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Research Article

Socio-Economic Characterization, Identification and Prioritization of Major Constraints and Potentials in Gara Ebanu Community Watershed in Sululta District, Ethiopia

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Abstract

Baseline characterization builds necessary foundation for the plan and obtains proper information for elective planning, implementation and monitoring of the research and development endeavors. The objective of the study was to document baseline information on socio-economic for planning and impact monitoring and to identify and document major socio-economic constraints and potential in the watershed. A total of 62 sample households were selected randomly from all farmers engaged in farming activities in the watershed. The average inorganic fertilizer (NPS and Urea) used in the watershed were 75 kg/ha and 75 kg/ha respectively. The response of the respondents showed that the average yield obtained in the watershed was about 10 qt/ha for barley, 12 qt/ha for wheat, 5 qt/ha for faba bean and field pea 6 qt/ha. The major livestock feed type in the watershed were crop residue (93.5%) followed by hay making (91.9%), grazing in the field (80.6%), local beverage by-products (72.6%), concentrates of different type (67.7%), green feed (50%), stubble grazing (41.9%) and improved forage (14.5%). The result of survey shows that the major income sources of the farmers living in the watershed were livestock production (77.4%) followed by crop production (45.2%) and off-farm activities (25.8%). About 71% of the households have encountered high cost and shortage of agricultural inputs followed by low crop productivity (19.4%), crop disease (8.1%) and existence storage pests (1.6%) were the common in the watershed. In the watershed, high cost of agricultural inputs, low crop productivity, crop disease, shortage of animal feed and fodder, inflation, lack of employment opportunity and other income source were addressed as the highest priority issues by the community that are contributing to the crop productivity reductions and low level of their livelihood in the watershed. By considering the addressed problem related to crop production, livestock production and socio-economic, the interventions on introduction and demonstration of improved and high yielding crop varieties that are resistant or tolerant to the already existing and emerging pests to increase production and productivity of crops should be done. In general, immediate short-term actions should be taken particularly participatory integrated watershed management were recommended.

Keywords

Watershed, Characterization, Identification, Prioritization

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1. Introduction

Ethiopia is one of the most populated countries in Africa with a growth rate of 2.6 percent annually and finite productive lands area. Agriculture is the mainstay of the economy, which contributes for 47.7% of the total GDP, 90% of export revenues, 80% of employment and 70% of raw material requirements of agro-based domestic industries and also a major source of the national food supplies [1, 2]. Specially, populations who live in rural areas are highly dependent on natural resources bases for economic development, food security and other basic necessities [1, 3]. To ensure agricultural development at the desired rate and on a sustainable basis, sustainable management of natural resources particularly soil resources, water and forest are crucial. However, the pressure of intense human activity and improper farming and management practices pose serious threats to the sustainability of the natural resources and maintaining ecological balance. These impose great pressure on land resources, worsening environmental degradation and raising the risk of food shortages [4]. Understanding these, Ethiopian government has been promoted a watershed based natural resource development and management in the country as a suitable strategy for enhancing agricultural productivity and sustainable intensification of agriculture since 1980s.

Watershed development program has emerged as a new paradigm for sustainable rural livelihoods and it occupied the central stage of rural development in the fragile and semi-arid environments of the developing nations. Management of natural resources at watershed level produces multiple benefits in terms of enhancing agricultural production and productivity with minimum disturbance to the environment, improving livelihoods of rural community, protecting environment, addressing gender and equity issues along with biodiversity concerns. It encompasses the all-inclusive approach to manage watershed resources that integrates forestry, agriculture, pasture and water management, which can be broadened to rural development with a strong link to the livelihoods of the local people [5]. At the earlier the concept of watershed management had a narrow focus primarily for controlling erosion, floods and maintaining sustainability of useable water yield. However, recently watershed management is not only for managing or conserving natural resources in a holistic manner, but also to involve local people for improvement of their lives. Its management is more people oriented and process based, than only physically target oriented [6].

Baseline socio-economic characterization is important to measure project performance before making any changes to the project processes. It used during the project to indicate progress towards the goal and objectives and after the project to measure the amount of change obtained because of intervention. It allows those involved in the project to understand the initial livelihood conditions of the people and what needs to be done to reach the goal of improving the livelihoods of the poor. Thus, baseline socio-economic characterization builds necessary foundation for the plan and obtains proper information for elective planning, implementation and monitoring of the research and development endeavors particularly in the field of natural resources [7].

The main purpose to characterize socio-economic systems in the watersheds are to identify existing and potential production constraints and propose potential areas for targeting technology transfer for sustainable development. Therefore, proper characterization of socio-economic systems in watersheds is a prerequisite for appropriate policy directions for enhancing of production and productivity and sustainable development.

Objectives of the study

1) To characterize and document baseline information on existing socio-economic aspects used as benchmark for planning and impact monitoring.
2) To identify major socio-economic constraints and potentials in Gara Ebanu watershed.
3) To recommend appropriate research intervention and action plans for the priority issues in the watershed.

2. Material and Methods

2.1. Description of the Study Area

2.1.1. Geographical Location

The study was conducted at Gara Ebanu community watershed in Sululta district of North Shewa zone, which is approximately located at 45 Km north of the capital city of Ethiopia (Addis Ababa) and 5 km from Chancho town which is capital city of Sululta district.

