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Original Research

Native Pasture Conditions and Utilization Status in the Amarti and Nashe Wetlands, Western Oromia, Ethiopia

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Abstract

The investigation aimed to assess the current and past usage of natural pastures in the Amarti and Nashe wetlands. A survey and observation of 105 homes with direct positive impacts were conducted. Results showed that household family size, animal holding, crop holding, and grazing land holding increased significantly around the Nashe wetland compared to the Amarti wetland areas. Additionally, the average size of the animal herd was larger around the Nashe wetland. Wetland natural pasture was the principal source of cattle feed in the Nashe wetland region (68.3% of animal intake) and the Amarti wetland areas (68.6% of animal intake) during the dry season. A little over half of respondents (43.8%) thought the wetlands around the Amarti wetland areas were poor, while nearly six-in-ten (62.5%), agreed. Reduced pasture area, excessive grazing, soil degradation in upland areas, and a general lack of knowledge about how to manage wetland resources were the main reasons for this low quality. While the Nashe wetland had an expected stocking rate of 7.75 TLU/ha, Amarti had a rate of 2.39 TLU/ha. Due to overpopulation, low species richness, and general poor condition, the assessed wetlands necessitated improvement, especially during the dry season.

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INTRODUCTION

A wetland is described as a swamp, bog, peat land, or water area that is either natural or manmade, permanent or temporary, and has fresh, brackish, or salt water that can be found standing or flowing. This definition also includes marine waters that are no deeper than six meters at low tide (Ramsar Convention of 1997). According to MEA (2005), wetlands offer a variety of environmental benefits, including clean water and air, better soil development and protection, pest control for plants, and habitat for various wildlife and plant species. Wetlands serve as natural water storage facilities and are essential for maintaining biodiversity, reducing pollution, and managing trash (Ramsar Convention, 2011). From an ecological perspective, wetlands are crucial for maintaining the biodiversity of both plants and animals as well as for water storage, filtration, flood protection, nutrient and toxin retention, and carbon sequestration (Abebe and Geheb, 2003). Ethiopia's great range of landforms and climate, which produce a vast wetland system throughout the nation, are the main reasons it is referred to as the "water tower of East Africa" (Hagos et al., 2013). Wetlands make up nearly 2% of Ethiopia's total landmass, according to the EPA (2004), and offer numerous socioeconomic benefits to the surrounding population. Ramsar (2004) states that Ethiopia is home to a variety of wetlands with diverse genesis.

There were all kinds of wetlands in Ethiopia, with the exception of large swamp forest complexes and those associated to the coast and ocean (Dixon and Wood, 2007).

According to reports, a number of Ethiopian wetlands are under tremendous strain from growing populations brought on by socioeconomic shifts and a lack of government regulations pertaining to the management and use of wetland resources (Dixon and Wood, 2003; Ambelu et al., 2013). The Amarti and Nashe wetlands in western Ethiopia are among the many wetlands that support livestock. They were formed as a result of hydroelectric dams and are thought to have the most potential for communal grazing and a diverse population of herbaceous plants (sedge, grass, legumes, and forbs). The growth of permanent standing water and the conversion of wetlands to arable land are periodically causing the upland grazing areas to decline. However, there was a dearth of specific information regarding the state of wetlands today, which is why this study was started to evaluate the native pasture in the wet grazing land areas of the Amarti and Nashe.

MATERIALS AND METHODS

Description of the study areas

Figure 1 shows the Amarti and Nashe marshes. The two wetlands are located in the western Ethiopian Oromia Region's Abay Choman and Horro districts of the Horro Guduru Wollega Zone. While Nashe Wetland is located between 9040'30" and 9049'30"N and 3707'30" and 37019'30"E, Amarti Wetland is located between 9034'30" and 9046'30"N and 3704'30" to 37019'30"E. The country's capital city, Addis Ababa, is roughly 289 kilometres to the west of the research areas. For the Amarti wetland and the Nashe wetland, the research areas' estimated grazing land area coverage was 881.73ha and 55.32ha, respectively.

Method of data collection

Household sampling

To get the data, basic random sampling techniques with a purpose were used. Based on the presence of wetlands and wetland native pasture resources, study districts and representative "Kebeles" (Kebeles are the smallest administrative unit in Ethiopia) are purposefully selected. The target population's homes were chosen at random for questionnaire interviews based on the sample size of every Kebele in each district.

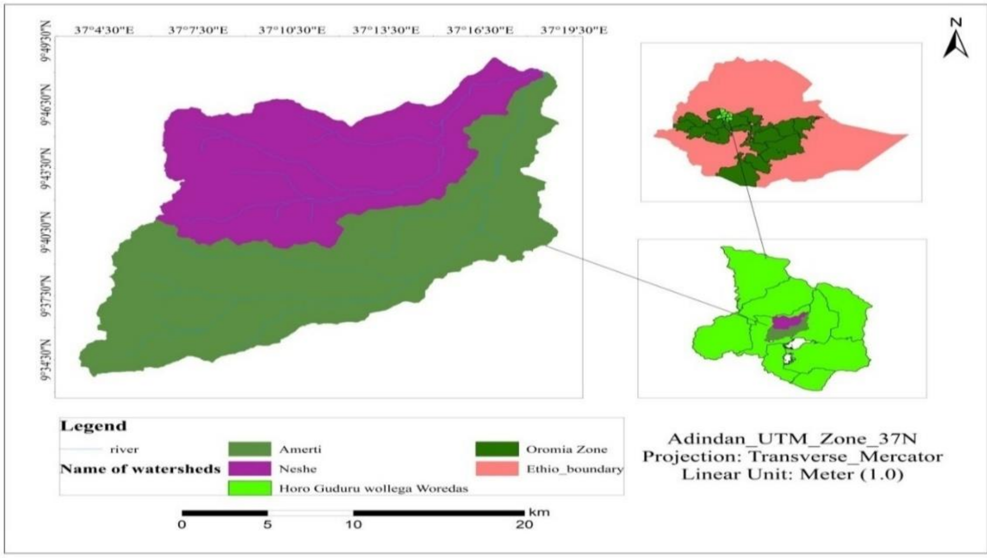

Figure 1. *A map showing the research area in the marshes of Amarti and Nashe*

Household Sample size determination

The proportional sampling method (Yamane, 1967) was used to calculate the sample size for each Kebele. It is based on the following formula: $\mathbf{n} = \frac{\mathbf{N}}{\mathbf{1+N}(e)^2}$ where n is the needed total sample size, N is the total household population size of all sample Kebeles, and e is the level of precision.

