shown in Table 15, the faba bean (22.4%) was the largest pulse crop in the Oda Nagelle watershed, followed by field pea (7.9%). Common bean, lentil, and linseed were produced only by 3.9%, 2.6%, and 1.3% of respondents, respectively.

Table 15: Pulse crops produced in the watersheds

Cereal crops	Descriptive	Wabe Seada		Oda Chefo		Oda Negelle		Total	
		Yes	No	Yes	No	Yes	No	Yes	No
Common bean	Frequency	0	23	0	22	3	73	3	118
	%		100		100	3.9	96.1	2.5	97.5
Faba bean	Frequency	0	23	0	22	17	59	17	104
	%		100		100	22.4	77.6	14	86
Field pea	Frequency	0	23	0	22	6	70	6	115
	%		100		100	7.9	92.1	5	95
Lentil	Frequency	0	23	0	22	2	74	2	119
	%		100		100	2.6	97.4	1.7	98.3
Linseed	Frequency	0	23	0	22	1	75	1	120
	%		100		100	1.3	98.7	0.8	99.2

Source: own computation from survey data, 2022

Major Horticulture and Cash Crops

The major horticultural and cash crops produced in the watersheds were tomato, mango, red pepper, banana, orange, sugarcane, and lime. According to the findings, horticultural and cash crops produced in the area were tomato, mango, red pepper, banana, orange, sugarcane, lime, potato, and khat. Tomato and orange were produced by 1.7% of total respondents. Similarly, mango, red pepper, banana, and sugarcane were produced by 3.3%, 5.8%, 7.4%, and 9.9% of respondents, respectively. Similarly, 0.8%, 4.1%, and 2.5% of the respondents participated in the production of lime, potato, and khat respectively (Table 16).

At the Wabe Seada watershed, the most common horticulture crop produced is bananas. Sugarcane is the most produced horticultural crop in Oda Chefo watershed which was produced by 31.8% of sample respondents (Table 16). Khat (13.6%) was the second most produced horticultural and cash crop the respondents stated. Potato was the only horticultural crop produced at the Oda Nagelle watershed by 6.6% and 1.3% of the respondents respectively (Table 16).

Table 11: Horticultural crops produced in the watersheds

Cereal crops	Descriptive	Wabe Seada		Oda Chefo		Oda Negelle		Total	
		Yes	No	Yes	No	Yes	No	Yes	No
Tomato	Frequency	2	21	0	22	0	76	2	119
	%	8.7	91.3		100		100	1.7	98.3
Mango	Frequency	3	18	1	21	0	76	4	113
	%	14.3	85.7	4.5	95.5		100	3.3	93.4
Red pepper	Frequency	7	16	0	22	0	76	7	114
	%	30.4	69.6		100		100	5.8	94.2
Banana	Frequency	8	15	1	21	0	76	9	112
	%	34.8	65.2	4.5	95.5		100	7.4	92.6
Orange	Frequency	1	22	1	21	0	76	2	119
	%	4.3	95.7	4.5	95.5		100	1.7	98.3
Sugarcane	Frequency	4	19	7	15	1	75	12	109
	%	17.4	82.6	31.8	68.2	1.3	98.7	9.9	90.1
Lemon	Frequency	1	22	0	22	0	76	1	120
	%	4.3	95.7		100		100	0.8	99.2
Potato	Frequency	0	23	0	22	0	76	5	116
	%		100		100		100	4.1	95.9
Khat	Frequency	0	23	3	19	5	71	3	118
	%		100	13.6	86.4	6.6	93.4	2.5	97.5

Source: own computation from survey data, 2022

Livestock Production in the Watersheds

Livestock Holding

The survey result shows out of the total survey households, 96.7% have livestock while 3.3% haven't. Livestock ownership was measured by Tropical Livestock Unit (TLU). Hence, the mean livestock ownership among the respondents is 6.14 TLU with a maximum of 30.73 TLU and a minimum of 0 TLU and 5.38 standard deviation (Table 17). According to the result, the major livestock reared in the area were cattle, goats, sheep, donkeys, horses, and chickens. Livestock is an integral component of conventional farming systems and plays a major role in the rural economy with a high contribution to the gross domestic product (Anantha *et al*., 2009). Since watershed development is expected to improve the feed and fodder situation and facilitate dairy development.