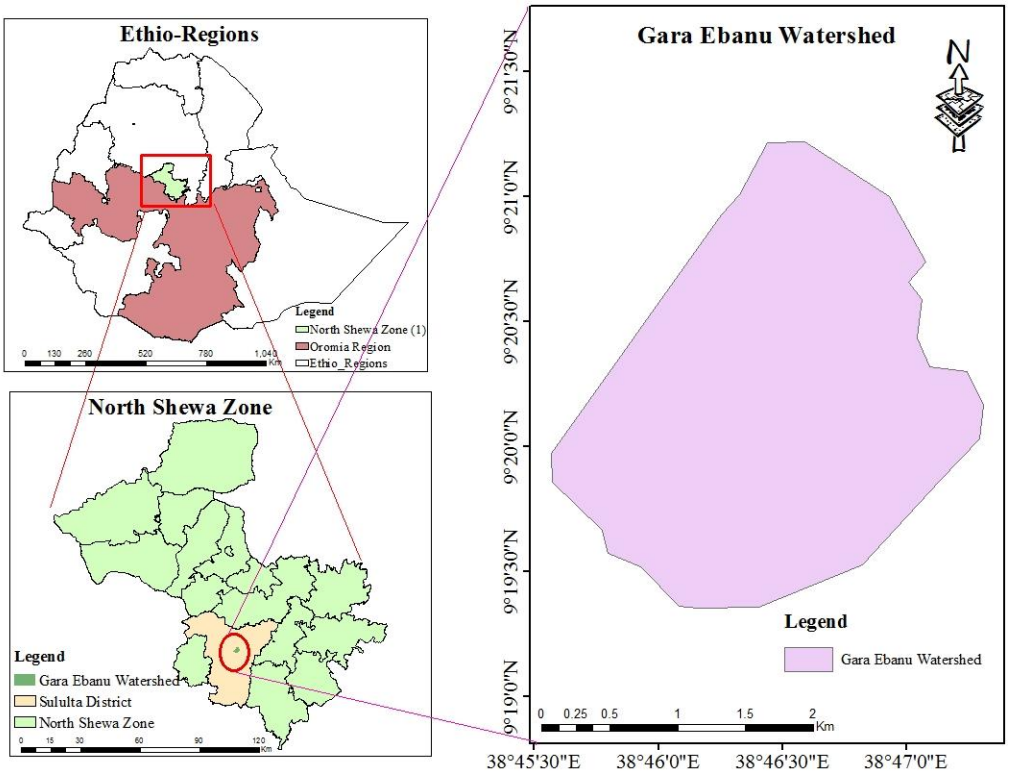

Figure 1. *Map of Gara Ebanu watershed.*

2.1.2. Topography and Climate

The land forms of the district are characterized by river, gorges, plateaus, mountains and plains. Thus, plain lands account (46%) of the total area, rugged topography account (22%) of the total area, plateaus account (26%) of the total area and the remaining 6% of the total area are characterized by mountain in the study area and the altitude of the district various between 1500m to 3571m above sea level. The district exhibits three major agro-ecological conditions. These are lowland area (*gammojji*), highland area (*baddaa*) and midland area (*badda-daree*) which account 3.6%, 71% and 25.4% of the district respectively. The district receives an average annual rainfall of 1232mm. The mean monthly temperature varies from 6.2 ℃ to 22 ℃ with mean annual temperature of 15.4 ℃.

2.1.3. Vegetation, Soil and Land Uses

The district had been covered by forest as generalized from the remnant tree species dominated by *juniper procera* (birbirsa), *oleo Africana* (Ejersa) and *podocarpus* (Zigba). The surrounding mountain sides were covered by forest which dominated by *Juniperus procera* tree species, and the lower slopes supported stands of *Acacia*, but now most of the hillsides are covered with plantations of *Eucalyptus.* Remnant indigenous vegetation such as *juniper procera*, *oleo Africana* and other species have dispersed distribution. Cambisols, Nitosols and Vertisols are the major soil type found in the district, which accounts for 49%, 24.5% and 0.5% respectively. The remaining soil types in the district made up 26 percent of the land. Three land use systems: cultivated lands under small holder subsistence farming system, controlled grazing lands with closed areas and communal open access grazing land exist in the district.

2.1.4. Population

According to 2007 national census report, a total population of sululta district was around 129,000, from this, about 64,516 were men and the remaining 64,484 were women; 15,145 or 11.74% of its population were urban dwellers with an estimated area of 3,900 square kilometers, sululta had an estimated population density of 47.8 people per square kilometer.

2.1.5. Site Selection and Mapping of the Watershed

Before site selection, multidisciplinary research team was established for site selection, characterization, planning and implementation of the watershed research. Accordingly, the research team was selected one model watershed in the district based on agro-ecological representation, prevalence of resource management and land degradation problems and accessibility for intensive follow-up and minimizing cost. Based on the preliminary outlet identified during the site selection process, the watershed boundary was delineated using primary data (GPS readings). The delineated watershed was geo-referenced and digitized for its contour, roads, rivers,

and other features. The preliminary delineated boundaries were verified in the field using GPS and establish reference bench marks for future operations. Finally, map of the watershed was produced; other information such as elevation ranges and slopes were extracted. Map of the watershed was developed and delineated from 1:50,000 scale aerial photographs/satellite images.

2.2. Source of Data and Method of Data Collection

The study used both qualitative and quantitative approaches to gather and evaluate primary and secondary data. The primary data was gathered through field observation, household survey method (questionnaires), focus group discussion and interview of key informants. The comprehensive filed observation was carried out to get detail information about socio-economic and major terrain features such as topography, erosion status and soil and water conservation practices.

The household survey questionnaire was conducted to gather data about demographic and socioeconomic characteristics of sample households, institutional services, plot level characteristics, crop production, livestock production, and major income source of the farmers in the study area. A structured interview questionnaire that involved both closed ended and open-ended questions were prepared and used to generate data from the respondents. Secondary data were gathered from published and unpublished information. The information was collected from regional, zonal and district level of agricultural and information and communication offices.

2.3. Sampling Design

Sample household farmers were selected from the watersheds by using simple random sampling technique with some stratification based on watershed position considering upper, middle and lower position of watershed. The total household heads in the watershed were identified and then the representative sample was selected from the farmers living in the watershed. Accordingly, from the total 103 farm household heads living in the watershed, 62 respondents were selected for the study. Key informants were selected purposely from the district agricultural experts, agricultural extension workers and watershed user cooperatives administrators. Accordingly, 3 key informants were employed. Eight knowledgeable participants were purposely selected for focus group discussion.

2.4. Data Analysis

The collected data was managed and analyzed using Statistical Package for Social Sciences (SPSS) and Microsoft excel 2010. Descriptive tools like percentages and frequencies were presented in tables, graphs and charts.