Table 1

Study population and sample size allocation

Study wetland	Potential Kebeles	Population size	Sample size
Amarti wetland	1. Didibe Kistana	59	43
	2. Homi	41	30
Nashe wetland	1. Alaku	24	18
	2. Boti	19	14
Total		N = 143	n = 105

Socio-economic data collection

The necessary data was gathered via an official, one-visit survey (ILCA, 1990). Prior to conducting the survey, the study wetland areas were visited, and secondary data pertinent to the areas under inquiry was gathered from every available source. To evaluate the methods used in the study areas to use the natural pasture resources found in wetlands, primary and secondary data sources were consulted (Table 1).

Choice of wetland condition assessment factors

Baars et al. (1997) evaluated the state of the wetlands in the study regions using two criteria: soil condition (erosion and compaction) and vegetation features (composition, basal cover, litter cover, age distribution, and number of seedlings of dominating species). Consequently, three of the parameters (herb composition, basal and litter cover) were assigned a maximum of 10 points, while the remaining four factors (number of seedlings, age distribution of dominant herbaceous species, soil erosion, and soil compaction) were assigned a maximum of 5 points. As per Baars et al. (1997), the evaluation factors concerning soil parameters and herbaceous vegetation sum up to 50 points. The evaluations were deemed excellent if the total points fell within the range of 41-50 points, good if the points fell between 31-40 points, fair if the points fell between 21-30 points, poor if the points fell between 11-20 points, and very poor if the rating was ≤ 10 points.

Composition of herbaceous plant species in wetlands (0-10 rating)

Estimating the percentage coverage of grasses, legumes, sedges, and forbs species in each 1 m^2 quadrat at 10-meter intervals for every transect allowed us to calculate the species composition of the herbaceous species at each location. By speaking with key informants regarding the distribution and palatability of every herbaceous species that was available in relation to the location of wetland, the species were divided into decreasers, increasers, and invaders. The highly desirable species that are likely to decline with high grazing pressure (decreasers), the intermediate species that are likely to increase (increasers) with high grazing pressure, and the undesirable species that are likely to invade with high grazing pressure (invaders) are the categories into which the grass species were divided, according to the pastureland succession theory (Dyksterhuis, 1949; Tainton, 1981). Key informants, including elders, ranchers, and guards at dams and reservoirs, were interviewed in order to obtain information regarding the health and palatability of a specific species. High-palatability species were seen as decreasers, whereas species that were least palatable and those with an intermediate palatability were thought to be increasers and unaffected by grazing pressure. According to Queiroz et al. (2015), the recorded plants from the study areas were divided into many growth forms (forbs, legumes, grass, and sedges). Based on a visual estimation of the proportion of increasers or decreasers at each sampling point, ratings were assigned (Baars et al., 1997). According to Baars et al. (1997), the decreasers' contribution was assigned a maximum score of 10 points when it was between 91 and 100%, and a score of 1 point when it was less than 10% or more than 50% of the increasers, with the remaining portion falling in between these ranges.

Basal cover and litter cover (0-10) score

The 1 m^2 quadrat was divided in half, and five examples of 1 m^2 regions were chosen for in-depth analyses of the basal and litter cover at each sample point. Baars et al. (1997) divided one half into quarters and then further divided one quarter into eighths. To make it easier to visually analyse the basal cover, the basal cover of every plant on the chosen 1 m^2 was clipped, held together, and drawn in the eighth segment. Based on the relative plant cover of the remaining live plants in the field, the basal cover rating was determined as follows: One rating is for 0%, another is for <1%, a third is for 1-3%, a fourth is for >3% of perennials, a fifth is for >6% with bare spots, a sixth is for >6% and evenly distributed, a seventh is for >9% with sporadic bare spots, an eighth is for >9% and evenly distributed, a tenth is for >12% with no bare spots, and so on. According to Baars et al. (1997), tuft species' base cover was rated as acceptable if the eighth was filled (12.5%) or as extremely poor if it was less than 3%.

Based on the proportion of fallen and dead plant components in the field, the litter cover was also rated as follows: 0 represents less than 3%, 2 indicates 3–10% with weeds or tree leaves, 4 indicates 3–10% primarily made up of grasses, 6 indicates 11–40% unevenly dispersed, 8 indicates 11–40% evenly distributed, and 10 represents more than 40%. According to Baars et al. (1997), the assessment of the litter cover inside a given 1 m^2 was assigned a maximum of 10 points, denoting great coverage if it surpassed 40%, and a minimum of 1 point, denoting bad coverage if it was less than 3%.

Number of seedlings (0-5 points)

Five sections, spaced 10 metres apart, each the size of a randomly chosen A4 sheet (30*21 cm), were used to count the number of seedlings at each sampling location. The sheet was lowered from two metres above the floor. The dominating species' seedling population was counted and scored in the field as follows: on the area of A4 paper, 0 points were awarded for no seedlings, 1 point for one seedling, 2 points for two seedlings, 3 points for three seedlings, 4 points for four seedlings and 5 points for more than four seedlings (Baars et al., 1997).

Age distribution of the dominant plants (1-5 points)

Visual observation and estimation of the size of the grass tufts within each transect of the research area were used to subjectively assess the age distribution, which represents the stage of maturity of the herbaceous plants, using five measurements of the 1 m2 quadrant. All size classes' distribution of the dominating species' small, medium, and large grass plants wastaken into consideration.The study area's predominant herbaceous plant species were classified into the following size classes:Baars et al. (1997) assigned scores of 5 for all grass size classes, 4 for small and medium-Sized groups, 3 for only big groups, 2 only for medium-sized plant groups, and 1 for the presence of only small plants.

