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Assessment of feed Resources and Mulberry (*Morus spp*.) plant use and production status in Coffee Ensete(*Enset ventricosum*) Based Production System of Selected Districts of Sidama and Gedeo Zones, Southern Ethiopia

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ABSTRACT

Study conducted in seven districts of Sidama and Gedeo zones of southern Ethiopia. From each district 20HH who own Mulberry plant were selected purposively and interviewed. Size and age of HH was 5.7 ± 1.56 and 51.5 ± 8.8 years respectively; land holding is 0.92 ± 0.4ha/HH, of which 0.9 ± 0.04ha is cultivated, 0.39 ± 0.21ha covered with coffee and 0.31 ± 0.15ha with enset. Land and feed shortage are major constraints, tethering, indoor and road side grazing are used. Enset leaf, maize leaf and stalk, sugarcane leaf and tops, banana leaf and pseudo-stem, chat (*Chata edulis*) and browses used in the dry period to mitigate feed shortage. Maize stover, crop aftermath and weeds available after harvesting seeds. Sugarcane leaf and tops, Enset leaf, banana leaf and pseudo-stem are available throughout the year. Number and age of plant was 1.45 ± 0.63/HH and 10.45 ± 3.39 years respectively. Highest number (4plants/HH) from Wondogenet district. Mulberry planted along a fence (60%), homestead (19.3%) and inter-crop (20.7%) with Coffee, Enset, Maize, Chat and used it for shade, feed and firewood. 90.7% of respondents lack information and planting material. Creating awareness, evaluating bio-mass yield, chemical composition, and animal performance is recommended.

Key words: Availability, constraints, feed, Mulberry, residue, shortage.
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INTRODUCTION

Agriculture is backbone of Ethiopian economy and therefore this particular sector determines the growth of all other sectors and, consequently, whole national economy. It contributes 39% of country's gross domestic product GDP (Wondifraw et al., 2016). Moreover, the sector contributes 73% of employment, and supplies 70% of the raw-material requirements of local industries. Livestock and livestock products were the leading contributors to agriculture-sector growth. It has an enormous contribution to Ethiopia's national economy and livelihoods of many Ethiopians. The subsector contributes about 16.5% of the national GDP and 35.6% of the agricultural GDP (Metaferia et al., 2011). It also contributes 15% of export earnings and 30% of agricultural employment (Behnke, 2010).

Despite high population, productivity of Ethiopian livestock is very low due to poor genetic potential, insufficient and poor quality feed, poor health care and management practices that animals are exposed to. Feed shortage in quantity and quality has been a critical problem in

Ethiopian livestock production system especially during the dry season (Adugna, 2009, Ahmed et al., 2010). Feed sources are mainly from natural pasture or grass and from crop residues, are either not available in sufficient quantities due to fluctuating weather condition or, when available, are of poor nutritional quality (Manaye et al., 2009). The role of natural grazing as a major livestock feed resource is diminishing from time to time due to high degree of chronic degradation and shrinking grazing land size due to increasing human population and need of land for producing more crops for human consumption. Production and supply of most agro-industrial by-products are expensive and not readily available, uneven and localized around the main urban centers and may not be easily accessible to smallholder farmers (Adugna, 2007).

Fodder trees and shrubs are highly valued by farmers and it is used as a major source of animal feeds. These forage plants contain appreciable amounts of nutrients that are deficient in other feed resources such as grasses during dry seasons (Jamala et al., 2013). Therefore, great attention is given to fodder trees and shrubs for improving livestock productivity (Franzel et al., 2014). Mulberry has advantages from the point of view of its nutritional value, its yield or its agronomic versatility, above traditional forages (Benavides, 2001). Mulberry is comparable with leguminous multi-purpose trees as a feed for ruminants (Kabi and Bareeba, 2008). It is under high quality forages and can substitute concentrate feeds due to its high CP (29.6%) content and IVOMD (75-90%) and lower fibre (10.1%) content. Mahesh et al. (2017) also indicated that highest crude protein and the lowest non digestive factor content of Mulberry foliage can be used as a supplement to poor quality forage based diets or as main component of a ration in livestock production systems. Mulberry was introduced to the districts as well as to the region before a long period of time. However, its period of introduction, availability and purpose of the plant was not well known. Therefore, this study was conducted with the objectives of assessing availability and purpose of mulberry plant and other feed resources in the districts.