3. Result and Discussion

3.1. Socio-Economic Characteristics of the Watershed

Socio-economic characteristic information is a guide to and starting point for research about basic information on the areas of investigation. Its information consists of numeric data or statistics involving groups of people. It includes household profile such as gender, age, household family size, level of education and marital status of the family members form a base for understanding demographic condition of the household.

3.1.1. Total Population and Gender Composition

According to sululta district agriculture office, the total population in the watershed is estimated to be 750; out of which 368 constitute males and the remaining 382 females. In terms of household, the watershed comprises 103 household heads. The figure 2 shows that among the sampled of 62 household the respondent stated (85.5%) of the heads of the household were male's and 14.5% were female's household head. And also, among the sampled households' family members 53.4% were male and 46.6% were female.

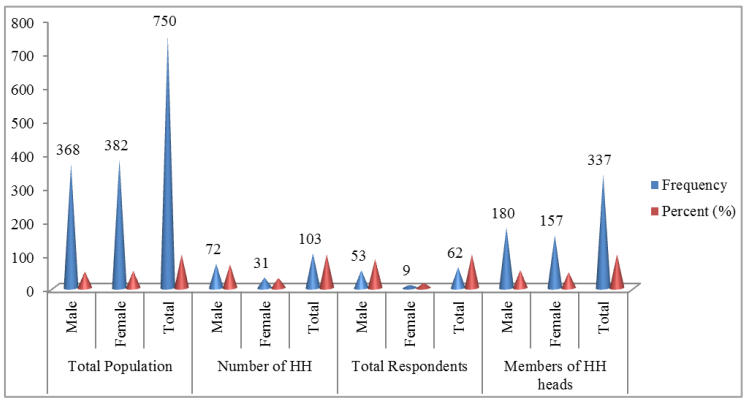

Figure 2. *Population and gender composition in the watershed.*

3.1.2. Age Distribution

Age is one of the important characteristics of the community which plays a significant role in any kind of employment pattern, mobility and quality of work done, particularly in agriculture, because the use of child labor on the farms is quite high.

Table 1. Socio-economic characteristics of the watershed.

Characters	Minimum	Maximum	Mean	Frequency	Percent
Age of HH head	22	87	47		
HH head Age category					
22-60				49	79
>60				12	21
Education level of HH head					
Un educated				33	53.2
Elementary school				25	40.3
Secondary school				4	6.5
Age of HH family	0.33	87	24.3		
HH family Age category					
<16 Male				67	19.9
<16 Female				60	17.8
16-60 Male				101	30.0
16-60 Female				89	26.4
>60 Male				12	3.6
>60 Female				8	2.4
Household Family Size	2	11	5.5		
Education level of HH family					
Un educated				145	43.0
Elementary school				165	49.0
Secondary school				26	7.7
College				1	0.3

Source: Household Survey, 2021

The respondents and their family members are divided into three age groups (i.e. up to 15, 16 to 60, and above 60 years of age). The idea behind these classes is that the middle age group (16-60 years) is the most productive age group in farming. Accordingly, the results (Table 1) indicate that the age distributions of most of respondents (79%) were in the age category from 20-60years group and 21% were in the age category of above 60 years. This indicates that the sample households are characterized by a high proportion of productive age group (20-60 years) and a low number of old-age persons (> 60 years). As age is one of the vital characteristics of society, it plays a significant role in the type of employment pattern, particularly in agriculture, as the use of child labor on farm activities mostly prevails [8]. The mean age of the sample respondent is 47 as well as the minimum and maximum ages of the sample household heads were 22 and 87, respectively.

Three age groups of family members were identified, about 37.7% of household family age category was less than 16 years, 56.4% were between 16 and 60 years, and 5.9% were older than 60 years (Table 1). In most Ethiopian rural areas, the main sources of labor are the family members, including wife and children. The sample households are characterized by a high proportion of productive age group (16-60 years) and a

low number of old-age persons (>60 years). The dependency ratio, that is the number of nonworking members per working family member, was about 0.77 indicating a high degree of dependency. This implies that every working member of the family supports on an average 0.77 non-working ones which includes children and senior citizens.

3.1.3. Household Family Size

Larger family size with the productive age category is important in rural households to share the variety of agricultural duties. According to the survey result, the family size of the sample farmers ranged from 2 to 11 persons and the average family size of sample households were 5.5 persons. About 59.7% of the households had a family size less than the average and the remaining 40.3% had household sizes above the average. The study conducted by Chomba, G and Abera, B stated that, large family size was necessary to provide the labor requirement for the construction and maintenance of soil and water conservation practices [9, 10].

3.1.4. Educational Background

Education plays an important role in the overall growth and development of any country. The level of education affects the planning and managerial abilities of the farmer in decision making and it represents the development of character or mental power which helps the farmers in raising their understanding and the level of acceptance of new farming techniques. The results (Table 1) indicated that, in the watershed about 53.2% of the household heads had no formal education, 40.3% were educated to elementary school and only 6.5% of household heads were having been reached secondary school. These indicate that, adoption of new technologies, the planning and managerial capacity of most farmers might be affected by their weak decision-making abilities due to lack of education. [11, 12] indicate that, better education level of the household heads has strong and positive relationship with their adoption of new technologies because of their ability to find new information and their understanding of new technologies. In addition, about 43% of household family members had no formal education, 49% were educated to elementary school and only 7.7% of household family members were educated to secondary school. Overall, the percentage of un-educated was about 53.2% of the sample farmers and 43% of household family members were found.

3.2. Land Ownership and Land Size Characteristics in the Watershed

Land is a scarce resource; hence its optimal use is essential. Land ownership builds a strong base for the utilization of resources for production purposes. In the context of watershed, land ownership determines the participation of the community in watershed development activities to conserve, manage and use of natural resources.

