Research Article
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Socio-economic characterization, identification and prioritization of major constraints and opportunities in Barite community watershed of Dabo Hana district of Buno Bedele zone

Abstract

Watersheds provide important ecosystem services to humanity and also maintain the physicochemical and biological processes that occur within the watershed. The study was conducted at Dabo Hana district in Barite micro-watershed with the identifying, prioritizing and analyzing constraints and opportunities of barite watershed at Dabo Hana district of Buno Bedele zone was selected purposively from zone based on potentiality of watershed and Barite sub-watershed was selected randomly. A total of 63 sample sizes were selected by employing Probability Proportional to Size (PPS). Data collection tools such as interviews, Focus Group Discussions (FGD), key informants' interviews, field observations and document analyses were used by developing questionnaire and checklist. The collected data were analyzed using descriptive statistics.survey result discovered that mixed farming systems were taken place in the watershed. The major cropping systems in the study area are mono cropping, intercropping and crop rotations systems. Results of survey study revealed that the main crop production constraints were disease and pest problem, soil fertility problems, high cost of fertilizer, shortage of improved varieties and weather fluctuation. Similarly, livestock production in study area is constrained by disease, shortage of animal feed and improved forage, lack of improved breed, shortage of veterinary service and lack of grazing land. Declining of soil fertility, soil erosion, deforestation and climate change were main constraints to natural resources. Therefore, there is need for research, development and institutional interventions to alleviate the identified constraints to crop, livestock production, natural resources and socioeconomic in the study area through holistic approach.

Keywords: watershed, characterization, Dabo Hana

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Introduction

Watershed is a given area of land that shares common water outlet channels and storages.[1] It can be too small with few meters square of land or bigger millions of hectares;[2] but both should have some common characteristics to be watershed some are boundaries, channel and outlet. The watershed is commonly named after river or lake.[3] It is unifying geographical characteristics for the common share of opportunities and constraints in a given community. [2] Watersheds are vital components of the terrestrial ecosystem. Healthy watersheds such as freshwater and land resource systems not only provide important ecosystem services to humanity.[4] Also maintain the physicochemical and biological processes that occur within the watershed.[5,6] By its nature of the watershed, tackling solution for affected part of the watershed should participate or include the not affected part of watershed in holistic approach.

Watershed projects in developing countries generally however focus on typically three objectives, namely, to conserve the natural resource base, optimize agriculture with other natural resources and support rural livelihood to alleviate poverty.[7] In 1970s various soil and water conservation measures have been implemented by Ministry of Agriculture in Ethiopia.[8,9,10] Since then the government, non-governmental organizations and local community efforts on rural development have been based on watershed development program.[11]There are success stories of watershed management like; water spring recharging again, soil loss reduction, regeneration and afforestation of the degraded land, soil fertility improvement, crop production increment, animal product improvement and in general the livelihood of the community changed positively could be listed where watershed management applied properly. [12,13,14,15]However, the approach was top down approach that was followed to implement different activities in the watershed.[16,14] That means instructions, plans and types of activities sent from the center to the community. This approach has failed in different watershed as a result of absence of consultation of the community during planning. In the early 2000s, community-based integrated watershed development was introduced to promote watershed management as a means to achieve broader integrated natural resource management and livelihood improvement objectives within prevailing agro-ecological and socioeconomic environments.[17] Recently, the government of Ethiopia has also launched an annual nationwide public campaign lasting for approximately 2 months (January and February) and aimed at mobilizing the community for integrated watershed management and development activities .[18,19] Its management is more people oriented and process based, than only physically target oriented.[20] Despite these huge and continuous efforts towards sustainable watershed management in almost all parts of the country, the achievements were far below the expectations, and watershed degradation has remained a big challenge for agricultural growth. Problem identification before implementing soil and water conservation and watershed management with local people participation make farmers more willing to accept these management practices. Baseline characterization helps understand the initial livelihood condition of

the people in the watershed before intervention. It builds necessary foundation for the plan and obtains proper information for effective planning, implementation and monitoring.[21] Watershed degradation is a particular concern in Ethiopia where millions of poor farmers depend on subsistence agriculture. Continuing watershed degradation mainly in the form of soil erosion, deforestation, and surface and subsurface water deterioration has resulted in a long-term reduction in quality and quantity of land and water resources, and seriously threatened the agricultural productivity of the country and people's livelihoods, particularly in highland parts where croplands are very scarce resources.[22,9,17,23] Similarly, land use practice in the selected Barite community watershed mostly subjected to less applying soil and water conservation measure which leads to the rapid degradation of soil fertility and diminishing of crop productivity. Understanding historical and present socio-economic characteristics of the watershed is very important for implementation of different management measures. Therefore, the objective of this study was to delineate and map the selected Barite community watershed based on existing land uses; to characterize, identify, prioritize and analyze constraints and opportunities of Barite community watershed, to prepare action plans and intervention measures for the priority issues in the selected watershed with local community participation and to describe and evaluate the present resource use, management practices and socio-economic conditions in the watershed.