MATERIALS AND METHODS

Description of the study area

The survey was conducted in selected districts of Sidama and Gedeo zones, in Southern Nation Nationalities and Peoples Regional State (SNNPR) of southern Ethiopia. Seven districts namely Aleta Chuko, Dale, Shebedino, Wondogenet from Sidama zone and Dilla zuria, Wonago and Yirgachefe from Gedeo zone were selected purposively based on availability of mulberry plant. Sidama zone, lies between 38^0 08' E to 39^0 10' E longitude and $6^0$40' N to 7^0 06' N latitude at an elevation ranging from 501 to 3000 meters above sea level (SNNPRS, 2010). Currently Sidama Zone is divided into 19 districts hosting a total population of over 3,504,049, with land mass of 6,832.85 sq. km and a population density of 512.8 Person/sq.km (CSA, 2012). Out of total land size of Sidama zone, 26.8% is lowlands, 45.49% midlands and 27.71% highlands (SNNPRS, 2010).

Gedeo zone lies at an altitude ranging from 1350 to 3000 m.a.s.1. Out of total land size 0.6% Kola (Lowland), 67.53% Weinadega (Mid land) and 32.41% Dega (Highland). The mean annual temperature and rain fall ranges between 12.6 - 22.5°C and 1001-1800 mm per year respectively. Gedeo is a densely populated area in the region with a population density of 626.5 inhabitants' per Km^2 (CSA, 2012). Farmers in the areas practices crop dominated mixed crop-livestock agriculture. It is one of major coffee growing areas of southern Ethiopia. Other than coffee, maize, haricot bean, root crops ("enset" and potato) and fruits are major crops grown in the zone. Chat (*Chata edulis*) production are other sources of cash after coffee. Enset (*Ensete ventricosum*) is a strategic crop substantially contributing to the food security of the zones (Kassu, 2009). The study area have bimodal production seasons known as "*Belg"* (short rainy season) from March to April and "*Meher"* (main rainy season) from June to September (SNNPRS, 2010).

Data Collection

Two zones namely Sidama and Gedeo zones were selected from southern Ethiopia. From Sidama 4 districts and from Gedeo 3 districts totaling 7 districts that were selected based on coffee-enset dominating production system. From each district 20 households (HH) totaling 140HH who own Mulberry plant were selected purposively based on the availability of plant. A pretested structured Questionnaire was designed and used to acquire information to assess available feed resource and mechanisms used to tackle feed shortage period and to assess status of mulberry plant in terms of number, year of growing experience, constraints of production, method of establishment, purpose of the plant and agronomic practices. The interview was conducted by trained enumerators under close supervision of the principal researcher. Field observations, group discussions were made and secondary data were obtained in collaboration with the development agents in the respective districts to verify and complement information acquired in the questioner survey in the districts.

Statistical Analysis

Data collected were systematically coded and analyzed using descriptive statistics by employing Statistical Packages for Social Sciences (SPSS, 2010) version 19. Qualitative data and data involving frequencies were coded and analyzed using descriptive statistics and

Table 1.Family size, age (Mean + SD) and education level of households in the study districts.

Districts	Family size	Age	Education level (N =140)			
			Illiterate	Read & write	1-4grade	5-8grade
Chuko	5.8 ± 1.36	51.7 ± 7.51	13(65)	4(20)	3(15)	-
Dale	5.4 ± 1.67	52.4 ± 7.3	14(70)	6(30)	-	-
Dilla zuria	5.35 ± 1.39	51.4 ± 8.2	18(90)	1(5)	1(5)	-
Shebedino	5.25 ± 1.94	47.4 ± 11.7	13(65)	3(15)	2(10)	2(10)
Wonago	5.95 ± 1.39	52.4 ± 5.96	18(90)	2(10)	-	-
Wondo genet	5.85 ± 1.63	54.1 ± 10.4	16(80)	4(20)	-	-
Yirgachefe	6.1 ± 1.48	51 ± 9.19	17(85)	2(10)	-	1(5)
Overall mean	5.7 ± 1.56	51.5 ± 8.8	109(77.8)	22(15.7)	6(4.28)	3(2.1)
X^2	26.735	210.3	-	-	-	-
p-value	0.968	0.261	-	-	-	-

SD = standard deviation, X^2 = chi-square.