Soil erosion (0-5) and soil compaction (1-5) score

Through eye observations, five measurements of a 1 m^2 quadrant were used to subjectively assess the degree of soil erosion and compaction in each transect of the research area. The number of pedestals and, in extreme situations, the existence of pavements determined the soil erosion rating (0–5). With 5 points for showing no evidence of erosion, 4 points for light sand mulch, 3 points for weak pavements, 2 points for steep-sided pedestals, 1 point for pavements, and 0 points for gullies, the highest score was awarded. Based on how much the surface soil had crusted or capped, soil compaction was graded from 1 to 5. A floor surface without any capping received the most points (5), followed by isolated capping (4 points), more than 50% (3 points), more than 75% (2 points), and nearly 100% (1 point) (Baars et al., 1997).

Methods of Data Analysis

The Statistical Package for Social Sciences (SPSS, 2016, version 20) was used to analyse all the data gathered from the survey on the characteristics of the household head (age, gender, education, marital status, and family size), the characteristics of the agricultural land (total land size and allocation), the economic activities carried out, the characteristics of the livestock (number, herd composition, purposes), and feed resources. With a 95% likelihood based on the least significant difference, the differences were deemed significant. Using the following methodology, an index was created to give a general ranking of the most significant feed sources for livestock: Index is calculated as follows: for each feed resource, divide the sum [4 for rank 1 + 3 for rank 2 + 2 for rank 3 + 1 for rank 4] by the sum [4 for rank 1 + 3 for rank 2 + 2 for rank 3 + 1 for rank 4] for all feed kinds (Musa et al., 2005). Vegetation attributes were fitted to the statistical software R (R Core Team, 2020, version 4.13). The species diversity and current wetland condition of the two wetlands under study were analysed using an independent sample t-test. The least significant test was used to separate the means, and the F values were significant at ($p<0.05$).

Stocking Rate Estimation

All of the herbivores in the study wetlands were first identified, and their numbers were approximated, in order to calculate the stocking rate. To determine the overall herbivore weight, the projected numbers of herbivores were multiplied by their average weight. To get a consistent measurement of the animals, the total weight of all herbivores was divided by 250 kg, or a tropical livestock unit (TLU). The FAO (2011) provided an estimate of the mean weights of the animals in the studied wetlands. Lastly, the total TLU of all herbivores in each wetland was divided by the total grazable area of the wetlands to determine the stocking rate of each wetland (Mulisa, 2017). Stocking rate= (Total TLU)/(Grazable land area)

RESULTS AND DISCUSSION

Results

Socio-Economic characteristics of Respondents

About 90.5% of household heads were male, while about 9.5% of the households in the present study areas were headed by females. This indicated that most households were male-headed and females heading households less participate in such interviews for various reasons, such as the women are looking after their children, preparing meals, and other related chores at home. The age groups of young (18-29 years), adults (30-65 years), and elders (>65 years) makeup 4.1%, 91.8%, and 4.1%, respectively, around Amarti wetland, while it was 3.1%, 81.3% and 15.6% around Nashe wetlands, respectively (Table 2). The dominant age groups of household heads around Amarti and Nashe wetland area were adult.

Concerning the education level, about 2.7% respondents were illiterate, while 30.1% of them had a basic but non-formal educational background and about 67.2% of them had a formal education (primary to high school) background. Around Nashe wetland areas, 50% of the respondents had a basic (non-formal) educational background and 50% had a formal educational background from primary to high school (Table 2). About 1.4%, 94.5%, 1.4%, and 2.7% of respondents around Amarti wetland were single, married, divorced, and widowed, respectively, while 3.1%, 90.6%, 0%, and 6.3% of those surveyed around Nashe wetland were single, married, divorced and widowed.

Table 2

Gender and age category of respondents around the Amarti and Nashe wetland

	Amarti (N = 73)		Nashe (N = 32)		Overall (N=105)	
Gender	Frequency	%	Frequency	%	Frequency	%
Male	65	89.0	30	93.8	95	90.5
Female	8	11.0	2	6.2	10	9.5
Total	73	100	32	100	105	100
Age category	Frequency	%	Frequency	%	Frequency	%
18-29 (young)	3	4.1	1	3.1	4	3.8
30-65 (adult)	67	91.8	26	81.3	93	88.6
>65 (elders)	3	4.1	5	15.6	8	7.6
Total	73	100	32	100	105	100

N= Number of respondents

Concerning the education level, about 2.7% respondents were illiterate, while 30.1% of them had a basic but non-formal educational background and about 67.2% of them had a formal education (primary to high school) background. Around Nashe wetland areas, 50% of the respondents had a basic (non-formal) educational background and 50% had a formal educational background from primary to high school (Table 3). About 1.4%, 94.5%, 1.4%, and 2.7% of respondents around Amarti wetland were single, married, divorced, and widowed, respectively, while 3.1%, 90.6%, 0%, and 6.3% of those surveyed around Nashe wetland were single, married, divorced and widowed.

Table 3

Education level and marital status of respondents around the study wetlands

	Amarti (N = 73)		Nashe (N = 32)		Overall(N=105)	
Education level	Frequency	%	Frequency	%	Frequency	%
Illiterate	2	2.7	0	0.0	2	1.9
Read and write	22	30.1	16	50.0	38	36.2

Table 3 continues…

Elementary school	31	42.5	7	21.9	38	36.2
Secondary school	17	23.3	8	25.0	25	23.8
High school and above	1	1.4	1	3.1	2	1.9
Total	73	100	32	100	105	100
Marital status	Frequency	%	Frequency	%	Frequency	%
Single	1	1.4	1	3.1	2	1.9
Married	69	94.5	29	90.6	98	93.3
Divorced	1	1.4	0	0.0	1	1.0
Widowed	2	2.7	2	6.3	4	3.8
Total	73	100	32	100	105	100

N= Number of respondents

Family size and land ownership (ha) of the household head in the study areas

Family size and land ownership of the household head around Amarti and Nashe wetland areas are indicated in Table 4. The average total family sizes of the Amarti and Nashe wetlands were 7.06 and 8.28, respectively. The average family size per household in the Amarti wetland was significantly ($p<0.05$) lower than Nashe wetland and there was no significant ($p>0.05$) difference between the female family size of the two wetlands studied, but the male family size of the Amarti wetlands is significantly ($p<0.05$) smaller than the male family size of the Nashe wetlands areas.