Methodology

Description of study area

The study was conducted in Barite community watershed, Dabo Hana District. It is located between 36°5′ 27" and 36°26′ 19"E longitude and 8°30′ 21" to 8°55′ 20"N latitude. And the district is about 519 km far from the capital city, Addis Ababa to the southwest direction. Barite community watershed is about 6 km far from Kone the town of the district and about 42km far from the zonal capital town, Bedele. Generally the district has a total area of 74,725.87 hectares. The altitude of the district ranges between 1190 and 2323 m.a.s.l.[24] Agro-ecologically, 74,426 ha (23.33%) the total land size of the district is Kola (hot) (500-1500 m.a.s.l), 76.63% Woinadega (temperate) (1500-2300 m.a.s.l.) and 0.043% Dega (cold) (>2300 m.a.s.l). The district receives an average annual rainfall of 900 to 2,200 mm. The rainy season extends from April to October and the maximum rain is received in the months of May, June, July, August, and September with the mean monthly rainfall exceeding 2,200 mm. The annual average, mean minimum and mean maximum temperatures are 19.8°c, 11°c, and 28°C, respectively (NMA_National Meteorological Agency, 2016 as cited in (Figure 1).[24]

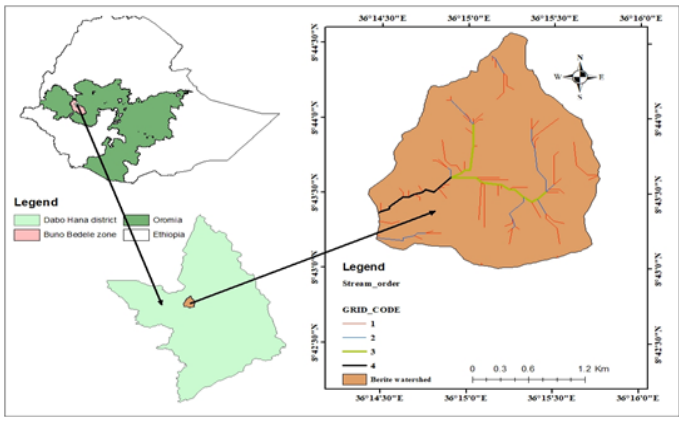

Figure 1 Map of Barite community watershed.

Sampling procedure and sample size

Multi-stage sampling techniques were employed for this study. At the first stage, Dabo Hana district of Buno Bedele zone was selected purposively from zone based on potentiality of watershed. In consultation with district office of agriculture, potential kebeles having watershed were listed. In the second stage, the Barite community watershed was selected purposively from wacale fato kebele of Dabo Hana district. At the third stage, from total house hold farmers (106) the sample size (63) was determined based on Yamane's formula $n = \frac{N}{1+N(e)\hat{}2}$. [25]

Where: n= sample size require

N= population size

E= level of precision / sampling of error (%)

Finally, simple random sampling technique was used to select sample respondent with some stratification based on watershed position considering both upper stream and downstream of the watershed.

Types of data and method of data collection

The data used for this study were collected from both primary and secondary sources. Primary data pertaining to demographic and socio-economic characteristics participation in agricultural extension activities of farmers whether practices or not, soil and water conservation, major agricultural productivities and production constraints were collected from sampled farm households using structured questioner. Participatory problems identification through close field observations both upper stream and downstream of Barite community watershed were the process of the data collection and correction of major mistakes in data- recordings have been made by the investigator together with the respondents while data were being collected. To supplement the primary data, secondary data were also gathered from concerned district office of Agriculture from published and unpublished sources.

Method of data analysis

The quantitative data collected through questionnaire based survey were entered into Statistical Package for Social Sciences (SPSS) software and analyzed using descriptive statistics as well as using various analytical tools based on the objectives of the study. Data gathered using focus group discussion and key informants were transcribed using qualitatively narrating.