Table 2. *Land use patterns characteristics of the watershed.*

Land use patterns (ha)	Frequency	Percent	Max	Min	Mean
Rain fed annual crops	53	85.5	4.25	0.25	1.41
Irrigated annual crops	1	1.6	0.5	0.50	0.50
Perennial crops	1	1.6	0.5	0.50	0.50
Grazing land	46	74.2	4	0.13	0.86
Shared in	31	50.0	6.75	0.25	1.82
Plantation	26	41.9	2	0.06	0.27
Fallow land	12	19.4	1	0.25	0.48
Shared out	10	16.1	3.5	0.38	1.41
Natural forest	3	4.8	0.75	0.25	0.42
Wetland	1	1.6	0.25	0.25	0.25

Source: Household Survey, 2021

The land utilization of households in the watershed mainly includes residence, cultivated land (rain fed and irrigated), Grazing, plantation (Eucalyptus tree), natural forest and wetlands. As shown in Table 2 the largest land utilization of households in the watershed is cultivated land and the lowest land utilization is wetland. Farmers' responses showed that, almost all the farmers interviewed owned land (95.2%), the rest 4.8% of respondents rely solely on settlement land. And also, most of the sampled farmers (85.5%) owned cultivated land and the rest 14.5% interviewed households had not

owned cultivated land in the watershed. This indicates that, the participation of the community in watershed management activities was good due to high sense ownership.

Table 2. Land ownership and land size characteristics of the watershed.

Land (ha)	Farm land ownership		Total land ownership	
	Frequency	Percent	Frequency	Percent
Landless	9	14.5	3	4.8
<1	14	22.6	10	16.1
1-2	21	33.9	16	25.8
2-3	16	25.8	9	14.5
3-4	1	1.6	15	24.2
>4	1	1.6	9	14.5
Total	62	100.0	62	100.0

Source: Household Survey, 2021

Land size is one of the major determinants of the financial status of farmers, which in turn affects their ability to adopt modern farming practices.

The result of study (Table 3) indicates that about 16.1% of the respondents had landholdings below 1 ha and 25.8% had between 1 and 2 ha. The remaining 14.5%, 24.2% and 14.5% had landholdings between 2 and 3 ha, 3 and 4 ha and above 4 ha, respectively. The average total farm land size owned (including cultivated, fallow, leased out, and sharecropped land) in the area was 2.428 ha, and the average cultivated land owned was about 1.411 ha. According to the study reported by [13] that practice of soil and water conservation measures is positively related to landholding size.

3.3. Farm Tools and Non-Farm Assets Ownership

Table 4. Farm and non-farm assets ownership in the watershed.

Farm and nonfarm tools	Frequency	Percent	Min	Max	Mean
Corrugated house	61	98.4	1	5	1.7
Hat house	39	62.9	1	2	1.1
Spade	47	75.8	1	2	1.1
Hoe	30	48.4	1	2	1.2
Axe	55	88.7	1	4	1.4
TV	16	25.8	1	1	1.0
Radio	35	56.5	1	2	1.0
Mobile phone	40	64.5	1	3	1.4
Solar power	11	17.7	1	1	1.0
Knapsacks spray	11	17.7	1	2	1.1

Source: Household Survey, 2021

Apart from lands, farmers also possessed farm and non-farm assets such as corrugated house, hat house, spade, hoe, axe, radio, mobile phone, solar power, knapsacks spray mainly used in crop production and gain information through it. The result of study (Table 4) shows that, nearly 98% of the households own corrugated house, hat house (62.9%), spade (75.8%), hoe (48.4%), axe (88.7%), mobile phone (64.5%), radio (56.5%), TV (25.8) and 17.7 % own knapsacks spray.

3.4. Crop Production in the Watershed

Information on crop production and yield of all major and minor crops grown in the production system required to examine spatial and temporal changes in area under different crops and possible crop substitution. This information is useful to compare the baseline situation with improved technology due to project intervention.

3.5. Major Crops Grown in the Watershed

In the watershed, crops produced are supplied to the district market to generate income for farmers. Farmers' responses (Figure 3) showed that major crops grown in the watershed include cereal crops: barley, wheat, oats and teff. Pulse and oil crops**:** Faba bean, Field pea, lentil linseed, common bean. Horticultural and root crops: potato, tomato, red pepper, and garlic.

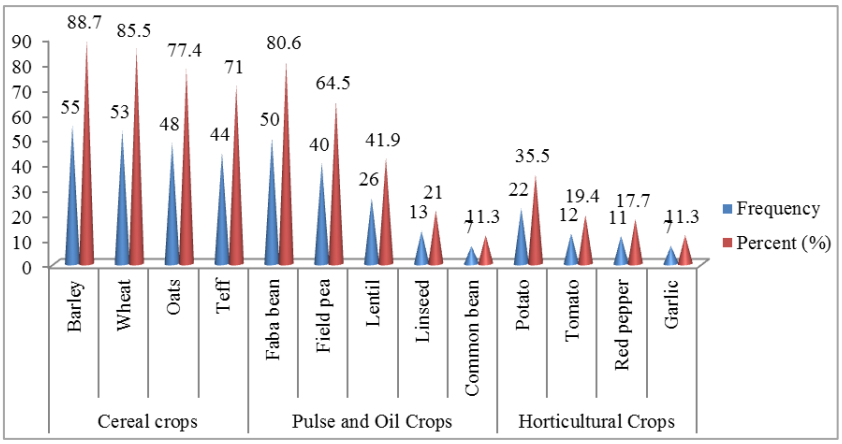

Figure 3. *Major crops grown in the watershed.*

3.6. Input Used and Yield of Crops

The baseline information on input use across crops is a prerequisite for identifying potential strengths and weaknesses of the agricultural production system. The information needed for input use characterization includes: crop wise inorganic and organic fertilizer use, crop wise labor use, crop wise pesticide use, crop wise cost of cultivation.