Table 4

Respondents' family size and land ownership (ha) in the study areas

	Amarti wetland (N = 73)		Nashe wetland (N = 32)		
Family size	Mean ± SE	%	Mean ± SE	%	p-value
Male	3.41±0.14	48.4	4.36±0.25	52.7	0.001
Female	3.64±0.15	51.6	3.92±0.29	47.3	0.329
Total	7.06±0.29	100	8.28±0.54	100	0.007
Land holding (ha)					
Crop land	1.93±0.16	83.2	4.09±0.53	84.4	0.000
Grazing land	0.39±0.03	16.8	0.76±0.09	15.6	0.000
Total	2.34±0.18	100	4.83±0.59	100	0.000

N= Number of respondents

The result of the current study showed that the total land holding per household around Nashe wetlands was significantly ($p<0.01$) higher (4.83±0.62ha/hh) than that of (2.34±0.19ha/hh) the Amarti wetlands areas. The mean crop land per household head around Nashe (4.09±0.53ha/hh) wetlands were significantly ($p<0.01$) higher than around the Amarti (1.93±0.16ha/hh) wetlands. Household land ownership indicates that crop land in the Amarti and Nashe wetlands accounted for about 83.2% and 84.4%, respectively, of the total land available in the areas. The overall mean grazing land per household around Amarti and Nashe wetlands was 0.39ha and 0.77ha, respectively. The mean grazing land of the current study was significantly ($p<0.01$) higher (0.76±0.09ha/hh) around Nashe wetlands than Amarti wetlands (0.39±0.03ha/hh).

Livestock herd composition

The mean total livestock holdings per household head around the Amarti wetland was 11.69TLU, of which 8.41 (71.8%), 0.75 (6.4%), and 2.55 (21.8%) were cattle, small ruminants, and equines, respectively. The average total livestock ownership per household head around the Nashe wetlands was 14.90TLU, of which 12.43 (81.8%), 0.7 (4.7%), and 2.01 (13.5%) were cattle, small ruminants, and equines, respectively (Table 5). The mean number of cattle (12.43±1.13) around Nashe wetlands was significantly ($p<0.01$) higher than the mean number of cattle (8.41±0.37) kept around Amarti wetlands. The mean number of sheep (0.42±0.03) around Amarti wetlands was significantly ($p<0.01$) higher than the mean number of sheep (0.25±0.05) kept around Nashe wetland areas(.

Table 5

Mean livestock composition and herd structure (TLU) of the respondents in the wetlands of Amarti and Nashe.

	Amarti (N = 73)		Nashe (N = 32)		Overall(N = 105)		
Species	Mean ± SE	%	Mean ± SE	%	Mean ± SE	%	P-value
Calves (TLU)	0.44±0.04	3.8	0.65±0.07	4.4	0.55±0.06	4.1	0.007
Heifers(TLU)	1.52±0.12	13	3.18±0.29	21.3	2.35±0.21	17.7	0.000
Bulls (TLU)	1.33±0.11	11.4	1.69±0.35	11.3	1.51±0.23	11.4	0.240
Oxen (TLU)	2.65±0.15	22.7	3.34±0.25	22.4	2.99±0.2	22.5	0.011
Cows(TLU)	2.45±0.14	21	3.33±0.43	22.3	2.89±0.29	21.7	0.003
Total cattle	8.41±0.37	71.8	12.43±1.13	81.8	10.29±0.99	77.4	0.000
Sheep (TLU)	0.42±0.03	3.6	0.25±0.05	1.7	0.34±0.04	2.6	0.001
Goats (TLU)	0.33±0.04	2.8	0.45±0.1	3	0.39±0.07	2.9	0.188
Total shoat	0.75±0.07	6.4	0.7±0.15	4.7	0.73±0.11	5.5	0.064
Donkey(TLU)	1.25±0.08	10.7	1.67±0.14	11.2	1.46±0.11	11	0.006
Horses (TLU)	0.97±0.14	8.3	0.17±0.09	1.1	0.57±0.12	4.3	0.000
Mule (TLU)	0.33±0.06	2.8	0.17±0.06	1.1	0.25±0.06	1.9	0.089
Total equines	2.55±0.28	21.8	2.01±0.29	13.5	2.28±0.29	17.1	0.001
Total (TLU)	11.69±0.91	100	14.90±1.83	100	13.30±1.39	100	0.013

N = Number of respondents; SE = Standard Error; TLU = Tropical livestock unit.

There was no significant (p>0.05) difference between the mean number of goats and the mean total number of small ruminants per household kept around the Amarti and Nashe wetlands.

Generally, small ruminants from the study areas were used to produce income and meat for household consumption. There was no significant (p>0.05) difference between the mean number of mules kept around the Amarti and Nashe wetlands. The mean number of donkeys (1.67±0.14) around Nashe wetland areas was significantly (p<0.05) higher than the mean number of donkeys (1.25±0.08) around Amarti wetland areas.

The average number of horses (0.97±0.14) kept around the Amarti wetlands was significantly (p<0.01) higher than the mean number of horses (0.17±0.09) kept in the Nashe wetlands. In general, the average total number of equines (2.55±0.28) kept around the Amarti wetlands was significantly (p<0.01) higher than the average total number of equines (2.01±0.29) kept around the Nashe wetlands. The mean total number of livestock per household head around the Nashe wetland (14.90±1.83) was significantly (P<0.01) higher than around Amarti wetland (11.69±0.91) areas (Table 6).

Table 6

Mean livestock composition and herd structure (TLU) of the respondents in the wetlands of Amarti and Nashe.