Results and discussion

Socio-economic characteristics of sample households (continuous variables) for Barite community watershed

The analysis of socioeconomic characteristics of households are helpful in determining the communities' infrastructures and resources need for planning future intervention of watershed management and could determine the extent to which the community could adopt the future intervention that might be useful in developing a plan for commencing community development work. The survey result indicated that the mean age of the total sample farm households was 41.16 years with the minimum and maximum ages of 20 and 81 years (Table 1). Also, the result showed that the mean family size of households was 5.67 years with the minimum and maximum of 2 and 11 family size (Table 1). As survey result indicate that the mean total size of households was 2.45 years with the minimum and maximum of 0.25 and 18 land size (Table 1).

Table 1 Socioeconomic characteristics of the sample households in the study area (continuous variables)

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age of households	63	20.00	81.00	41.16	16.13
Family size of households	63	2.00	11.00	5.67	1.96
Total size of land holding	63	0.25	18.00	2.45	2.67

Source: Household survey result, 2022.

As shown (Table 2) from the total number of farm households surveyed 95.2% were male and 4.8 % were female farm households. From the sample households, 38.1% of the respondents cannot read and write, 55.5% of them attended formal education from grade one up to eight while 4.8% and 1.6% attended Secondary (9-10) school and College respectively (Table 2). This indicates the majority of the respondent could attain formal education. This is also important as household members' education may contribute in different ways on the decision to enter other income generating activities. The study also indicates that respondents were categorized on the basis of marital status into four categories namely, single, married, divorced and widowed. From the sample respondents, 96.8% of them were married; While 1.6 and 1.6% were divorced and widowed respectively (Table 2). This indicates that majority of the respondents were married and they could be more stable.

Table 2 Demographic characteristics of the sample households (dummy variables)

Variables		Frequency	Percentage (%)
Sex of household	Male	60	95.2
	Female	3	4.8
Religion of house hold	Orthodox	20	31.7
	Protestant	43	68.3
	Other	-	-
House hold marital status	Married	61	96.8
	Divorced	1	1.6
	Widow/widower	1	1.6
House hold education levels	Cannot read and write	24	38.1
	Primary (1-6)	28	44.4
	Junior (6-8)	7	11.1
	Secondary (9-10)	3	4.8
	College	1	1.6
HH head primary Occupation	Agriculture	62	98.4
	Other	1	1.6
HH head secondary occupation	Agriculture	14	22.2
	Traders	5	7.9
	No secondary occupation	44	69.8

Source: Household survey result, 2022.

The study result indicated that the majority (68.3%) of the sampled households are Protestants followers followed by Orthodox (31.7%) in the watershed areas. Around 98.4% and 1.6% of the sample households had primary occupation. This indicates that Agriculture is the principal occupation of a majority of headed households. About 22.2% and 7.9% of headed households had agriculture and petty trade as secondary occupation.

Household land ownership

Land is one of the basic factors of production which affect the production and productivity. Land holding is the size of land a household is entitled to, is measured in hectare. Smallholder farmers in the study area use their land for all farming activities mainly for the production of food crops and cash crops, livestock grazing, and house construction. The survey result shows that the majority of the sampled households (96.8%) were owner of the land (Table 3). Regarding the mode of land acquisition, about 70%, 17.5% and 12.5% of households were acquired from parent, by renting in and government, respectively.

Table 3 means of sample households land acquisition

Variables		Frequency	Percentage (%)
Land ownership	Yes	61	96.8
	No	2	3.2
Means of land access (ha)	From parent	56	70.0
	From government	10	12.5
	Renting in	14	17.5

Source: Household survey result, 2022.

Bio-physical resources characteristics of Barite community watershed

Land uses of Barite community watershed

In the watershed crop land covers the highest portion of area (Table 4) followed by tree land. As indicated (Table 4), range land and Built area were also a part of watershed. LULC 2021 (Figure 2).

Table 4 Land use types of Barite community watershed

Code	Description	Area(ha)	Area (%)
1	Tree	90.15	19.81
2	Crop land	313.56	68.91
3	Built area	4.15	0.91
4	Range land	47.19	10.37
Total		455.05	100

Source: European Space Resources Innovation Centre (ESRIC).

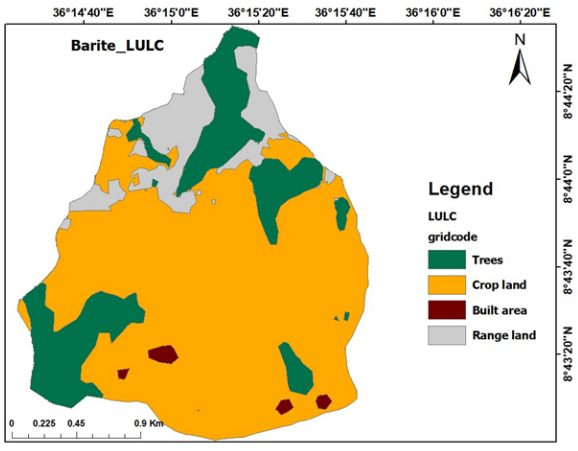

Figure 2 Land use/ cover Map of Barite community watershed.