Table 2. Land use patterns and holding (ha) per household in the study districts.

Land use type	Districts								
	Chuko	Dale	DZ	SH	Wonago	WG	YCH	Overall	Sig.
Total land	1.03ab	1.13c	0.80ab	1.07ab	0.69a	1.01ab	0.74ab	0.92(0.04)	0.009
Cultivated land	0.99	1.04	0.80	1.07	0.69	0.98	0.74	0.90(0.04)	0.099
Private Grazing	0.004a	0.078b	-	-	-	0.027a	-	0.016(0.01)	0.001
Forest land	0.035	0.013	-	-	-	-	-	0.007(0.05)	0.139

DZ= Dilla zuriya, SH=Shebedino, WG=Wondogenet, YCH=Yirgachefe

ranked data analyzed based on Friedman rank test and quantitative variables were analyzed using one way analysis of variance using General Leaner Model (GLM) procedure and Pearson Chi-square (X^2) were used to compare categorical variables between surveyed districts.

RESULTS AND DISCUSSION

House Hold Characteristics

The average family size, age and educational level of the household heads in the districts are presented in Table 1. Family size was not significantly (P>0.05) different among the districts. Majority of the respondents were illiterate and only very small number was able to read and write because very few joined school. The current family size is higher than the average family size of 4.9 reported for Sidama and Gedeo zone and it is close to the family size reported for national average of 5.2 (CSA, 2007) and lower than the family size reported (7.5 ± 0.25) for Dale district (Endeshaw, 2007) and Shebedino district (7.07 ± 2.43) (Tegene et al., 2015).

Land holding and land use system

land holding and land use pattern is presented in Table 2.

The overall average land holding size was 0.92 ± 0.04ha per house hold (HH) in the districts. The current land holding size is higher than the average land holding (0.3, 0.43 and 0.69) reported for rural HHs of Sidama zone SNNPR (CSA, 2007) of Shebedino district (Tegene et al., 2015) and of Kedida Gamela district in southern Ethiopia (Mengistu, 2016), respectively. However it is close to the average land holding of 0.89ha reported for southern region and lower than that of Dale districts (1.77ha) of Sidama Zone (Endeshaw, 2007).Overall average total land holding of Dale district was significantly (P< 0.05) higher than other districts. The lowest overall average land holding was recorded from Wonago districts. Private grazing land recorded from Dale districts was significantly (P< 0.05) higher than other districts.

Land allocated for different crops are shown in Table 3. Most of the land is cultivated and small portion is allocated for grazing and forest and it agree with the result (Mengistu et al., 2016) for kedida Gamela district. The dominant crops produced in the districts were coffee, enset, maize, sugarcane, chat (*Catha edulis*), sweet potato and pineapple. The highest portion of land is covered with coffee and enset (*Enset ventricosum*). Land allocated for coffee in Dale, Dilla zuria, Shebedino and Yirgachefe districts were higher (P<0.05) than other districts. Coffee is the often-leading cash crop in the districts, which was cropped with other perennial and

Table 3. Allocation of land (ha) (Mean ± SD) for production of different crops in the districts.

Crop produced	Districts							Overall Mean	Sig.
	Chuko	Dale	DZ	SH	Wonago	WG	YCH		
Coffee	0.38ab	0.46b	0.43b	0.47b	0.38ab	0.25a	0.42b	0.39(0.21)	0.013
Enset	0.28	0.36	0.29	0.35	0.24	0.34	0.28	0.31(0.15)	0.084
Maize	0.145b	0.18b	0.06a	0.15b	0.04a	0.12ab	0.04a	0.1(0.11)	0.000
sugarcane	0.001a	0.061a	0.017a	0.035a	0.02a	0.199b	-	0.044(0.12)	0.000
Chat	0.124b	-	-	0.043a	-	0.09b	-	0.038(0.09)	0.000
Sweet potato	0.012	-	0.014	0.027	-	0.008	-	0.032(0.08)	0.481
Pineapple	0.05	-	-	-	-	-	-	0.05(0.11)	-

Table 4. Livestock number in the study districts of SNNPR of southern Ethiopia (mean and SD).