In the context of watershed management, less livestock holding/ownership was promoted but its emphasis was on the quality and productivity of the livestock through improved feeds and fodder (Birtukan *et al*., 2020). This implies that watershed management technology adoptions recommended less livestock so that the quality could be assured and the productivity of livestock was increased giving more emphasis on watershed rehabilitation. Similarly, watershed management also promoted the cut-and-carry practice of feeding systems which discourages livestock mobility and number (Birtukan *et al*., 2020).

The number and size of livestock units per household were found to be higher in untreated watersheds than in treated watersheds (Arya *et al*., 2011 and Meaza, 2015). The overall baseline survey result showed that characteristics of livestock feed sources, conditions, and the number of livestock owners might be the possible causes of land degradation in the given watershed. Large livestock farmers are highly interested in participating in watershed management programs as compared to less livestock ownership (Agidew and Singh, 2018). This might be due to the crop-livestock mixed economy being beyond direct food production due to it includes multipurpose such as skins, fiber, fertilizer, and fuel, as well as capital accumulation so such large livestock needs feed and fodder which is one goal of degraded watershed rehabilitation.

Table 17: Livestock ownership and holding

<table>
<tr><td>Livestock ownership</td><td colspan="2">Frequency</td><td>Percent (%)</td></tr>
<tr><td>Yes</td><td colspan="2">117</td><td>96.7</td></tr>
<tr><td>No</td><td colspan="2">4</td><td>3.3</td></tr>
<tr><td>Total</td><td colspan="2">121</td><td>100</td></tr>
<tr><td colspan="4">Total livestock holding (TLU)</td></tr>
<tr><td>Minimum</td><td>Maximum</td><td>Mean</td><td>Std. Deviation</td></tr>
<tr><td>0</td><td>30.73</td><td>6.14</td><td>5.38</td></tr>
</table>

Source: own computation from survey data, 2022

Source of Livestock Feed in the Watersheds

According to the result, the main sources of animal feed in the area are grazing in the field, green feed, hay, crop residue, and open grazing. Accordingly, 48.7% of all respondents used grazing in the field as a feed source with 39.1%, 23.8%, and 58.9% of respondents at the Wabe Seada, Oda Chefo, and Oda Nagelle watersheds, respectively. About 37.6% of all sample respondents used green feed (cut and carry) as a feed source with 56.5%, 42.9%, and 30.1% of respondents at Wabe Seada, Oda Chefo, and Oda Nagelle watersheds, respectively (Table 18). Out of all respondents, only 12.8% of them used hay as a feed source. Hay is used by 13%, 4.8%, and 15.1% of respondents from the Wabe Seada, Oda Chefo, and Oda Nagelle watersheds, respectively. The majority (73.5%) of the respondents in the watersheds used crop residue to feed their livestock with 73.9%, 42.9%, and 82.2% of the respondents from the Wabe Seada, Oda Chefo, and Oda Nagelle watersheds, respectively (Table 18).

Among all surveyed respondents, only 7.7% of them used improved forage as a feed source with 23.8% of respondents from the Oda Chefo watershed and 5.5% of respondents from Oda Nagelle. There were no respondents who used improved forage from the Wabe Seada watershed. This result showed that there is limited access to improved forage in the watersheds and the need to introduce feed technology in the area. Similarly, only 4.3% of all respondents use local beverage by-products for feed with 4.8% and 5.5% of respondents from the Oda Chefo and Oda Nagelle watersheds respectively.

The finding also revealed that about 70.1% of all respondents used open grazing as a feed source in the areas. All (100%) of the respondents from the Wabe Seada watershed used open grazing. Similarly, 90.5% of the respondents from the Oda Chefo watershed and 54.8% from the Oda Nagelle watershed used open grazing. The finding showed that the feed source of the watersheds mostly depends on the traditional way and there was a limitation of feed technologies. Similar, constraints such as feed shortage, disease, marketing, lack of improved genotype, and low reported by (Mulugeta *et al*., 2017).