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Slope gradient of Barite community watershed

Environmental factors such as slope aspect induced by microclimate differences, topography, parent materials, and vegetation communities are significantly influenced by the spatial variation of soil properties.[26]According to [27] slope gradients have a marked influence on soil properties expressed in the soils' distribution along with slope positions. Slope gradient of Barite community watershed ranges from 0 to 30 and the slope gradient of 5-10 (slop) and 2-5 (gently slop) cover the greatest in area coverage representing 236.15 ha and 95.87 ha respectively (Table 5). This indicates that more of the watershed landscape might be exposed to erosion and nutrient leaching at time of high rain fall occurrences. This is in line with the findings of [28] stating that the soil erosion increased exponentially with increasing slope gradient.

Table 5 Slope gradient of Barite community watershed

No	Slope Classes (Degree)	Description	Area (ha)	Area (%)
1	0-2	Flat to very gently slop	20.15	4.43
2	2-5	Gently slop	95.87	21.09
3	5-10	Slop	236.15	51.94
4	10-15	Strongly slop	90.84	19.98
5	15-30	Moderately steep	11.65	2.56
Total			**454.66**	**100.00**

Source: FAO slope classification, 2006.

Crop production in the watershed

Major crop grown the area

Crop production pattern is mainly depends on agro-ecology factors namely climate, soil types, crops types, and community crop production habit. Maize, tef, bread wheat, field peas, haricot beans, faba bean and red pepper are some of the major crops produced in the community watershed (Table 6). Maize, Bread wheat, faba bean, field pea and common bean are used as food crops. According to information obtained from focus group discussion, maize and tef are the most and the dominant crop produced for consumption and income generation. Productivity of crops is affected by multitude of challenges, including limited use of improved technologies, biotic and abiotic factors, low quality of crop products, low soil fertility, soil acidity, lack of access to markets and limited/no access to credit.

Table 6 Summary of crop productivity and area coverage produced

Major crops grown	Minimum (ha)	Maximum (ha)	Average area allocated (ha)
Maize	0.13	5.00	0.88
Tef	0.25	2.00	0.68
Common bean	0.13	0.50	0.18
Faba bean	0.13	0.50	0.23
Field pea	0.13	0.50	0.23
Bread wheat	0.13	0.25	0.18
Red pepper	0.13	0.25	0.15

Source: Household survey result, 2022.

The survey results revealed that sampled headed households used different types of fertilizers to enhance their production (Table 7).

Table 7 Agricultural input used during production

Crops produced in the watershed	Types of Inputs used for crop productions							
	Inorganic fertilizer		Organic fertilizer		Integration of both		Not used	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Cereal	52	82.5	-	-	9	14.3	2	3.2
Pulse and Oil	4	6.3	1	1.6	-	-	58	92.1
Horticultural	5	7.9	2	3.2	4	6.3	52	82.6

Source: Household survey result, 2022.

Out of sampled headed households, about 82.5% and 14.3% used inorganic fertilizers and integration of both, respectively. The survey result also indicates most of the households planted pulses and oils and horticultural crops without any fertilizers.

Cropping systems and pattern

The term cropping system refers to the crops and crop sequences and the management techniques used on a particular field over a period of years. Mono cropping, intercropping and crop rotations systems are the major cropping systems in the watershed.

Mono cropping is the practice of continuously cultivating the same type of crop on the same piece of land year after year and around 17.5% was practiced in the study area. An intercropping is the cultivation of two or more crops simultaneously on the same field. The most common type of intercropping in the area is intercropping of maize with haricot bean and others with 11.1% of practices. Crop rotation practiced in watershed (71.4%) was cereal with pulse and oil crops, cereal with horticultural crops and pulse with horticulture crops (Table 8).

Table 8 Cropping pattern practiced in the watershed

Cropping system	Responses	
	N	Percentage (%)
Inter cropping	7	11.1
Rotation	45	71.4
Mono cropping	11	17.5

Source: Household survey result, 2022.

Soil and water conservation (SWC)

There are two major types of soil and water conservation practices in community watershed. In community watershed, 36.5% of farmers practiced physical soil and water conservation practices whereas 7.9% practicing both physical and biological soil and water conservations and about 55.6% did not practice any soil and water conservation on their own farm lands (Table 9). The widely used physical soil and water conservation was soil bund and cutting check-dam for soil erosion decrease, increase soil moisture and improved soil fertility while planting grass was started in small extent among the biological

types of soil and water conservation. The farmers planted grasses like vetiver grass to protect soil erosion.