Table 5. *Input used for crop production.*

Input Used	Frequency	Percent	Amount of used in kg/ha or lit/ha		
			Min	Max	Mean
NPS	2	3.2	50	100	75
UREA	5	8.1	30	100	75
Both NPS & Urea	11	17.7	50	250	150
Conventional compost	5	8.1	500	1200	250
FYM	10	16.1	1000	10000	400
Herbicide	30	48.4	0.16	0.75	0.35
Insecticide	3	4.8	0.16	0.5	0.23

Input Used	Frequency	Percent	Amount of used in kg/ha or lit/ha		
			Min	Max	Mean
Fungicide	2	3.2	0.2	1	0.45

Source: Household Survey, 2021

The response of the respondents shows that, some farmers in the watershed use inputs like inorganic (NPS and Urea) and organic fertilizers (Conventional compost and farmyard manure (FYM)) to improve soil fertility and also use herbicide, insecticide and fungicide for crop protection. However, the result of survey indicates that only 11% of the sample farmers had been regularly using some amount of NPS and Urea fertilizer for only cereal crops such as barley, wheat, tef and sorghum. According to interviews with DAs and experts from district agriculture office, NPS and Urea was supplied to support farmers to increase production, however, there were limitation in used. This might decrease the crop yield cultivated from a unit of area. About 10% and 5% of them also indicated that they use FYM and conventional compost annually on crop lands, respectively. This perhaps points to a high level of soil nutrient depletion in the watershed, as an addition of external inputs to restore soil fertility and nutrients that are depleted with harvest and soil erosion seems to be limited. The average inorganic fertilizer (NPS &Urea) used in the watershed were 75 kg/ha and 75 kg/ha, respectively as shown in Table 5. The use of farmyard manure (FYM) and conventional compost is done before planting of crops. The rate of application of FYM and conventional compost vary (1000-10000 kg/ha and 500-1200 kg/ha respectively) from one farmer to another depending on availability of material. Some herbicides were applied for cereal crops and insecticides were used for pulse crops as well as fungicides were used for selected crops such as wheat, barley, field pea and faba bean.

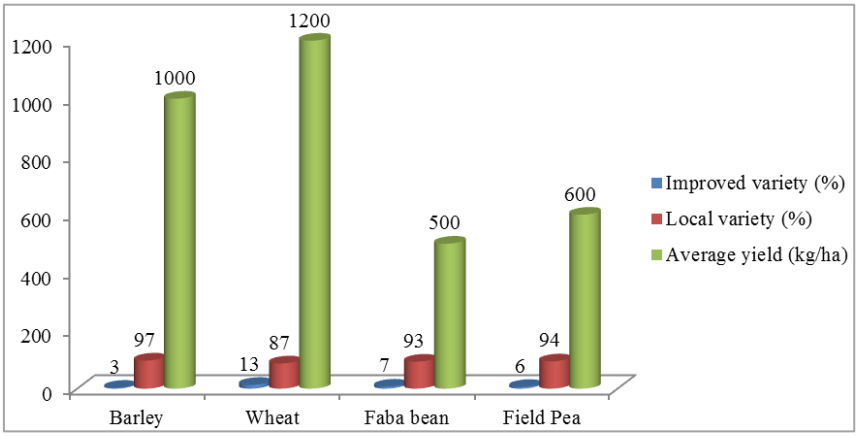

Figure 4. *Yield of crops and crop varieties used by farmers in the watershed.*

The results of survey (Figure 4) shows that relatively most of households grew crops such as barley, wheat, faba bean, and field pea for domestic consumption and very few farmers grew potato, lentil, linseed and garlic as cash crops. However, the crop variety used by farmers for barley (97%), wheat (87%), faba bean (93%), and field pea (94.1%) of sample respondents local seeds in the watershed. The average yield of barley was about 10 qt/ha, wheat 12 qt/ha, faba bean 5 qt/ha and field pea 6 qt/ha. The result of the study revealed that the yield of all crops was very low. Hence, most of the farmers sow their crops without fertilizer and use locally available crop varieties they produced low level of yield per unit area as a result. The biophysical factors include use of traditional low yielding varieties, depleted soil fertility, continuous cultivation without use of fertilizers (inorganic and organic) and soil erosion accelerated by poor agronomic practices and lack of soil conservation measures [14, 15].

3.7. Livestock Production and Feed Source in the Watershed

3.7.1. Livestock Production in the Watershed

Livestock is an integral part of agriculture and provides meat, milk, cash, draft power, hauling services, insurance, and social capital [16]. Summary of livestock and livestock

products owned by the farmers were presented in Table 6.

Table 6. Livestock and livestock product ownership.

Owned livestock/product (number and liter/year)	Frequency	Percent	Min	Max	Average
Local cow	40	64.5	1	5	2.2
Cross breed cow	36	58.1	1	20	2.6
Milk	45	72.6	60	1500	462.3
Ox	38	61.3	1	6	2.4
Local bulls	13	21.0	1	3	1.7
Cross breed bulls	15	24.2	1	2	1.4
Local heifers	16	25.8	1	2	1.6
Cross breed heifers	27	43.5	1	2	1.3
Calves	41	66.1	1	5	2.0
Sheep	38	61.3	1	21	5.3
Horse	11	17.7	1	2	1.2
Donkey	47	75.8	1	4	1.8
Local chicken	23	37.1	1	14	3.5
Exotic chicken	20	32.3	1	90	9.1

Source: Household Survey, 2021

The majority of farmers in the watershed are mixed crop-livestock producers. The major types of livestock rearing in the watershed included cow (local and cross breed), ox, bulls (local and cross breed), heifers (local and cross breed), calves, goats, sheep, horse, donkey and chicken (local and cross breed). There are also livestock products such as milk, butter, cheese, egg and others. The result of the study (Table 6) indicated that about 64.5% of the households owned local cow and 58.1% owned cross breed cow. About 61.3% of the households owned ox, 66.1% and 61.3% of sample households owned calves and sheep in the watershed respectively. Similarly, some of households owned local bulls (21%), cross breed bulls (24.2%), local heifers (25.8%), and cross breed heifers (43.5%), local chicken (37.1%), and exotic chicken (32.3%). The farmers also owned donkey (75.8%) and horse (17.7%) needed for transportation. The average ownership of different types of animals was 2.2 (local cow), 2.6 (cross breed cow), 2.4 (ox), 1.7 (local bulls), 1.4 (cross breed bulls), 1.6 (local heifers), 1.3 (cross breed heifers), 2 (calves), 5.3 (sheep), 3.5 (local chicken), 9.1 (cross breed chicken). About 72.6% of sample households produced milk with the average product of 462.3 liter per year.