	Amarti (N = 73)		Nashe (N = 32)		Overall(N = 105)		
Species	Mean ± SE	%	Mean ± SE	%	Mean ± SE	%	P-value
Calves (TLU)	0.44±0.04	3.8	0.65±0.07	4.4	0.55±0.06	4.1	0.007
Heifers(TLU)	1.52±0.12	13	3.18±0.29	21.3	2.35±0.21	17.7	0.000
Bulls (TLU)	1.33±0.11	11.4	1.69±0.35	11.3	1.51±0.23	11.4	0.240
Oxen (TLU)	2.65±0.15	22.7	3.34±0.25	22.4	2.99±0.2	22.5	0.011
Cows(TLU)	2.45±0.14	21	3.33±0.43	22.3	2.89±0.29	21.7	0.003
Total cattle	8.41±0.37	71.8	12.43±1.13	81.8	10.29±0.99	77.4	0.000
Sheep (TLU)	0.42±0.03	3.6	0.25±0.05	1.7	0.34±0.04	2.6	0.001
Goats (TLU)	0.33±0.04	2.8	0.45±0.1	3	0.39±0.07	2.9	0.188
Total shoat	0.75±0.07	6.4	0.7±0.15	4.7	0.73±0.11	5.5	0.064
Donkey(TLU)	1.25±0.08	10.7	1.67±0.14	11.2	1.46±0.11	11	0.006
Horses (TLU)	0.97±0.14	8.3	0.17±0.09	1.1	0.57±0.12	4.3	0.000
Mule (TLU)	0.33±0.06	2.8	0.17±0.06	1.1	0.25±0.06	1.9	0.089
Total equines	2.55±0.28	21.8	2.01±0.29	13.5	2.28±0.29	17.1	0.001
Total (TLU)	11.69±0.91	100	14.90±1.83	100	13.30±1.39	100	0.013

N = Number of respondents; SE = Standard Error; TLU = Tropical livestock unit.

Household income sources of the study areas

The source of income for the respondents' families around Amarti and Nashe wetland areas is shown in Table 7. The main sources of income of the household were the sale of grain (43.8%), the sale of livestock and livestock products (31.5%), the sale of honey and honey products (16.4%), and other sources (8.2%) of those surveyed in the Amarti wetland, while it accounted for about 50%, 34.4%, 12.5% and 3.1% of the Nashe wetland from grain, livestock and livestock products, honey and honey products and other sources, respectively.

Table 7

Sources of family income of respondents around Amarti and Nashe wetland areas

	Amarti (N = 73)		Nashe (N = 32)		Overall (N = 105)	
Major income sources	Frequency	%	Frequency	%	Frequency	%
Sales of cereal grain	32	43.8	16	50.0	48	45.7
Sales of livestock and its product	23	31.5	11	34.4	34	32.4
Sales of honey and its product	12	16.4	4	12.5	16	15.2
Other sources	6	8.2	1	3.1	7	6.7
Total	73	100	32	100	105	100

N= Number of respondents

Available Feed Resources and Utilization Practices in the Study Areas

Natural pasture, crop residues, and woody plants were the most important feedstuffs around both wetlands (Table 8). The present study revealed that the dry season main feedstuffs of livestock were from wetland natural pastures that accounts for about 68.6% and 51.3% of respondents in the Amarti and Nashe wetlands respectively followed by utilization of crop residues 17.7% and 23.1% in Amarti and Nashe wetlands, respectively. During the rainy season of the year, the main livestock feedstuffs were shifted to the upland grazing for about 62% of the respondents in the Amarti and 53.9% of Nashe wetlands.

Table 8

Types of feed used at different times of the year around Amarti and Nashe wetland

	Amarti wetland (N=73)									
	Wet season					Dry season				
Feed types	1	2	3	4	Index	1	2	3	4	Index
Native pasture	17.4	12	7	63.6	0.183(4)	68.6	17.3	9.7	4.5	0.350(1)
Upland grazing	62	21.6	8.7	7.4	0.338(1)	7.6	10.1	24.7	58	0.168(4)
Crop residue	4.1	52.9	21.4	21.6	0.239(2)	17.7	52.4	19.7	11	0.278(2)

Table 8 continues

Browse resources	16.2	13.5	62.9	7.4	0.238(3)	6.1	20.2	45.9	27	0.204(3)
	Nashe wetland (N=32)									
	Wet season					Dry season				
Feed types	1	2	3	4	Index	1	2	3	4	Index
Native pasture	10.5	15.6	12.6	61.1	0.175(4)	51.3	13.8	17.9	17	0.299(1)
Upland grazing	53.9	20	26.1	-	0.327(1)	7.7	17.6	24.8	50	0.183(4)
Crop residue	15.9	54.6	15.1	13.7	0.271(2)	23.1	56.2	11.4	9.3	0.293(2)
Browse resources	19.5	10.7	46.2	25	0.227(3)	17.9	12.7	45.9	24	0.225(3)

Natural pasture in the Amarti and Nashe wetlands

Table 9 presented the socio-economic roles of the Amarti and Nashe wetlands. The wetland area studied serves the local community as a source of water for their livestock, reeds for thatched roofing, handicrafts or flooring, source of pasture for their livestock and as a source of income. About 92.4% of the households reflected that the wetlands around their areas were the main sources of pasture and water for their livestock. About 85.7% of the households responded that their children collect grass (Caffee and Sarmalee) from the wetlands of Amarti and Nashe in their free time to generate income by selling to surrounding towns, where the grasses are used as floor decor in restaurants and coffee houses and also used as cattle feed resources.

Table 9

The main socio-economic contribution of the Amarti and Nashe wetlands

	Amarti (N = 73)		Nashe (N = 32)		Overall (N = 105)	
Socio-economic use of wetland	Frequency	%	Frequency	%	Frequency	%
Livestock grazing	70	95.9	27	84.4	97	92.4
Livestock watering	67	91.8	30	93.8	97	92.4
Irrigation	24	32.9	11	34.4	35	33.3
House construction/hatch roof	28	38.4	13	40.6	41	39.0
Sedge(Caffee) for ceremony	64	87.7	26	81.3	90	85.7

N=Number of respondents

Farmers' perceptions on the wetlands condition of the study areas

Wetland conditions and causes of wetland degradation were determined based on respondents' perceptions around the Amarti and Nashe wetlands (Table 10). According to the present study, about 24.8%, 25.7%, and 49.5%, of the respondents categorized the wetland studied as good, fair, and poor respectively. Lack of pastureland in the uplands (28.6%), overgrazing (28.6%), water runoff/flooding (24.9%) and limited knowledge of wetland resources (18.1%) were the main reasons for poor wetland condition of the studied wetlands.