Table 9 Soil and water conservation practices

SWC Practices	Frequency	Percentage (%)
Physical	23	36.5
Physical and Biological	5	7.9
Not implements	35	55.6
Total	63	100

Source: Household survey result, 2022.

Livestock production System in the watershed

Livestock holding is very important asset and indicator of wealth for farm households in the study areas. Livestock are kept for various purposes including source of food for the family mainly meat, milk and milk byproducts, draught power, transport, income generation (sale of products and live animals) and manure production for soil fertility management. They are the drivers of crop production mainly as sources of draught power and provision of manure for soil fertility restoration. Sampled household keeps livestock such as cattle, sheep, goats, horse, donkey and poultry. The mean numbers of various species owned by household and purpose of rearing livestock in the study areas shown is shown in Table 10. Local cows are dominant species followed by donkey and local heifers, respectively.

Table 10 Livestock production in the watershed

Livestock type	N	Mean
Local Cow	54	2.33
Oxen	4	1.87
Local Bulls	30	1.50
Cross Breed Bulls	2	2.00
Local Heifers	35	1.86
Cross Breed Heifers	1	2.00
Calves	28	1.43
Sheep	12	2.33
Goat	22	2.91
Horse	2	1.00
Mule	1	1.00
Donkey	37	1.41
Local Chicken	24	3.29
Exotic Chicken	35	2.51

Source: Household survey result, 2022.

Livestock feed sources

Livestock management practices are based on the traditional knowledge of the farmers and farmers had lack of adequate knowledge and skills in improved livestock management practices. Livestock producers practiced grazing systems including own grazing land, green feed (cut and carry), hay making, open grazing, crop residues, and communal land (Table 11). Grazing in the field is the commonly practiced system of grazing in the area. The feed resources in the selected community watershed are primarily natural pasture (own grazing and communal), crop residues and purchased feed. As indicated (Table 11), about 30.7% of households' respond own grazing lands and crop residues are the major sources of livestock feeds. The study further revealed that second most important provider to livestock feed supply is communal land and purchased grazing land (Table 11).

Table 11 Livestock feed types and sources in the community watershed

Feed Type	Feed Sources	Responses	
		N	Percentage (%)
Grazing in the field	Own grazing	35	30.7
	Purchasing grazing land	8	7.0
	Gift	4	3.5
	Communal grazing	8	7.0
Green Feed(Cut And Carry)	Own grazing	4	3.5
Hay Making	Own grazing	4	3.5
Crop Residues	Own grazing	35	30.7
Local Beverage By Product	Own grazing	5	4.4
	Purchasing grazing land	2	1.8
Open Grazing	Communal grazing	9	7.9

Source: Household survey result, 2022.

As the survey result indicates own grazing land is the first most important feed source followed by communal grazing land in the study area (Table 12).

Table 12 Livestock feed sources rank in the community watershed

Feed Sources	Rank
Own grazing	1
Communal grazing	2
Purchasing grazing land	3
Gift	4

Source: Household survey result, 2022.

Beekeeping activities

Only about 19% of the households practice beekeeping using traditional beehive and around 81 percent of the households did not practice beekeeping because of different reasons (Table 13). According to information obtained from FGD, the most common reason that was not practice beekeeping was because of own ignorance while pest and predators and chemical applied to crops was also the most important cause for not practicing beekeeping.

Table 13 Beekeeping farm practices of respondents

Beekeeping practice		Frequency	Percentage (%)
Do you practice beekeeping	Yes	12	19.0
	No	51	81.0
Type of beehives	Traditional	11	17.5
	Modern	1	1.6

Source: Survey result, 2022.

Access to credit**:** Credit service is an important institutional service which was required by the respondents in the study area. During the cropping season, 15.9% of the sample farmers had access to credit in the form of cash. However, the majority of sample respondents (about 84.1 % of them) had not used credit (Table 14).

Table 14 Access to credit services of sample households

Access to credit service		Frequency	Percent
Did you receive a credit service?	Yes	10	15.9
	No	53	84.1
	Total	63	100.0

Source: Survey result, 2022.

Major constraints in the watershed

For more than five decades encouraged progressive efforts have been made on watershed management practice in Ethiopia and as a result different degraded areas were changed to productive sites. However, different watershed management measures across the country were failed due to various constraints. Identifying the major constraints of watershed management in the country in general and study areas in particular could help the users to find alternative solution in tackling the prioritized constraints for the effectiveness of the watershed management measures. Accordingly, different constraints of Barite community watershed were identified and prioritized using different combinations of comparison methods (Pairwise ranking and analytical hierarchy process) based on Barite community watershed users responses (Table 15). Each of the major constraints was discussed in detail below.