Table 18: Source of livestock feed in the Watersheds

Feed Sources		Watershed							
		Wabe Seada		Oda Chefo		Oda Negelle		Overall Total	
	Derivative	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Grazing in field	Yes	9	39.1	5	23.8	43	58.9	57	48.7
	No	14	60.9	16	76.2	30	41.3	60	51.3
Green feed (cut and carry)	Yes	13	56.5	9	42.9	22	30.1	44	37.6
	No	10	43.5	12	57.1	51	69.9	73	62.4
Hay making	Yes	3	13.0	1	4.8	11	15.1	15	12.8
	No	20	87	20	95.2	62	84.9	102	87.2
Crop residues	Yes	17	73.9	9	42.9	60	82.2	86	73.5
	No	6	26.1	12	57.1	13	17.8	31	26.5
Improved forage	Yes	0	0	5	23.8	4	5.5	9	7.7
	No	23	100	16	76.2	69	94.5	108	92.3
Beverage by products	Yes	0	0	1	4.8	4	5.5	5	4.3
	No	23	100	20	95.2	69	94.5	112	95.7
Open grazing	Yes	23	100	19	90.5	40	54.8	82	70.1
	No	0	0	2	9.5	33	45.2	35	29.9

Source: own computation from survey data, 2022

Beekeeping Practices in the Watersheds

Beehive Ownership and Types of Bee Hive Owned by Bee Keepers

Among the respondents, the majority of the respondents at Wabe Seada Watershed (60.9%) have bee hives, while 39.1% haven't. At the Oda Chefo watershed, only 19.0% of respondents have bee hives, whereas 81.0% have no bee hives. Similarly, only 32.0% of the respondents at Oda Nagelle participate in beekeeping, and 68.0% do not. In total, among overall respondents, the majority (64.7) of them did not participate in beekeeping. This result showed that beekeeping is a more common practice in Wabe Seada watersheds than any other watersheds (Table 19).

Among the beekeepers who participated in the survey, the traditional type of beehive is the most dominant in all areas which was about 97.7% of all respondent beekeepers. All (100%) of respondent beekeepers from the Wabe Seada and Oda Chefo watersheds have traditional beehives. Similarly, about 95.8% of respondent beekeepers from the Oda Nagelle watershed owned traditional beehives. Only 4.2% of beekeepers from Oda Nagelle had traditional beehives (Table 19). Modern beehives did not exist in all watersheds. The result revealed that the practice of bee-keeping technology in the area is almost null.

Table 19: Beehive ownership among respondents and type of beehive owned

Watersheds	Descriptive	Beehive ownership			Type of beehive		
		Yes	No	Total	Traditional	Transitional	Total
Wabe Seada	Frequency	14	9	23	14	0	14
	%	60.9	39.1	100	100	0.0	100
Oda Chefo	Frequency	4	17	21	5	0	5
	%	19	81	100	100	0.0	100
Oda Negelle	Frequency	24	51	75	23	1	24
	%	32	68	100	95.8	4.2	100
Total	Frequency	42	77	119	42	1	43
	%	35.3	64.7	100	97.7	2.3	100

Source: own computation from survey data, 2022

Trends of Beehive among Bee Keepers in the Watersheds

Out of the total number of beekeepers in the watersheds, only 7.6% of beekeepers responded that the number of beehives they own is increasing. About 5.9% of respondents in Wabe Seada watershed said their number of beehives is increasing and 10.3% of the respondents in Oda Nagelle said their number of beehives is increasing (Table 20). According to the respondents, the reason for increasing the number of beehives among beekeepers was due to increased awareness of bee beekeeping and the increased market price of honey bee products.

The survey result also demonstrated, that out of all beekeepers, about 89.4% of them replied their trend of beehives is decreasing. About 88.2% of the respondents in the Wabe Seada watershed responded that the number of beehives they own is decreasing. Similarly, all respondents (100%) of beekeepers in the Oda Chefo watershed said their trend of the beehive is decreasing while 87.2% of beekeepers at Oda Nagelle said their beehive is decreasing. According to them, a decrease in the number of bee hives is due to problems such as lack of bee forage, pests and predators, lack of beekeeping materials, and the effect of agrochemicals.