Districts	Cattle		Sheep		Goats		Donkey	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Chuko	4.5^{bc}	1.8	3.4	0.9	2.4	1.9	0.15	0.37
Dale	4.95^{c}	1.7	3.85	1.6	2.2	1.8	0.25	0.44
Dilla zuria	3.55^{ab}	1.1	3.85	1.0	1.7	1.5	0.1	0.31
Shebedino	4.8^{bc}	1.67	3.6	1.5	2.1	1.7	0.25	0.44
Wonago	3.05^{a}	0.9	3.85	1.3	1.45	1.6	0.05	0.22
Wondo Genet	4.7^{bc}	1.5	3.15	1.42	2.0	1.7	0.2	0.41
Yirgachefe	3.15^{a}	0.9	4.25	1.4	1.3	1.5	0.1	0.31
Over all mean	4.1	1.6	3.7	1.35	1.87	1.69	0.16	0.37
Sig.	0.000		0.204		0.333		0.479	

annual crops in different combinations such as enset, maize, chat, root crops and sugarcane.

Land allocated for enset production was not significantly (P>0.05) different among the districts. Enset is one of the oldest domesticated and cultivated plants in Ethiopia and it is the main staple crop in southern Ethiopia. It represents about (65%) of the total crop production in southern regional state (Amare et al., 2016). Most farmers are dependent on enset for food and the leaf for their animals. Maize is also the main staple food next to enset and it is the main source of crop residue for animal feed. Chuko, Dale and Shebedino districts were the highest (P<0.05) producer of maize as compared with other districts. Sugar cane production was higher (P<0.05) in Wondo Genet district, which agree with (Esayas, 2016) and sugarcane leaf and tops are sold as feed in the market. Large amount of chat (*Chata edulis*) is produced in Chuko and Wondogenet districts as cash crop. Pineapple is produced only in Chuko district. Farmers grew different crops to ensure family food supply and as sources of cash on the small farm size they possess and practice multiple spatial and temporal cropping (CSA, 2007).

Livestock number

The dominant livestock in the district were cattle, sheep, goats and donkeys (Table 4). The highest number of livestock per HH was cattle followed by sheep and goats. The highest number of cattle (p<0.05) was from Dale because, it had the largest land size compared with other districts. The lowest number of cattle was recorded from Wonago districts. The highest number of sheep and goats was recorded from Yirgachefe and Chuko districts respectively. The overall mean livestock holding in the HH of the districts was 9.83. This result is lower than the overall mean (13.1) livestock holdings per HHs reported for Dale district (Endeshaw, 2007). There were very few numbers of donkeys in the districts.

Constraints of livestock production

Constraints of livestock production is presented in Table 5. The majority of respondents revealed that the most important constraints of livestock production were land and feed shortages. Lack of improved animal breed, credit services, access for market and awareness and disease were other constraints. Land is most constraint of animal production and the population pressure brought land to be the most limiting production constraint which agree with (Selamawit and Matious, 2015) for Gedeo zones. Due to its limitation the available land is mainly allocated to the major cash crop and staple food of the area, Coffee and Enset, (Tsegaye, 2001).

Critical feed shortage periods and coping mechanism

Table 5. Basic constraints of animal production in the districts.

Parameters	Rank (N=140) 1	2	3	4	5	6	7	Index	Over all Rank
Land shortage	115	21	3	1	-	-	-	0.244	1
Feed shortage	29	109	2	-	-	-	-	0.223	2
Disease	-	-	1	1	7	18	89	0.039	7
Lack of awareness	-	1	12	8	31	80	7	0.092	5
Lack of credit service	-	-	92	32	18	1	-	0.165	3
Lack of improved variety	-	-	32	93	14	1	-	0.148	4
Access for market	-	-	-	1	92	32	6	0.089	6
Total	144	131	142	135	162	132	102		

Percentages exceed 100% within columns as respondents mentioned two or more constraints of production.

Table 6. Critical feed shortage periods ranked by respondents in the districts.