Table 15 Pairwise ranking and analytical hierarchy process result for major Barite community watershed constraints

No	Constraints	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Row total	Decimal value	Rank
1	Soil erosion (A)		5	1	2	5	5	5	5	5	5	5	5	5	5	58	0.18	1st
2	Soil fertility decline (B)			2	2	4	4	4	3	3	3	4	2	2	3	36	0.11	2nd
3	Deforestation (C)				1	4	4	4	3	4	4	2	2	2	3	33	0.10	3rd
4	Climate change (D)					1	4	4	4	5	4	2	2	1	4	31	0.10	3rd
5	Agricultural inputs (E)						2	4	3	3	3	5	5	5	5	35	0.11	2nd
6	Crop pest and disease (F)							5	3	4	3	4	4	4	4	31	0.10	3rd
7	Crop productivity decline (G)								5	3	3	2	4	3	5	25	0.08	4th
8	Feed related (H)									4	3	3	3	3	3	19	0.06	5th
9	Animal disease (I)										3	3	3	3	3	15	0.05	6th
10	Grazing system related (J)											2	3	3	3	11	0.03	7th
11	Credit service (K)												5	5	5	15	0.05	6th
12	Market service (L)													4	5	9	0.03	7th
13	Transport accessibility (M)														4	4	0.01	8th
14	Cooperative membership (N)															322		

Source: Survey result, 2022.

Soil and water conservation (SWC) constraints

The major constraints of natural resources identified by respondents were soil erosion, soil fertility decline, deforestation and climate change. The survey result showed that about 69.8% and 22.2% of respondents were reported soil erosion and poor soil fertility as main important constraints, respectively. The reasons of not practicing conservation were not aware of advantage of conservation structures, no need of structures, lack materials and labor to make structures. Deforestation and climate change also were reported as important constraints by 1.6% and 6.3% of respondents, respectively in the study areas (Table 16).

Table 16 Soil and water conservation major constraints of respondents

Major constraints (n=63)	Responses		Rank
	N	Percentage (%)	
Soil erosion	44	69.8%	1
Soil fertility decline	14	22.2%	2
Deforestation	1	1.6%	4
Climate change	4	6.3%	3

Source: Survey result, 2022.

Major crop production constraints

Crop production is one of the major agricultural activities undertaken by community in the Berite community watershed. The assessment conducted during main cropping year showed there has been no common use of the crops varieties with their recommended technology package. In addition to these gaps, shortage/lack of improved seed and fertilizer, high cost of fertilizer and improved seed were the main constraints. The major crops production constraints include Agricultural inputs (38.3%), crop pest and disease (31.7%) and crop productivity decline (30.0%) were the main constraints in the watershed which ranked ranges of 1-3 (Table 17).

Table 17 Major crops production constraints of respondents

Major constraints	Responses		Rank
	N	Percentage (%)	
Agricultural inputs (time, price, quantity supply)	23	38.3	1
Crop pest and disease	19	31.7	2
Crop productivity decline	18	30.0	3

Source: Survey result, 2022.

Livestock production constraints

Livestock producers were asked to give their views on most important constraints affecting their livestock farm operations and their responses were summarized (Table 18). In general the livestock production constraints were tried to be identified and prioritized in order of their importance in the community watershed. Overall constraints were categorized into three clusters as feed related constraints, health related constraints and grazing system related constraints (Table 18). Animal breed and disease constraints are ranked first by discussion made with experts and household level survey data in the watershed. The main problems related with animal disease were absence of vaccines and medicines and location of health clinics at distant places from farmers' of the study area. These problems forced farmers to use non-prescribed medicines without the knowledge of health professional and opened black marketing of drugs trading which causes; high priced drugs, invited expired and ineffective drugs to the market. Concerning feed, shortage of grazing land due to expansion of farm land to marginal areas, inaccessibility of supplementary feeds, lack of improved forage varieties, lack of awareness and skill on improving nutritional value and straws due to poor extension service on livestock sector were the main production constraints.

Table 18 Livestock production constraints in the watershed

Major constraints	Responses		Rank
	N	Percentage (%)	
Feed related	13	22.8	2
Animal breed and disease related	32	56.1%	1
Grazing system related	12	21.1%	3

Source: Survey result, 2022.