On the other hand, only 3% of the overall respondents said that their trend of beehive ownership is unchanged with 5.9%, 0%, and 2.6% of respondents at Wabe Seada, Oda Chefo, and Oda Nagelle watersheds respectively (Table 15). The finding showed that bee keeping in the area had many challenges that may hinder farmers from benefiting from the sector. The increased use of agrochemicals, pests, predator attacks, lack of beekeeping equipment, limited awareness creation, and reduction in honeybee floral resources are the major constraints in beekeeping production (Mulugeta *et al*., 2017).

Table 20: Trends of beehive among bee keepers in the watersheds

Watersheds	Descriptive	Trends of beehive		
		Increasing	Decreasing	Unchanged
Wabe Seada	Frequency	1	15	1
	%	5.9	88.2	5.9
Oda Chefo	Frequency	0	10	0
	%	0.0	100	0.0
Oda Negelle	Frequency	4	34	1
	%	10.3	87.2	2.6
Total	Frequency	5	59	2
	%	7.6	89.4	3.0

Source: own computation from survey data, 2022

Farmers' Perception on Bee Keeping Profitability in the Watersheds

As the result shown in Table 10, the majority of the respondents (94.8%) perceived that beekeeping practice is profitable in the watersheds. On the contrary, only 5.2% perceived it as not important. All respondents from the Wabe Seada watershed perceived beekeeping as profitable in their watershed. About 88.9% and 95.1% from the Oda Chefo and Oda Nagelle watersheds perceived beekeeping practices as profitable, respectively (Table 21).

Table 21: Farmers' perception on bee keeping profitability in the watersheds

Watersheds	Descriptive	Keeping profitable in the watershed	
		Yes	No
Wabe Seada	Frequency	18	0
	%	100	0
Oda Chefo	Frequency	16	2
	%	88.9	11.1
Oda Negelle	Frequency	58	3
	%	95.1	4.9
Total	Frequency	92	5
	%	94.8	5.2

Source: own computation from survey data, 2022

Credit Access and Use among the Respondents

One of the major constraints that significantly affect the growth of agricultural production and productivity in developing countries, including Ethiopia, is limited use of modern inputs and technologies. Among these, one cause for this is a lack of finance for rural farm households (EEA, 2021). Hence, ensuring rural poor financial access has a crucial role in improving technologies adoption among smallholder farmers by alleviating cash constraints and enabling them to buy agricultural inputs. According to Kiplimo *et al.,* (2015), credit financial access has been argued to be the engine of sustainable rural development and a factor necessary for household food security and poverty reduction.

Agricultural credit is crucial for agricultural growth and accelerates technological change to stimulate agricultural production by increasing smallholder farmers' productivity, asset creation, and food security. It serves as a temporary replacement for personal savings. The result of this study showed that about 94.2% of the respondents haven't access to credit services while only 5.8% have credit access (Table 22).

According to the responses from the respondents, none of them used credit services. The major reason for not using credit was lack of access to it. The other reasons include collateral problems, religious purpose, reliance on their resource, and lack of awareness of credit importance. Access to credit services supports to purchase of agricultural inputs and overall it reduces problems that households could face in watershed management (Mpawenimana, 2005 and Agidew and Singh, 2018). Thus, access to credit services is positively correlated with the farmers' decision to engage in watershed management programs.