Table 10

Wetland condition and causes of degradation in the Amarti and Nashe wetlands.

	Amarti (N = 73)		Nashe (N = 32)		Overall (N=105)	
Wetland condition	Frequency	%	Frequency	%	Frequency	%
Good	21	28.8	5	15.6	26	24.8
Fair	20	27.4	7	21.9	27	25.7
Poor	32	43.8	20	62.5	52	49.5
Total	73	100	32	100	105	100
Major causes of degradation	Frequency	%	Frequency	%	Frequency	%
Upland grassland shortage	22	30.1	8	25.0	30	28.6
Overgrazing	21	28.8	9	28.1	30	28.6
Water runoff/flooding	16	21.9	10	31.3	26	24.8
Limited knowledge on wetland	14	19.2	5	15.6	19	18.1
Total	73	100	32	100	105	100

N = Number of respondents

The indicators for wetland degradation according to the respondents' perception in the wetlands of Amarti and Nashe are shown in Table 11. The present study showed that the reduction in livestock output (33.3%), the reduction in vegetation cover (25.7%), and the reduction in the number of animals (23.8%) were the main factors contributing to the deterioration in the indicated condition of wetlands.

Table 11

Indicators for wetlands degradation of Amarti and Nashe wetlands

	Amarti (N = 73)		Nashe (N = 32)		Overall (N=105)	
Indicators of degradation	Frequency	%	Frequency	%	Frequency	%
Reduction in livestock number	18	24.7	7	21.9	25	23.8
Reduction in livestock output	23	31.5	12	37.5	35	33.3
Change in grasses proportion	6	8.2	1	3.1	7	6.7
Increment in invasive species	2	2.7	1	3.1	3	2.9
Reduction in water body	7	9.6	1	3.1	8	7.6
Reduction in vegetation cover	17	23.3	10	31.3	27	25.7
Total	73	100	32	100	105	100

N = Number of respondents

Season of feed shortages and animal production constraints in the study area

The greatest problems for livestock farming identified in the study area were mainly the scarcity of grazing land (37%), followed by lack of forage (32.9%) and animal diseases and animal drowning by the marsh (15.1%) in the wetlands of Amarti and grazing land scarcity and feed shortages (34.34%), animal diseases (21.9%) and drowning of animals in the marshes (9.4%) of the Nashe wetland (Table 12). In the study area, grazing land and feed shortages (36.2%) and (33.3%), respectively are a common problem in animal production over the years with the highest severity followed by animal diseases (17.1%) and drowning of animals in marshy wetlands (13.3%) of the Amarti and Nashe. According to respondents, the wet season is the most critical time when forage shortages occurred in the Amarti (61.6%) and Nashe (62.5%).

Table 12

Season of feed shortages and production constraints in the study wetland areas

	Amarti (N = 73)		Nashe (N = 32)		Overall(N=105)	
Season	Frequency	%	Frequency	%	Frequency	%
Wet season	45	61.6	20	62.5	65	61.9
Dry season	28	38.4	12	37.5	40	38.1
Total	73	100	32	100	105	100
Major Constraints	Frequency	%	Frequency	%	Frequency	%
Feed shortage	24	32.9	11	34.4	35	33.3
Animal disease	11	15.1	7	21.9	18	17.1
Grassland shortage	27	37.0	11	34.4	38	36.2
Animal drowning	11	15.1	3	9.4	14	13.3
Total	73	100	32	100	105	100

N = Number of respondents

The Condition of Native Pasture in Amarti and Nashe Wetlands

The condition of the pasture in Amarti and Nashe wetlands is shown in Table 13. There was a significant difference ($p<0.05$) between the two wetlands in terms of basal cover, litter cover, age distribution, number of grass seedlings, soil erosion, and compaction. The composition of the herbaceous species in the examined wetlands did not differ significantly ($p>0.05$). This could be associated with the same topographical gradient, the same soil (hydric soil), and moisture content in both wetlands studied. The basal cover in the Amarti wetland was significantly higher ($p<0.05$) than in the Nashe wetland. The herbaceous basal cover was generally low in the Nashe wetland, with a mean of 4.07. This value could be further supported by the low score for the number of grass seedlings.

The litter cover in the Amarti wetland was significantly ($p<0.05$) higher than that in the Nashe wetland. Litter cover was generally low in the Nashe wetlands, averaging 3.27. Amarti wetlands were significantly higher ($p<0.05$) than Nashe wetlands in the number of grass seedlings. Amarti wetlands were significantly higher (*p<0.05*) than Nashe wetlands in their age distribution. Amarti wetland was rated as good on the overall condition score of (33.0), while the Nashe wetland was rated as fair condition (29.6).

Table 13

Native pasture conditions in Amarti and Nashe wetlands

	Condition analysis parameters									
Wetland	HSC	BC	LC	NS	AD	SE	SC	TWC	CC	N
Amarti	3.87	4.93	4.33	4.87	5.0	5.0	5.0	33.0	Good	15
Nashe	4.53	4.07	3.27	4.53	4.4	4.2	4.6	29.6	Fair	15
Mean	4.2	4.5	3.8	4.7	4.7	4.6	4.8	31.3		
P-value	0.158	0.030	0.002	0.049	0.0004	2.95E-6	0.0086	0.0006		
LSD	0.96	0.77	0.65	0.32	0.28	0.20	0.28	1.85		
CV	30.57	22.92	22.77	9.21	7.92	5.72	7.75	7.88		

LSD = Least significant difference; CV = Coefficient of variation; HSC = Herbaceous species composition; BC = basal cover; LC = Litter cover; SE = Soil erosion; SC = Soil compaction; AD = Age distribution of grasses; NS = Number of grass seedlings; TWC = Total wetland condition score; CC = Condition class; N = sample quadrats

Stocking rate of animal species in the examined wetlands

Stocking rate in Amarti and Nashe wetland

Major herbivore species in the Amarti wetland include *Bos indicus, Ovis aries, Capra hircus, Equus caballus, Equus asinus,* and *Tragelaphus strepsiceros*. The total TLU of all available and estimated herbivores were estimated to be 2,157TLU. More specifically, 1,995TLU, 12TLU, 8TLU, 48TLU, 40TLU, 6TLU for *Bos indicus, Ovis aries, Capra hircus, Equus caballus, Equus asinus,* and *Tragelaphus strepsiceros*, respectively (Table 14). Therefore the stocking rate = 2,157TLU/881.73ha = 2.39TLU/ha and this indicates that 2.39 herbivores with a live weight of 250kg could live on one hectare of land.