Institutional services and infrastructure constraints

Availability of efficient institutional services plays a crucial role to increase agricultural production and productivity. Such institutional support services include extension services, market services, and credit facilities and cooperative (farmers' organizations). Extension provides a source of information on new technologies for farming communities which when adopted can improve production, incomes and standards of living.[31]During survey conducted farmers told they had access to extension service three times a year on general agricultural production in the 2020 production season. Credit service is another institutional factor that is crucial element in agricultural activities for increasing production and productivity. Depicts that out of the institutional services found in the community watershed, credit service (35.7%) is the first major constraint (Table 19). This indicates the majority of the sample households' did not get credit services for their implementation of agricultural practices on their farmlands in the watershed for the case of high interest rate, inappropriate payback period of received loan, amount of credit low and shortage of credit service. Rural roads facilitate the provision of extension and increase access to market opportunities that incentivize the take up of technologies recommended by extension. Transport service is a key in marketing of crops produced especially for perishable crops, and provision of different agricultural services to farmers. Limited transport service affects agricultural production in the watershed. The survey result also indicates that poor road structure and limited transport service is the second major constraint (29.4%) of institutional and infrastructure in the watershed (Table 19). The survey result is in line with[32] in depth review of the public extension service in Ethiopia found that the poor rural road network was one of the main constraints that limited the provision of agricultural extension services to farmers.

Table 19 Institutional characteristics of sample households in the study area

Institutional services			Rank
Major constraints	N	Percentage (%)	
Credit service	18	35.3	1
Market service	4	7.8	4
Transport accessibility	15	29.4	2
Membership of cooperative	14	27.5	3

Source: Survey result, 2022.

Cooperative is primary established to improve the living standards of members by reducing production and service costs by providing input or service (credit) at a minimum cost or by finding a better price to their products or services as well as supplying consumable commodities to stabilize the current unfair market. The survey result revealed that the majority of sample households were non-membership of cooperatives and only about 27.5% of households were members of cooperative. The reasons for non-membership of cooperatives were lack of well-functioning in providing input such as; improved varieties and fertilizers, lack of enough information on importance of cooperative, lack of interest to join a cooperative, lack of capital to buy initial share and believed as cooperative not perceived benefit. According to[33,34]people are not well informed about the objectives of the movement to join the cooperatives.

Market service is also institutional factor that affects agricultural production and the benefit generated from the sector. Market access and proximity to the market is one of those key institutional variables to improve marketing and productivity of smallholder farmers. It is the constraint in successful participation of smallholder farmers in market oriented agricultural production. The survey result showed that only about 7.1% of respondents were access to market service (Table 19).

Opportunities of agricultural production in the watershed

Despite there were many constraints that affect production and productivity in the watershed, there were also some of opportunities toward increment of production and watershed management. Good attention of the government on the watershed management, intervention of NGO, presence of labor/human power, construction of rural road, availability of informal institution (Dabo and Iqub) which increase farmers' relationships and promote farmers on natural resource conservation and farmers cooperatives were the main opportunities identified. This finding also, agreed with Gebrehaweria et al.[35] stated that hydrological relationships across a watershed can influence a large number of stakeholders due to the use and management of resources. Furthermore, hydrological relationships within a watershed often go beyond administration boundaries, and ownership rights with limited regulation and institutions governing the rights and duties of different stakeholders.

Conclusion

The survey was undertaken in selected watershed of Dabo Hana district of Buno Bedele zone of Oromia. Barite community watershed was selected out of existing watershed based on road accessibility. From the community watershed out of 106 house hold about 63 samples of households were selected for this study. Data collection tools such as interviews, Focus Group Discussions (FGD), key informants' interviews, field observations and document analyses were used by developing questionnaire and checklist. The mixed farming systems were take place in the watershed and both livestock and crop production take place within the same locality. In mixed farming system the ownership of the crops or land and the livestock is combined.

Majority of smallholder farmers in the study area of were the owner of the land and use their land for all farming activities mainly for the production of food and cash crops, livestock grazing, and house construction. Watershed has consisting highest portion of area suitable for cultivation with land slope gradient of 5-10 degree. Barite community watershed has endowed favorable climatic condition with wide range varieties of crop production. Maize, tef, bread wheat, field peas, haricot beans, faba bean and red pepper are some of the major crops produced in the watershed. The major cropping systems in the study area are mono cropping, intercropping and crop rotations systems. The major problems of crop production in selected watershed include disease and pest problem, soil fertility problems, high cost of fertilizer, shortage of improved varieties and weather fluctuation.