Table 22: Credit access and use among the respondents

Credit categories	Descriptions	Frequency	Percent (%)
Access to credit	Yes	7	5.8
	No	114	94.2
	Total	121	100
Credit use	Used	0	0
	Not used	121	100
	Total	121	100

Source: own computation from survey data, 2022

Prioritization of Major Constraints in the Watersheds

Priority constraints in watersheds were identified and ranked according to how often respondents responded to them as a constraint in their area. These constraints are soil erosion, soil fertility issues, deforestation, and climate change are the land and land-related constraints identified in the area. According to the results, the problem of soil erosion occupies the leading position in watersheds. Soil fertility, climate change, and deforestation are the second, third, and fourth constraints in the area, respectively (Table 23). Declining crop yields are the primary production-related problem in watersheds. Crop pests and diseases were identified as the second and third most prominent problems in the region, while lack of access to irrigation was identified as the fourth problem (Table 23). Soil degradation, high prices of chemical fertilizers, lack of improved seeds, and the existence of pests, diseases, and weeds are major constraints in agricultural production and contribute significantly to low yields (Mulugeta *et al*., 2017).

The major institutional and infrastructural-related constraints identified in the watersheds were credit constraints, market constraints, road accessibility constraints, and cooperative constraints. Among these constraints, credit is the first constraint while cooperative, road accessibility, and market ranked second up to fourth, respectively (Table 23). According to the respondents, the existing transportation was costly. Similarly, the cooperatives are ineffective.

The major livestock-related constraint in the area was feed and fodder constraints which ranked first. Animal disease was the second constraint whereas the grazing system was the third constraint (Table 23). The feeding system majorly depends on the natural fodder and planted crops. Some farmers replied that open grazing systems affect them especially planting, and soil and water conservation was affected by livestock. The major socio-economic constraints identified in the area were human disease, employment opportunities, food shortage, and water scarcity. Among these constraints, lack of employment opportunities was the first problem, and human disease ranked second. Water scarcity and food shortage were the third and fourth constraints, respectively (Table 23).

Table 23: Prioritization of major problems in the Watersheds

No.	Constraints	Wabe Seada		Oda Chefo		Oda Negelle		Total	
1	**Land and soil**	Frequency	Rank	Frequency	Rank	Frequency	Rank	Frequency	Rank
	Soil erosion severity	21	3rd	19	2nd	76	1st	116	1st
	Soil fertility decline	22	2nd	19	2nd	73	2nd	114	2nd
	Deforestations	16	4th	14	4th	61	4th	91	4th
	Climate change	23	1st	21	1st	66	3rd	110	3rd
2	**Production**								
	High agricultural input price	17	3rd	19	2nd	40	3rd	76	3rd
	Pest and disease	18	2nd	18	3rd	69	2nd	105	2nd
	Yield decline	20	1st	22	1st	70	1st	112	1st
	Lack of irrigation access	2	4th	0	-	1	4th	3	4th
3	**Institute and infrastructure**								
	Lack of credit access	21	1st	18	2nd	64	1st	103	1st
	Market linkage	21	1st	11	3rd	42	4th	74	4th
	Road	8	4th	6	4th	46	3rd	60	3rd
	Cooperatives facility	19	3rd	20	1st	47	2nd	86	2nd
4	**Livestock**								
	Feed and fodder shortage	23	1st	21	1st	71	1st	115	1st
	Disease	21	2nd	21	1st	59	3rd	101	2nd
	Grazing system	17	3rd	13	3rd	62	2nd	92	3rd
5	**Socioeconomic**								
	Human disease	17	1st	11	2nd	70	2nd	70	2nd
	Unemployment	17	1st	18	1st	98	1st	98	1st
	Food shortage	6	3rd	7	3rd	27	3rd	27	4th
	Water shortage	6	3rd	10	4th	29	4th	29	3rd

Source: own computation from survey data, 2022

Prioritization of Major Opportunities in the Watersheds

Prioritization of the existing opportunities is essential as the cornerstone for planning and interventions of development programs that can improve the living standard of the communities in the area. Starting programs based on existing opportunities can lead to more success. Consequently, in this study, the prioritization of significant opportunities in the watersheds was carried out by evaluating the responses of the sample respondents.

Socioeconomic Opportunities

Availability of labor force, market accessibility, transport services, and source of feed were the socioeconomic opportunities identified by the respondents in the area. According to the respondents, the availability of a labor force was the first-ranked socioeconomic opportunity in the area. The other opportunities were market accessibility, transport services, and source of feed are the second, third, and fourth opportunities in the area, respectively (Table 24).