Months	Rank 1	2	3	4	5	6	7	8	9	10	11	12	Index	Over all Rank
Jan	127	1	6	3	2	-	-	-	1	-	-	-	0.148	1
Feb	9	118	7	4	-	2	-	-	-	-	-	-	0.138	2
Mar	7	9	105	3	5	2	6	3	-	-	-	1	0.123	3
Apr	4	6	7	105	5	7	-	1	2	-	2	1	0.111	4
May	2	1	14	5	97	-	6	2	3	3	3	4	0.097	5
Jun	4	6	9	6	9	102	-	-	1	2	2	1	0.095	6
Jul	-	2	2	6	15	13	1	-	78	10	8	4	0.061	8
Aug	3	6	3	6	7	9	1	3	12	77	4	7	0.056	9
Sep	-	-	-	-	6	1	8	-	5	-	120	-	0.033	11
Oct	-	-	-	1	1	4	1	8	2	6	-	117	0.021	12
Nov	-	-	-	-	-	-	82	6	11	7	8	6	0.055	10
Dec	-	-	-	-	2	1	8	117	0	6	6	17	0.063	7
Total	156	149	153	139	149	141	113	140	115	111	153	158		

Table 7. Ways of feeding livestock in the study districts (% of respondents).

Ways of feeding	Districts Chuko	Dale	DZ	SH	Wonago	WG	YCH	Over all N = 140
Indoor feeding	9(45)	7(35)	9(45)	6(30)	5(25)	7(35)	5(25)	48(34.3)
Graze on grazing land	8(40)	12(60)	3(15)	8(40)	6(30)	11(55)	2(10)	50(35.7)
Tether in grazing land	6(30)	10(50)	5(25)	6(30)	8(40)	9(45)	2(10)	46(32.8)
Tether around the house	17(85)	15(75)	16(80)	15(75)	15(75)	14(70)	18(90)	110(78.6)
Road side grazing	6(30)	4(20)	5(25)	4(20)	5(25)	4(20)	6(30)	34(24.3)

DZ= Dilla zuriya, SH=Shebedino, WG=Wondogenet, YCH=Yirgachefe.

According to respondents January to June is the critical feed shortage period (Table 6). This is in agreement with the result reported by (Assen et al., 2016) for Tigray region. There is shortage of feed during dry period and land preparation for cropping. Enset leaf, sugar cane leaf and tops, banana leaf pseudo stem are the main sources of feed during dry period of the year. Enset covers the larger share of the feed use and it is a good feed source because the feed part is rich in protein (Tsegaye, 2001). Majority of respondents tether livestock around the house and uses cut and carry system and others tether and feed their livestock on natural pasture, indoor and road side (Table 7).

Types of crop residue

According to respondent's enset leaf, maize leaf and stalk, sugarcane leaf and tops, banana leaf and pseudo stem and chat leftover are the major crop residue in the district. All farmers feed enset leaf, and majority of them maize leaf and stalk, but the rest of respondents feed sugarcane leaf and tops and chat left over and banana leaf and stem as major feeds for livestock (Table 8).

The crop residues such as, maize stover, enset leaves and other parts and sugar cane tops are the most important residues used by farmers in the district which is in

Table 8. Types and sources of crop residues used in the districts and season of utilization (% of respondents).

Parameters	Districts							Over all N = 140
	Chuko	Dale	DZ	SH	Wonago	WG	YCH	
Crop residues								
Enset leaf	20(100)	20(100)	20(100)	20(100)	20(100)	20(100)	20(100)	140(100)
Maize leaf & stock	19(95)	18(90)	8(40)	19(95)	9(45)	17(85)	6(30)	96(68.6)
Sugarcane leaf & tops	3(15)	10(50)	3(15)	3(15)	2(10)	15(75)	5(25)	41(29.3)
Chat left over	15(75)	-	-	1(5)	1(5)	12(60)	2(10)	31(22.1)
Leaf & stem of banana	-	3(15)	7(35)	3(15)	3(15)	1(5)	3(15)	20(14.3)
Sources of residue								
private farm	19(95)	20(100)	20(100)	17(85)	20(100)	14(70)	20(100)	130(92.9)
Purchased	1(5)	-	-	3(15)	-	6(30)	-	10(7.1)
Season of utilization								
Dry	20(100)	19(95)	20(100)	20(100)	20(100)	17(85)	20(100)	136(97.1)
Wet	5(25)	6(30)	6(30)	8(40)	5(25)	10(50)	5(25)	45(32.1)

Percentages exceed 100% within columns as respondents mentioned two or more constraints of production.

Table 9. Available feed resources in different months of the year.