Table 14

Estimated population, mean weight and equivalent TLU of herbivores in the Amarti and Nashe wetland

Amarti wetland					
Species	Scientific name	Local name	Estimated population(No)	Mean weight(kg)	Total TLU
Cattle	*Bos indicus*	loon	2,850	175	1,995
Sheep	*Ovis aries*	Hoolaa	120	25	12
Goat	*Capra hircus*	Re'ee	80	25	8
Horse	*Equus caballus*	Farda	120	200	48
Donkey	*Equus asinus*	Harree	80	125	40

Table 14 continues…

Greater kudu	*T. strepsiceros*	Borofa	60	25	6
Total					2,109
Nashe wetland					
Species	Scientific name	Local name	Estimated population(No)	Mean weight(kg)	Total TLU
Cattle	*Bos indicus*	loon	550	175	385
Sheep	*Ovis aries*	Hoolaa	110	25	11
Goat	*Capra hircus*	Re'ee	25	25	2.5
Horse	*Equus caballus*	Farda	10	200	4
Mule	*Equus mulus*	Gaangee	3	200	1.8
Donkey	*Equus asinus*	Harree	40	125	20
Greater kudu	*T. strepsiceros*	Borofa	25	25	2.5
Bushbuck	*T. scriptus*	Bosonuu	20	25	2
Total					428.8

TLU = Tropical livestock unit; T. strepsiceros = Tragelaphus strepsiceros; T. scriptus = Tragelaphus scriptus

Major herbivore species in the Nashe wetland includes *Bos indicus, Ovis aries, Capra hircus, Equus caballus, Equus mulus, Equus asinus, Tragelaphus strepsiceros*, and *Tragelaphus scriptus*. The total TLU of all available and estimated herbivores in the Nashe wetland were estimated to be 433.1TLU. More specifically: 385TLU, 11TLU, 2.5TLU, 4TLU, 1.8TLU, 20TLU, 2.5TLU, and 2TLU for *Bos indicus*, *Ovis aries*, *Capra hircus*, *Equus caballus*, *Equus mulus*, *Equus asinus*, *Tragelaphus strepsiceros*, and *Tragelaphus scriptus*, respectively. Therefore the stocking rate = 428.8TLU/55.32ha = 7.75TLU/ha, which suggests that 7.75 herbivores with a live weight of 250kg could live on one hectare of land.

Discussion

Family size and land ownership (ha) of the household head in the study areas

The mean total family size of Amarti wetland area was slightly lower than the Ethiopian national average family size (7.4) (USAID, 2009). This indicates the suitability of a particular area for settlement and the outcome of socio-economic and historical events that affect the population distribution of a particular area. The average total land holding in this study is higher than the national average of (1.14ha) per household (CSA, 2014). The reason associated with the highest crop land around Nashe wetland areas might be due to the Nashe wetland areas was under rural areas in which ample lands were available for both crop cultivation and livestock grazing, while Amarti wetland areas were surrounded by towns like Homi and Didibe Kistana in which human population is high and this affects land allocated to crop cultivation and livestock grazing were expanded.

The land allocated for crop cultivation in the current study was higher than the report by (Dawit *et al*., 2013) in the Adami Tulu district, since (69%) of the land for crop cultivation and the national percentage of land for a temporary crop (73.4%), (CSA, 2014). Yesihak *et al*., (2013) also reported that the proportion of grazing land in the study areas was significantly different, with Seka (0.28±0.06), Mana (0.46±0.08), and Dedo (0.21±0.03) which is lower than the findings of the current study. Of the total land of the current study areas, about 15.6% and 16.8% of the land was allocated as grazing land around Amarti and Nashe wetlands respectively. This implied that much of the land ownership was allocated to grazing land around Nashe wetlands. In this study, a higher proportion of grazing land is reported compared to the national percentage of land area for grazing land of 9.9% (CSA, 2014).

Livestock herd composition

Livestock herd composition results of the study areas is similar to that of Ayantu *et al*. (2012), in which cattle and small ruminants were the dominant livestock in the Horro district in western Ethiopia. The composition of the livestock species in all examined wetland areas showed that cattle were the dominant livestock species around both wetlands, followed by sheep, goats, and donkeys, whereas horses and mules were the least common. The cattle breeds kept by the households surveyed in the study areas were local Horro cattle, which represent an intermediate between the Zebu and Sanga types (Ayantu *et al*., 2012). The higher proportion of cattle rearing around both wetlands could be due to the favorable environmental conditions, high demand of cattle for crop production (draught and fertilization), and other agricultural activities in the areas. Adaptation to their environment and resistance to Trypanosomosis disease in Horro cattle is also the most likely explanation for the economic importance of the breed (Stein *et al*., 2011).The average total number of cattle holdings around both study areas was lower than the report (14.7±0.55) by Ayantu *et al*., (2012) in the mid-altitude of Horro District in western Ethiopia. The overall mean of cattle holding (10.29±0.99) documented in the current study was higher than the (4.53±0.4) reported for Central Ethiopia by (Belay *et al*., 2012), but lower than the value (13.23±0.54) reported by Ayantu *et al*., (2012) in the Horro district in western Ethiopia. This indicated that there were more upland grazing resources and presence of conducive environment for animal production around the Nashe wetlands than around Amarti wetlands. The mean total livestock holding of the respondents in the current study areas (13.30±1.39) was higher than the previous report (6.15±0.53) of the central highlands of Ethiopia.