Institutional Opportunities

The institutional opportunities in the watersheds are farmer cooperatives, the availability of livestock clinics, the availability of youth and women's associations, and informal organizations such as Equb and Debo. Among these opportunities, informal institutions ranked first whereas the availability of livestock clinics, farmers' cooperatives, and availability of youth and women associations ranked second to fourth, respectively (Table 24).

Table 24: Prioritization of major opportunities in the Watersheds

No.	Opportunities	Wabe Seada		Oda Chefo		Oda Negelle		Total	
1	**Socioeconomic opportunity**	Freq	Rank	Freq	Rank	Freq	Rank	Freq	Rank
	Availability of labor force	23	1st	22	1st	71	1st	116	1st
	Source of feed	3	4th	5	4th	31	4th	39	4th
	Local Market accessibility	9	3rd	14	3rd	51	2nd	74	2nd
	Transport services	12	2nd	17	2nd	38	3rd	67	3rd
2	**Institutional opportunity**								
	Farmer cooperatives	6	2nd	3	2nd	35	3rd	44	3rd
	Livestock clinic	0	-	1	4th	53	2nd	54	2nd
	Youth and women association	3	3rd	3	2nd	27	4th	33	4th
	Informal intuitions	13	1st	14	1st	56	1st	83	1st

Source: own computation from survey data, 2022

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

The baseline socioeconomic and biophysical status assessment, characterization, identification, and prioritization of major constraints and opportunities is a crucial role and priority activities to be done to bring positive and significant impact during interventions and finally, better monitoring and evaluation of a given project's performance. The overall respondents' perception and status of socioeconomic and biophysical status variables namely age, marital status, gender, family size, educational status, farm size, livestock production, land owner and use types, and slope are key factors that influence negatively or positively the watershed management programs.

During the baseline survey conducted in three selected community watersheds, a majority of the respondents identified several significant constraints. These included soil fertility decline, soil erosion, climate change, feed shortage, crop and livestock diseases, infrastructure problems, and lack of awareness. These constraints had negative consequences such as decreased crop production, loss of biodiversity, decline in livestock production and productivity, and food insufficiency.

It is crucial to prioritize efforts towards increasing production to address these challenges and improve the livelihoods of the communities. This can be achieved through the integration of various watershed management technologies in agriculture, enabling efficient utilization of resources and promoting sustainability.

Furthermore, the survey results provide valuable insights into the potential changes that may occur after implementing interventions in the economic, ecological, and social systems of the community's watersheds. They also serve as valuable inputs for planners, decision-makers, and other stakeholders with diverse objectives.

Recommendation

- A baseline survey should be recommended in the first phase of any activities and interventions in the watershed to ensure fruitful works and impact analysis in degraded watershed rehabilitation and improve the livelihoods of communities.
- Training and awareness creation for different stakeholders' severity and extent of erosion possible adoption and practices of watershed management technologies, multi-disciplinary team, and FRG should be established to initiate their commitment, plan and coordinate at the community watershed is recommended
- Integrating biophysical soil and water conservation measures for the reclamation rehabilitation of the expansions of gully's erosion and other forms of soil erosion is recommended.
- In addition to layout and construction of biophysical SWC measures and vermiculture establishment and vermicompost production for soil erosion control and soil fertility improvement promote households' income-generating activities at the homestead namely, planting of fruit trees, vegetable production, and fodder trees together are recommended.

Acknowledgements

The authors express their sincere gratitude to the Oromia Agricultural Research Institute for its collaborative efforts and extensive work in improving community livelihoods through multi-stakeholder engagement. Special recognition is also extended to the CALM P4R project for providing financial support that enabled the successful execution of this study. The authors would like to acknowledge the invaluable logistic support provided by the Sinana Agricultural Research Center. Furthermore, the authors would like to extend their thanks to all individuals who contributed to the completion of this study.