	Months of the year											
Types of feed	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**De**
Natural pasture						##						
Maize leaf and stalk						******************************						
Sugar cane leaf and Tops												
Enset leaf	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx											
Banana leaf and stem	//											
Crop after math							>>>>>>>>>>>>>>>>>>>>>>>>>>>					
Weeds							+++++++++++++++++++++++++++					
Leaf of multi-purpose tree	LLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLL											

agreement with (Adugna, 2007 and Samuel, 2014)). In the pick dry period banana leaf and stem are fed to livestock. Enset leaves can play a significant role in supplementing the diet of animals, especially during the dry season and drought years. Enset is drought resistant, but it matures slowly, requires substantial manure inputs from cattle, and intensive processing (Robert et al., 2015). Use of enset as animal feed could play a significant role because of on-farm availability and easy access by farmers Nurfeta et al. (2008a).

Chat leftover fed commonly in Chuko and Wondogenet district to small ruminants, due to high production of plant as cash crop. Majority of farmers have no access to purchase crop residues from the market except few of them in dry season; mostly they get the crop residue from their own farms during cropping season. About (30%) of the respondents purchased sugar cane tops from Wondogenet followed with Shebedino district. Maize leaf and stalks and sugarcane leaf and tops are the major crop residue purchased from the market. Crop residues used in both seasons of the year and it is higher in dry season.

Available feed recourses in different Months of the year

Availability of feed resources in different seasons of the year are indicated on Table 9. Accordingly natural pasture is available from June up to the end of December. Maize leaf and stalk are available from June up to November. Sugarcane leaf and tops, enset leaf, banana leaf and pseudo-stem are available throughout the year. However, their utilization is more common in dry period. But, wet period utilization depends on the availability of other feed resources. Weeds and crop after math are available from July up to December during cropping and after harvesting the crop. Leaf of multi-purpose tree is available throughout the year. However, some of the trees shade their leaves during the dry period and the Leaf of these

Table 10. Number and age of mulberry plant in the study districts.

Districts	Mulberry number (Mean ± SE)		Age (year) (Mean ± SD)	
	Mean	SE	Mean	SD
Chuko	1.15[a]	0.082	10.20[b]	2.30
Dale	1.40[a]	0.134	11.00[b]	2.08
Dilla zuria	1.40[a]	0.112	12.10[b]	2.24
Shebedino	1.50[a]	0.115	7.65[a]	5.11
Wonago	1.25[a]	0.099	11.75[b]	2.27
Wondo genet	2.25[b]	0.176	8.20[a]	3.29
Yirgachefe	1.20[a]	0.092	12.30[b]	2.36
Over all	1.45	0.627	10.45	3.39
Sig.	0.000		0.000	

SE=standard error, SD = standard deviation.

Table 11. Number of Mulberry plant in house hold level in the study districts.

District	Number of mulberry plant (Number (N=140) and % of respondents)			
	1	2	3	4
Chuko	17(85)	3(15)	-	-
Dalle	13(65)	6(30)	1(5)	-
Dilla zuria	12(60)	8(40)	-	-
Shebedino	10(50)	10(50)	-	-
Wonago	15(75)	5(25)	-	-
Wondo Genet	3(15)	10(50)	6(30)	1(5)
Yirgachefe	16(80)	4(20)	-	-
Over all	86(61.4)	46(32.9)	7(5)	1(0.7)

plants used mostly during dry period when the feed shortage occur.

Number and Age (year) of mulberry plant

The overall mean number of mulberry plant per HH in the district and mean age of the plant are shown in Table 10. The mean number of mulberry plant in a HH from Wondo genet district was significantly ($P < 0.05$) higher than other districts. Over all mean number of mulberry plant per HH in the district was much lower than the value reported for Tigray region, northern Ethiopia. However, the mean age of mulberry plant in this study was much higher than reported for Tigray region (Assen et al., 2015).

This shows that the farmers have long year experience of planting mulberry and it was introduced to the districts before a long period of time and its local name was known as “Gora”. However it’s expansion was limited due to lack of awareness and information about the use of the plant. Mulberry falls under the category of perennial crops and once it is properly raised during the first year, it can come to full yielding capacity during the second year and last for over 15 years in the field without any significant deterioration in the yield of leaf (Krishnaswani, 1986). Numbers of mulberry owned by households are indicated in Table 11. Therefore, households who own only 1 plant was (61.4%), 2 plants was (32.9%), 3 plants was (5%) and 4 plants was (0.7%). The highest number of plant per HH was observed from Wondo genet.