3.7.2. Livestock Feed Sources in the Watershed

The major livestock feed type and feed source in the watershed were presented in Table 7.

Table 7. Livestock and livestock product ownership.

Used feed type	Used respondents		Source of feed	
	Frequency	Percent	Own	Purchased
Crop residues	58	93.5	41	10
Hay making	57	91.9	28	25
Grazing in the field	50	80.6	35	14

Used feed type	Used respondents		Source of feed	
	Frequency	Percent	Own	Purchased
Local beverage by-products	45	72.6	-	45
Concentrates of different types	42	67.7	-	42
Green feed (cut & carry)	31	50.0	21	10
Stubble grazing	26	41.9	23	-
Improved forages/fodder	9	14.5	1	8

Source: Household Survey, 2021

The result of the study (Table 7) revealed that the feed type used in the watersheds was dominantly crop residue (93.5%) followed by hay making (91.9%), grazing in the field (80.6%), local beverage by-products (72.6%), concentrates of different type (67.7%), green feed (50%), stubble grazing (41.9%) and improved forage (14.5%). As well as the majority source of feed type were obtained by purchasing and owned by self.

3.7.3. Household Income Source in the Watershed

Table 8 presents a summary of income injected in the watershed through livestock rearing, crop production and off-farm activities.

Table 8. *Household income source in the watershed.*

Income Source	Owned farmers		Obtained income in ETB		
	Frequency	Percent	Min	Max	Average
Crop production	28	45.2	1000	72000	20930.56
Livestock production	48	77.4	4320	286000	102863.1
Off farm activities	16	25.8	1000	54000	15790

Source: Household Survey, 2021

The result of survey (Table 8) shows that the major income sources of the farmers in the watershed were livestock production (77.4%) followed by crop production (45.2%) and off-farm activities (25.8%). Most of farmers in the watershed were rearing different types of animals for different economic or social interests in the watershed. As shown in Table 8 the highest income from livestock production in the watershed was 286,000 birr and the lowest income from livestock production was 4,320 birrs in a year and the average income obtained from livestock production was 102,863 birrs in the year. The response of farmers in the watershed showed that more than 61% of sample households generate their annual income mainly from sell of milk.

Farmers use the total production of a given crop to meet various needs (used for domestic consumption, source of income and seed), depending on crop type and the product of crops. Most of the crops produced in the watershed were used for subsistence (domestic consumption) whiles others such as cash crops (garlic, potato and linseed) were grown mainly for sale.

Survey result (Table 8) indicated that some farmers in the watershed were engaged in off-farm activities including daily laborer, hand craft, petty trade, sales of alcohol (*areke)* and remittance as a supplementary source of income. Accordingly, the highest income from off-farm activities in the watershed was 54,000 birr and the lowest income was 1000 birr in a year and the average income obtained from off-farm activities was 15,790 birrs in the year.

3.8. Agricultural Extension Services and Source of Information in the Watershed

Frequency of farmers visited by agricultural extension agents is positively associated with the farmers' watershed management programs to boost their agricultural productivity. In the watershed, agricultural extension services visited/

contacted sample farmers from 1 to 12 times. Most sample farmers (96%) were contacted with agricultural extension services 1-6 times and only 4% of sample farmers were contacted 7-12 times to train and assistance solving crop production, natural resources management and livestock production related problem. In the study area, agricultural extension services are intended to train farmers on crop production (fertilizer use, crop protection and management, seed rate and row planting, improved crop varieties and compost preparation), livestock production (animal health, milk production, dairy rearing practices, animal feed, fattening and feeding system).

Farmers' responses indicated that, about 11% of the sample farmers attended on different field days and only 8% of the sample farmers hosted field days in the watershed. The survey result has shown that the major information sources of the farmers in the watershed were fellow farmers (63%) followed by zone/district agricultural extension agent (42%) and media (34%) in the watershed. According to the study conducted by [12] farmers cannot adopt technologies if they do not have access to all the relevant information. The research conducted by [17] in Ethiopia also indicated that, farmers who receives better information from agricultural extension agents will be agree able to manage natural resource.

3.9. Credit Access and Family's Food Security in the Watershed

Credit access reduces liquidity problems that household could face while intending to purchase agricultural inputs and hence paves the way for the timely application of inputs, thereby increasing the overall productivity and farm income [18]. In the watershed, farmers' responses indicated that, about 73% of the sample farmers not accessed credit services and rest 27% of the sample farmers had credit access and about 47% of the sample farmers had credit access received credit from different sources. From this; 62.5% of sample farmers received credit from Sinqe Bank and the remaining sample farmers (37.5%) were borrowed from Hortu credit and saving association.