REFERENCES

- Abebe, A. M. (2022). Factors Affecting Adoption of Watershed Management Program in Mirab-Abaya Districts of Southern Ethiopia. *J Agri Horti Res,* 5(2), 122-130.
- Abebe, A. M. (2022). Factors Affecting Adoption of Watershed Management Program in Mirab-Abaya Districts of Southern Ethiopia. *J Agri Horti Res,* 5(2), 122-130.
- Adimassu, Z., Kessler, A., & Stroosnijder, L. (2013). Co-investments in land management: lessons from the Galessa watershed in Ethiopia. *International Journal of Sustainable Development & World Ecology*, *20*(6), 532-541.
- Agidew, A. M. A., & Singh, K. N. (2018). Factors affecting farmers' participation in watershed management programs in the Northeastern highlands of Ethiopia: a case study in the Teleyayen sub-watershed. *Ecological processes*, *7*, 1-15.
- Agidew, A. M. A., & Singh, K. N. (2018). Factors affecting farmers' participation in watershed management programs in the Northeastern highlands of Ethiopia: a case study in the Teleyayen sub-watershed. *Ecological processes*, *7*, 1-15.
- Ahmed, M., Mumtaz, R., & Anwar, Z. (2022). An enhanced water quality index for water quality monitoring using remote sensing and machine learning. *Applied Sciences*, *12*(24), 12787.
- Ahsanuzzaman, A. (2015). Three essays on adoption and Impact of Agricultural Technology in Bangladesh.
- Aklilu Amsalu Taye, A. A. T. (2006). Caring for the land: best practices in soil and water conservation in Beressa watershed, highlands of Ethiopia.
- Alufah, S., Shisanya, C. A., & Obando, J. A. (2012). Analysis of factors influencing adoption of soil and water conservation technologies in Ngaciuma sub-catchment, Kenya. *African Journal of Basic & Applied Sciences*, *4*(5), 172-185.
- Anantha, K. H., Wani, S. P., & Sreedevi, T. K. (2009). Baseline socio-economic characterization of watersheds.
- Anowar, M., Parveen, A., Ferdous, Z., Kafi, A. H., & Kabir, M. E. (2015). Baseline survey for farmer livelihood improvement at farming system research and development, Lahirirhat, Rangpur. *Int. J. Bus. Manag. Soc. Res*, *2*, 92-104.
- Arya, S. L., Panwar, P., & Yadav, R. P. (2011). Role of watershed management in bridging demand–supply gap of fodder for enhancing livestock production in Shivaliks, Haryana. *Agricultural Economics Research Review*, *24*(2), 225-234.
- Asfaw, D., & Neka, M. (2017). Factors affecting adoption of soil and water conservation practices: the case of Wereillu Woreda (District), South Wollo Zone, Amhara Region, Ethiopia. *International Soil and Water Conservation Research*, *5*(4), 273-279.
- Belete, L. K. (2017). Factors affecting adoption of soil and water conservation practices in the case of Damota Watershed, Wolayita zone, Southern Ethiopia, *International Journal of Agricultural Science Research*, *7*(1).
- BER (Bale Eco-Region). (2017). Bale Eco-Region Watersheds: Socio-economic Profile. SHARE Bale Eco-Region Research Report Series no. 8.
- Chavai, A. M., Barange, P. K., & Pawar, Y. B. (2012). Adoption of salt affected soil reclamation practices by the farmers of Maharashtra. *Journal of Agriculture Research an d Technology*, *37*(3), 429-432.
- CSA (Central Statistical Agency). 2021. Federal Democratic Republic of Ethiopia Central Statistical Agency Agricultural Sample Survey 2020/21 (2013 E.C.) Volume II Report on Livestock and Livestock Characteristics (Private Peasant Holdings).
- Dufera, B., Dube, D. K., & Aschalew, A. (2020). Socio-Economic Impacts, and Factors Affecting Adoption of Watershed Management Practices Between the Treated andUntreated Micro-Watersheds in the Chirachasub-Watershed of Ethiopia. *PalArch's Journal of Archaeology of Egypt/Egyptology*, *17*(9), 4528-4548.
- EEA (Ethiopian Economics Affair). (2021). Agricultural Finance and Insurance in Ethiopia : Challenges and Policy Options.
- Eshetu, M., Sebboka, S., & Almata Gezachew, F. (2017). Assessment, Resources Characterization and Mapping of Ilasa Watershed in the Case of Goba Distinct in Highland of Bale Zone, Southeastern Ethiopia. *American-Eurasian J. Agric. & Environ. Sci*, *17*(6), 499-513.
- Firdaus, R., Nakagoshi, N., & Idris, A. (2014). sustainability assessment of humid tropical watershed: a case of Batang Merao watershed, Indonesia. *Procedia Environmental Sciences*, *20*, 722-731.
- Gebregziabher, G., Abera, D. A., Gebresamuel, G., Giordano, M., & Langan, S. (2016). *An assessment of integrated watershed management in Ethiopia* (Vol. 170). International Water Management Institute (IWMI)..
- Gebremeskel, K., Teka, K., Birhane, E., & Negash, E. (2019). The role of integrated watershed management on soil-health in northern Ethiopia. *Acta Agriculturae Scandinavica, Section B—Soil & Plant Science*, *69*(8), 667-673.
- Habtamu, T. (2011). Assessment of sustainable watershed management approach case study lenche dima, tsegur eyesus and dijjil watershed. *Master of professional studies thesis, Cornell University, Dahir Dar*.
- Hurni, H., Berhe, W. A., Chadhokar, P., Daniel, D., Gete, Z., Grunder, M., & Kassaye, G. (2016). Soil and water conservation in Ethiopia: guidelines for development agents.
- Kiplimo, J. C., Ngenoh, E., Koech, W., & Bett, J. K. (2015). Determinants of access to credit financial services by smallholder farmers in Kenya. *Journal*