Livestock holding is very important asset and indicator of wealth for farm households in the study areas. Livestock are kept for various purposes including source of food for the family mainly meat, milk and milk byproducts, draught power, transport, income generation and manure production for soil fertility management. Sampled

household keeps livestock such as cattle, sheep, goats, horse, donkey and poultry. Local cows are dominant species followed by donkey and local heifers respectively. The feed resources in the selected watershed are primarily natural pasture, crop residues and purchased feed. A few number of households are practiced Beekeeping because of the practice have different challenges like bee is affected pest and predators, chemical applied to crops and their own ignorance. The major problems of livestock production are disease, shortage of animal feed and improved forage, lack of improved breed, shortage of veterinary service and lack of grazing land.

Physical and biological soil and water conservation practices are practiced in the watershed. Physical soil and water conservation practice such as; soil bund, cutting check-dam for soil erosion decrease, increase soil moisture and improved soil fertility while planting vetiver grass was started in small extent among the biological types of soil and water conservation. The major constraints of natural resources identified by respondents were soil erosion, soil fertility decline, deforestation and climate change.

Institutional services include extension services, market services, and credit facilities and cooperative are also found in the watershed. Availability of efficient institutional services plays a crucial role to increase agricultural production and productivity. The major constraints of institutional services in the watershed are lack of access to credit (high interest rate and inappropriate payback period of received loan), limited transport service, lack of access to market service and cooperative membership. In spite there were many constraints that affect production and productivity in the watershed, there were also some of opportunities like; Good attention of the government on the watershed management, intervention of NGO, presence of labor/human power and construction of rural road.

Recommendations

The following recommendations are drawn based on the findings for future technologies improvement and the sector development in the study area.

Natural resources

a) Developing and popularizing well adapted multipurpose trees species in the study area should be given an attention by district and forestry research programme

b) Soil and water conservation structures for sound natural resources conservation in the area are crucial. Therefore, Promote farmers awareness and participation toward soil and water conservation intervention through the provision training and demonstration of improved SWC technologies

c) Research and extension services should be strengthened for wider promotion of improved soil and water conservation measures.

d) Farmers' awareness should be promoted and supported by research to use physical and biological soil conservation for rehabilitation of degraded lands and renewal of the declined soil fertility in the study area.

e) Mapping of soil fertility and fertilizer requirement should be developed for sustainability of soil fertility management and improve production and productivity.

Crop production

a) Ensure supply and distribution of crops technologies and improved agronomics practices for the watershed

b) Ensures sufficient supply of agro-chemicals and encourage farmers' effective demand for agro-chemicals usages.

c) Ensure the sustained supply of improved seeds and supplying high quality seeds of major crops

d) Increase production and productivity of the crops optimum usage of improved technologies and appropriate agronomic management practices are the crucial. So, Provide training to the farmers and developments agents on improved crops technologies packages

e) Technologies that control disease, insect and weed should be developed as a watershed, district and zone

f) Capacitates farmers indigenous knowledge on disease and insect managements and should be supported scientifically by developing and strengthen agricultural research on crops disease and insect control for better control of crop pests.

g) Use of crop agriculture research findings on disease and insect control for similar agro-ecologies

h) Strengthen specialization on cash crops and diversification of major field crops to transfers smallholders from subsistent farming to commercialization

Livestock productions

a) Veterinary services and vaccine quality control should be improved to control infectious diseases and parasites and avoid illegal traders of vaccines

b) Improve and expand animal health services by rehabilitations of existing clinics and animals health posts

c) Strengthen the artificial inseminations (AI) services by supplying AI equipment and facilities and enhance livestock productivity and production through breed improvements

d) Improved forage technologies should be introduced and enhanced to enhance livestock production through developing forage seed in the study area

e) Improve farmers' awareness on crop residues and other supplementary feed sources usages for their animals

f) Develop and expands honey productions through introduce and popularize apiculture technologies for the zone.

g) Expands and promote livestock productions and products for the markets in high quality.

Institutional services and infrastructure

a) Expanding accessibility of infrastructures such as road and transportation facilities needs government intervention to promote the effective marketing of crops.

b) The extension system should be efficient as much as possible through capacity building interventions in relation to increase agricultural production.

c) Training and demonstration of improved agricultural technologies should be strengthened.

d) Marketing systems of crops and livestock should be improved through controlling illegal traders, organizing legal marketing system, strengthens of market information and linkage.

e) To solve weak bargaining power producers should be make market their product through cooperative and cooperative should be strengthened.

f) Cooperative was limited to only the supplying of some commodities like fertilizers and also not on time. So, it should be go further by distributing improved seeds, buying farmers' crops products from farmers, creating job opportunities and delivering credit services for the farmers in the area.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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