4. Major Constraints in the Watershed

4.1. Major Constraints Related to Socio-Economies

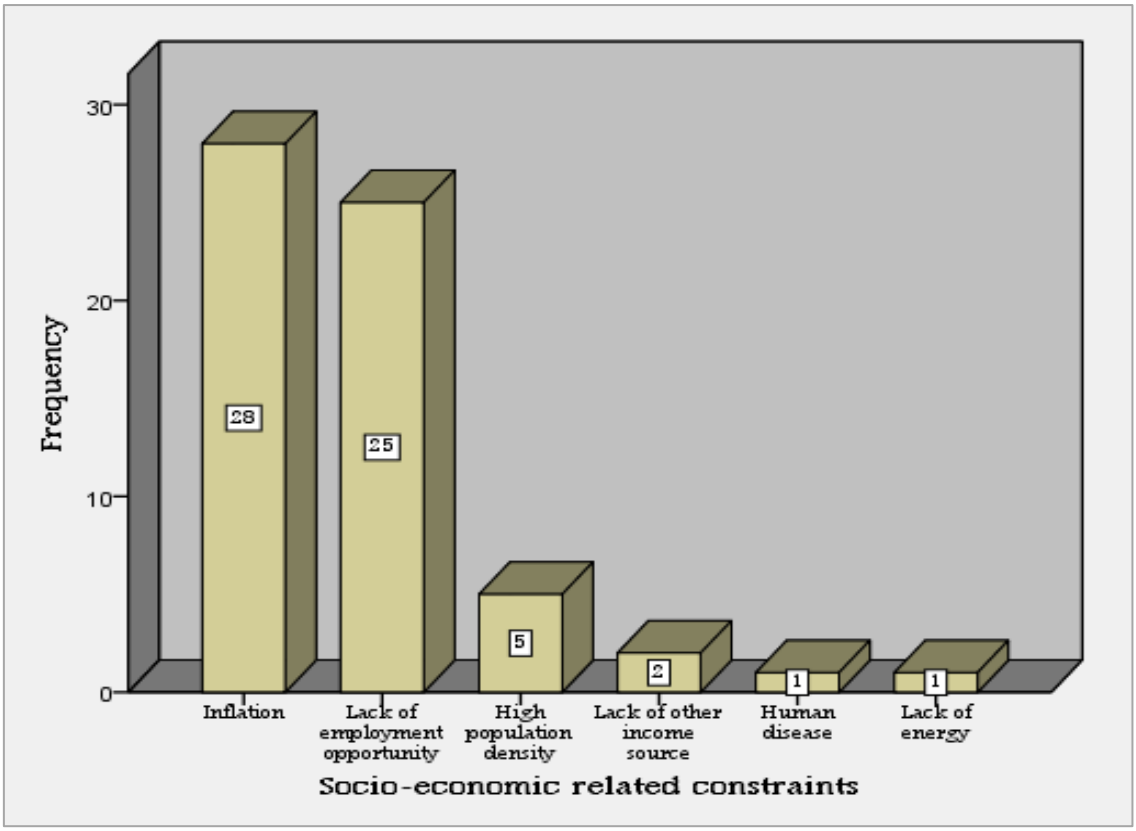

Figure 5. *Major socio-economic related constraints in the watershed.*

Table 9. Major constraints related to socio-economic in the watershed.

Socio-economic related constraints	Frequency	Percent
Inflation	28	45.2
Lack of employment opportunity	25	40.3
High population density	5	8.1
Lack of other income source	2	3.2
Human disease	1	1.6
Lack of energy source	1	1.6
Total	62	100.0

Source: Household Survey, 2021

Analysis of the result (Table 9) showed that about 45.2% of the sampled households have encountered high inflation problems followed by lack of employment opportunity (40.3%), and also high population density, lack of other income source, human disease and lack of energy source were the common constraints related to socio-economic in the watershed.

4.2. Major Constraints Related to Crop Production

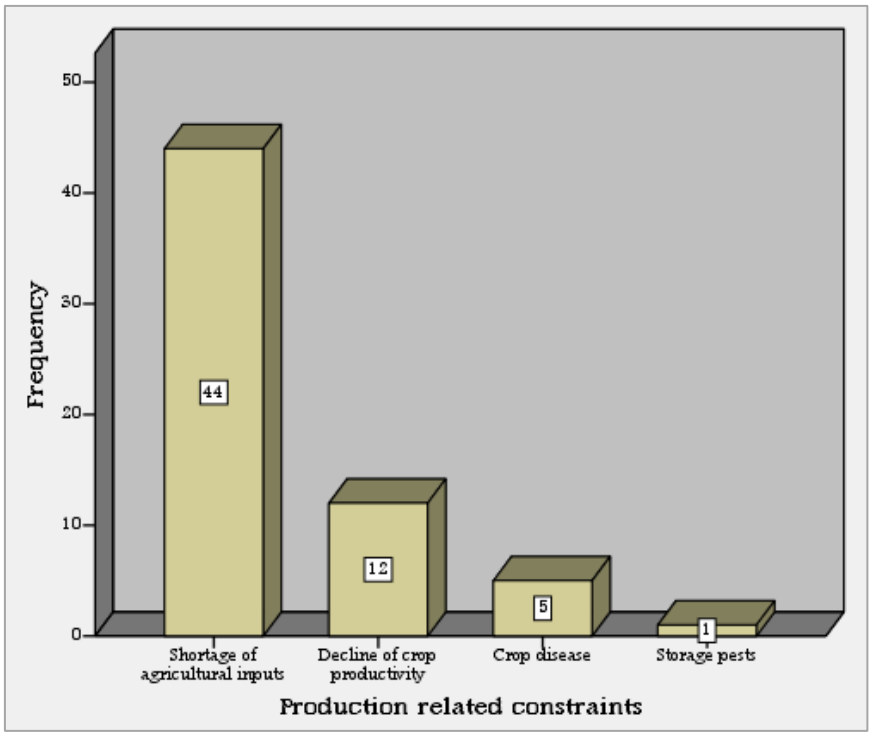

Figure 6. Major production related constraints in the watershed.

Table 10. Major constraints related to crop production in the watershed.

Production related constraints	Frequency	Percent
Shortage of agricultural input	44	71.0
Decline of crop productivity	12	19.4

Production related constraints	Frequency	Percent
Crop disease	5	8.1
Storage pests	1	1.6
Total	62	100.0

Source: Household Survey, 2021

Analysis of the result (Table 10) showed that, about 71% of the households sampled have encountered high cost and shortage of agricultural inputs problems followed by decline of crop productivity (19.4%), crop disease (8.1%) and existence storage pests (1.6%) were the common in the watershed.

4.3. Major Constraints Related to Livestock Production

Table 11. Major constraints related to livestock in the watershed.