of Development and Agricultural Economics, *7*(9), 303-313.

- Meaza, H., & Hadush, M. (2015). the role of community based watershed management for climate change adaptation in Adwa, Central Tigray Zone. *International Journal of Weather, Climate Change and Conservation Research*, *1*(1), 11-35.
- MoA (Ministry of Agriculture Agents). 2016. Soil and Water Conservation in Ethiopia (Guidelines for Development), Ethiopia.
- Negasa, D. J. (2020). Major constraints of watershed management practices in Ethiopia and ways forward. *International Journal of Environmental Protection and Policy*, *8*(4), 70-76.
- Shiferaw, A., Hurni, H., & Zeleke, G. (2013). Long-term changes in soil-based ecological services at three sites in Ethiopia. *Journal of Ecology and the Natural Environment*, *5*(8), 172-180.
- Taiy, R. J., Onyango, C., Nkurumwa, A., & Ngetich, K. (2017). Socio-economic characteristics of smallholder potato farmers in Mauche Ward of Nakuru County, Kenya. *Universal Journal of Agricultural Research*, *5*(5), 257-266.
- Temesgen, Z. (2012). *Factors influencing land degradation in the Bilatte Watershed: The case of Dimtu and Shelo sub-watersheds, Southern Ethiopia* (Doctoral dissertation, Hawassa University, Ethiopia).
- Woldeab, B., Ambelu, A., Beyene, A., Efrem, Z., Deribe, S., Megersa, M., ... & Mereta, S. T. (2022). Assessment of farmers' socioeconomic and conservation practice towards watershed management in the South West of Ethiopia.
- Yaebiyo, G. M., Tesfay, Y., & Assefa, D. (2015). Socio-economic impact assessment of integrated watershed management in Sheka watershed, Ethiopia. *Journal of Economics and Sustainable Development*, *6*(9), 202-212.
- Yalgaw, Y. W. (2013). Assessing the Determinants of Farmers' Decision to Use and Maintain Improved Soil and Water Conservation Measures: The Case of Choke Mountain Watershed, Upper Blue Nile, Ethiopia (Doctoral dissertation, Addis Ababa University).

Cite This Article: Mulugeta Eshetu, Bayeta Gadissa, Regassa Gosa, Daniel Abegeja, Tesfaye Ketema (2024). Assessment, Characterization, Identification and Prioritization of Major Constraints and Potentials of Three Selected Community Watersheds of Agarfa District, Bale Zone, Oromia, Ethiopia. *East African Scholars Multidiscip Bull*, *7*(8), 139-159.