Household income sources of the study areas

The main source of income for the study areas was generated from crop farming and animal husbandry, which suggests that the farmers in the study areas operate mixed crop-animal farming. The result of the current study is in line with the report by Solomon *et al*., (2014), in which crop and livestock make up a large part of household income in the Metekel zone of the Benishangul Gumuz region in Western Ethiopia.

Available Feed Resources and Utilization Practices in the Study Areas

The result of the current study revealed that the livestock production system around both the study wetland areas during dry season of the year was mainly dependent on wetland natural pasture than other forage resources of the area. This indicate that herbivores use wetland natural pasture resources than the upland native pasture resources during the dry season due to the availability of green and nutritious and natural pasture and access to drinking water. The current study result agrees with the report of Duguma *et al*. (2012) in Dandi district in the central Ethiopia who reported that natural pasture and crop residues dominate the total feed of livestock in the study areas.

Natural pasture in the Amarti and Nashe wetlands

Household respondents indicated that their children collect grass (Caffee and Sarmalee) from the wetlands of Amarti and Nashe in their free time to generate income by selling to surrounding towns, where the grasses are used as floor decor in restaurants and coffee houses and also used as cattle feed resources. Similar experiences were reported by Asmare (2015), in which wetlands of the Chemoga plains play an important role in livestock feeding and drinking water for the animals, as well as the means of income of the areas.

Farmers' perceptions on the wetlands condition of the study areas

Respondent's response indicated that wetland native pasture of the study areas were decreasing from time to time due to overexploitation more than its natural regenerative capacity. This indicated that anthropogenic activity was the main cause of the overexploitation of wetlands native pasture. This is similar with the finding of Tessema and Simane, (2019), who reported that siltation due to soil erosion, and overexploitation of wetlands to farming activities due to dwindling of farmland resulted in wetlands degradation of Fincha'a Sub-basin, western Ethiopia. According to Dixon (2001), the disappearance of natural wetland vegetation and the invasion of non-wetland (upland) vegetation or weed species is a sign of environmental degradation in wetlands. This is because every plant species has a limited tolerance towards pressures in their habitats.

Season of feed shortages and animal production constraints in the study area

The reason why wet season is the most critical time when forage shortages occurred in the wetland area is that the wetlands which are used as grazing fields in the dry seasons are usually filled with water during the wet season that downs animals. At that time herbivores are forced to compete for limited upland grazing resources which are found surrounding wetlands and beneath crop farmlands. Farmers in the study areas cope up with the severity of the feed shortage during the wet season by tying up their animals on small land designated as grazing land (kaloo) near their crops, feed by harvesting corn leaves and hacks, tree leaves such as Vernonia amygdalina and Maytenus ovatus. Among the most important animal diseases in the study areas, Trypanosomosis, Fasciolosis, lump skin disease, black leg disease, and internal (leech) and external (tick) parasites were the most important diseases that impaired animal production and productivity in the study areas.

The Condition of Native Pasture in Amarti and Nashe Wetlands

The possible reason for the lower basal cover values in the Nashe wetland could be higher grazing activity, which might have resulted in the replacement of the palatable species like *Leersia hexandra* by creeping, spreading, and grazing resistant species such as *Cynodon dactylon* and *Pennisetum clandestinum species*, which are common in the Nashe wetlands. This is in line with the results of previous studies of (Amsalu and Baars, 2002). In arid environments, the accumulation of litter layers is very dynamic due to high turnover, increased temperature, and overgrazing (Oba *et al*., 2001a).

Based on the results of the current study, the soil in the Nashe wetland was more eroded and compacted than in the Amarti wetland. Soil erosion and compaction depend on several anthropogenic and natural factors including vegetation cover, soil type, bare land cover, and pasture management systems in an area. The high level of erosion and compaction in the Nashe wetland might be due to the low basal cover, a low number of grass seedlings, and low age distribution of the grass, as a result of the increased grazing pressure on wetland pasture, which could lead to its compactness and loss of soil. These could affect the productivity of the soil by changing the hydrological regime (infiltration and water holding capacity), range plants rooting depth, and soil susceptibility to adverse erosion in the longer term. The frequency of visits to farm animals could cause severe trampling and soil compaction, leading to increased soil erosion in these areas. This agrees with the result of Pluhar *et al*. (1987) who reported that overstocking exacerbated the hoof effect, increasing soil density, resulting in decreased infiltration.

Overgrazing due to high livestock could reduce the composition and diversity of herbaceous species, which could exacerbate grazing land degradation. As reported by other researchers (Baars *et al*., 1997; Abule *et al*., 2005b; Admasu, 2006; Belaynesh, 2006), high grazing pressure can lead to a reduction in plant species composition and basal cover. On the other hand, the highest basal and litter cover, age distribution, and the number of grass seedlings in the Amarti wetland could be traced back to the relatively lower impact of grazing and trampling pressure due to the huge livestock population. The result of the present study showed that the overall condition class of the pasture in the wetland of Amarti is better than in the Nashe wetland.

Stocking rate of animal species in the examined wetlands

The pastureland in the Amarti wetland appears to be sufficient for the animals to provide feed requirement. Nashe wetland native pasture seems to be insufficient for the animals to provide feed requirement. This finding is supported by the conventional stocking rate theory, which states that effects of a high stocking rate are generally undesirable and lead to a change in species composition, reduced productivity, and increased erosion (Pluhar *et al*., 1987).

CONCLUSIONS

The estimated stocking rate were 2.39TLU/ha in Amarti wetland and 7.75TLU/ha in Nashe wetland areas. From this, it could be clearly noted that Nashe wetland was more overstocked than Amarti. Both wetlands need improvement interventions in terms of their conditions to enhance its carrying capacity. This study showed that there were large reserves of wetland herbaceous plant species in the local flora of the study areas and that they could potentially be used for livestock feeding, especially during the dry season when the upland forage dries up. These feeds, if fully managed and improved, could help to increase the production and productivity of livestock for households in the area. The current status of the wetlands showed that the natural pasture of the areas was over exploited and conservation and improved management practices are required.

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DATA AVAILABILITY STATEMENTS

The data of this study are available from the corresponding author upon request.

DECLARATION

The authors declare that there is no conflict of interest.

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