Livestock related constraints	Frequency	Percent
Shortage of animal feed and fodder	53	85.5
Animal disease	6	9.7
Absence of good grazing system	3	4.8
Total	62	100.0

Source: Household Survey, 2021

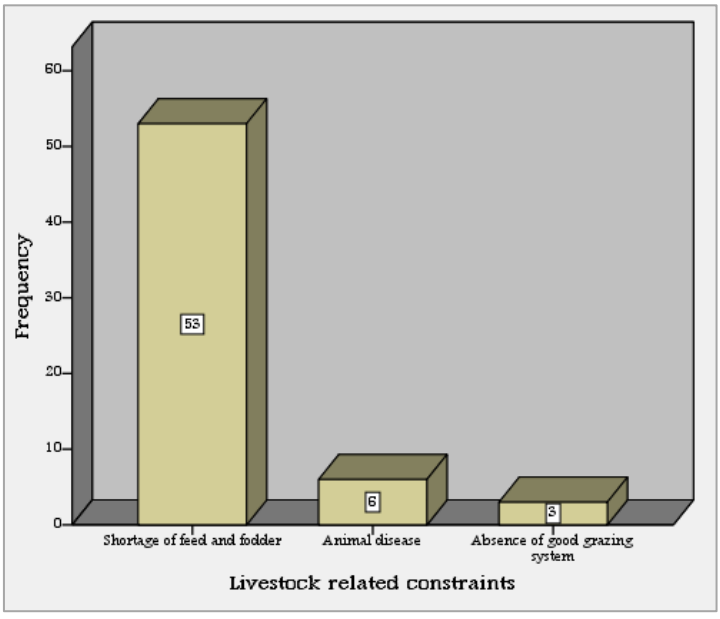

Figure 7. Major livestock related constraints in the watershed.

As the result of survey (Table 11) shows that, about 85.5% of sample households encountered shortage of animal feed and fodder followed by animal disease (9.7%), and absence of good grazing system (4.8%) in the watershed. The key informants also said that, shortage of animal feed and fodder is the major constraints related to livestock production in the watershed.

4.4. Major Constraints Related to Institution and Infrastructure

Table 12. Major constraints related to institution and infrastructure in the watershed.

Institutional and infrastructure related constraints	Frequency	Percent
Lack of drinking water	32	51.6
Lack of electricity	25	40.3
Lack of credit access	2	3.2
Lack of market access	2	3.2
Lack of animal clinic	1	1.6
Total	62	100.0

Source: Household Survey, 2021

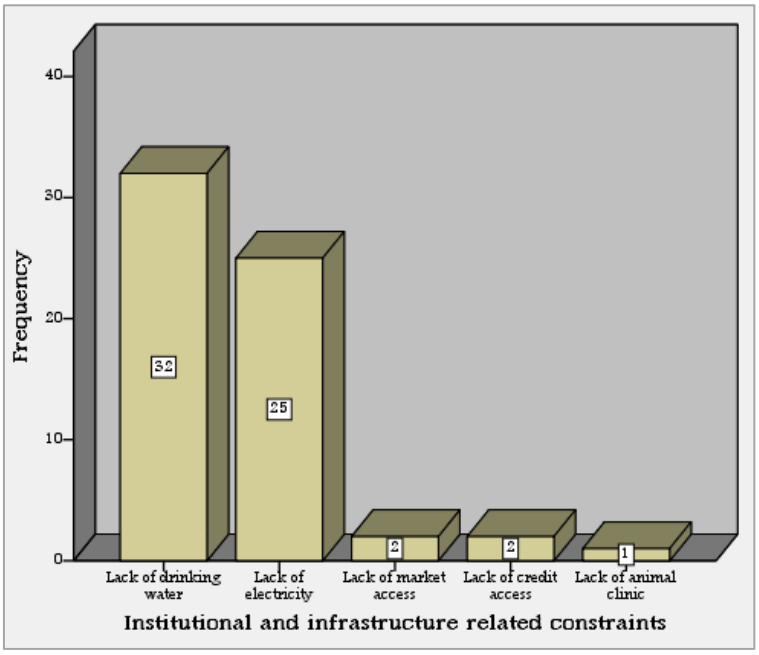

Figure 8. Major institutional and infrastructure related constraints in the watershed.

The result of survey (Table 12) indicated that about 51.6% of the sampled households were encountered shortage of drinking water problems followed by lack of electricity (40.3%) in the watershed.

Table 13. Major potentials in the watershed.

Potentials	Frequency	Percent
A. Socio-economic potentials		
Availability of labor force	49	79.0
All weather road	11	17.7
Market access	2	3.2
Total	62	100.0
B. Institutions potentials		
Informal institutions	40	64.5
Schools	22	35.5
Total	62	100.0

Source: Household Survey, 2021

Considering the potentials related to socio-economic, there were available labor forces (79%), all weather road (17.7%), and market access (7.2%) as per the data collected from sampled farmers in the watershed. On the other hand, the major potentials related to institution in the watershed were informal institution and school (Table 13).

5. Conclusion and Recommendation

Based on the result of the study it can be concluded that, there is poor level of awareness creation of farmers on improved crop production technologies and very low level of adaption of improved seeds and fertilizers in watershed. In the watershed, high cost of agricultural inputs, low crop productivity, crop disease, shortage of animal feed and fodder, inflation, lack of employment opportunity and other income source were addressed as the highest priority issues by the community that are contributing to the crop productivity reductions and low level of their livelihood in the watershed. By considering the addressed problem related to crop production, livestock production and socio-economic, the interventions should be taken on introduction and demonstration of improved and high yielding crop varieties that are resistant or tolerant to the already existing and emerging pests to increase production and productivity of crops and also demonstration of chemical use and safe handling mechanisms should be done. Introduction and demonstration of improved forages, feed system and management like feed trumping techniques and multiplication improved forage from small to large scale farming should be done.

Abbreviations

°C	Degree Centigrade
DA's	Developmental Agent's
FYM	Farmyard Manure
GDP	Gross Domestic Product
GPS	Global Positioning System
ha	Hectare
Kg	Kilograms
Km	Kilometers
km^2	Square Kilometers
mm	Millimeters
qt	Quintals
SPSS	Statistical Package for Social Sciences

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Data Availability Statement

All the data reported here are available from the authors upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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