Purpose and production constraints of mulberry plant

Purpose and constraints of production of mulberry is indicated in Table 12. About 99.3% of respondents used it for shade around homestead and in the crop field and 61.4% used it as feed for animals and 16.4% used for firewood. The purpose of planting mulberry in the districts was different from Tigray region where it is used as a feed for silk-worm (Assen et al., 2015). Regarding the production constraints of mulberry; majority had no information and awareness about the importance of the plant about half of the respondents had no access to planting material and others were not interested in expanding the plant due to lack of information. Most of the respondents agreed that the plant is fast growing and a few classified it as medium. The plant is propagated by using seed, stem cutting and seedlings (Sanchez, 2002). In the districts the plants were propagated by stem cutting and the source of planting material was the farmers as opposed to Tigray region where planting material was

Table 12. Constraints of production and purpose of Mulberry plant in the study districts (Number and % of respondents.

Parameters	Districts							Over all (N=140)
	Chuko	Dale	DZ	SH	Wonago	WG	YCH	
Constraints of production								
Lack of information	18(90)	19(95)	19(95)	18(90)	19(95)	16(80)	18(90)	127(90.7)
Lack of awareness	19(95)	16(80)	14(70)	14(70)	15(75)	12(60)	18(90)	108(77.1)
Lack of planting material	17(85)	8(40)	16(80)	14(70)	9(45)	5(25)	6(30)	75(53.6)
Lack of interest	9(45)	6(30)	7(35)	8(40)	4(20)	9(45)	3(15)	46(32.9)
Purpose of the plant								
Shade	20(100)	20(100)	20(100)	20(100)	20(100)	19(95)	20(100)	139(99.3)
Feed	12(60)	14(70)	10(50)	15(75)	9(45)	18(90)	8(40)	86(61.4)
Firewood	2(10)	3(15)	2(10)	3(15)	4(20)	5(25)	4(20)	23(16.4)

DZ =dilla zuriya SH =shebedino, WG = wondogenet, YCH=yirgachefe.

Table 13. Level of consumption, consumed plant parts and season of utilization of Mulberry DZ = dilla zuriya SH = shebedino, WG = wondogenet, YCH = yirgachefe.

Parameter	Districts							Over all(N=140)
	Chuko	Dale	DZ	SH	Wonago	WG	YCH	
Level of consumption								
High	15(75)	10(50)	16(80)	11(55)	14(70)	12(60)	10(50)	88(62.9)
Medium	5(25)	10(50)	4(20)	9(45)	6(30)	8(40)	10(50)	52(37.1)
Animals consume more								
Goats	12(60)	13(65)	12(60)	13(65)	10(50)	8(40)	12(60)	80(57.1)
Sheep	7(35)	6(30)	8(40)	7(35)	9(45)	4(20)	8(40)	49(35)
Cattle	1(5)	1(5)	-	-	1(5)	8(40)	-	11(7.9)
Consumed plant parts								
Leaf	17(85)	12(60)	14(70)	14(70)	13(65)	17(85)	12(60)	99(70.7)
Edible branch and stem	3(15)	8(40)	6(30)	6(30)	7(35)	3(15)	8(40)	41(29.3)
Season of utilization								
Dry	13(65)	14(70)	17(85)	17(85)	14(70)	15(75)	15(75)	105(75)
Wet	2(10)	2(5)	3(15)	1(5)	1(5)	3(10)	1(5)	13(9.3)

distributed by governmental (GO) and non-governmental organizations (NGO) (Assen et al., 2015).

Consumption of mulberry plant by animals

Level of consumption, consumed plant parts and season of utilization of mulberry plant is indicated in Table 13. Accordingly animals like goats, sheep and cattle are consuming the plant in general. It is mostly preferred by goats than sheep and cattle.

Majority of respondents observed that intake by animals is high. Leaf of the plant was the most consumed part followed by edible stem. Mulberry plant is fed to animals by the majority of the respondents in dry season and only very few use it during wet season.

Agronomic practices and location of planting

Place of planting, plants intercropped with mulberry plant and effects of intercropping mulberry with other crops are indicated on Table 14. Therefore, most farmers planted mulberry along their fence, some around homestead and others by inter-cropping with other crops. Mulberry is inter-cropped with coffee, enset, maize and chat. Very few said intercropping has good, very good and no effect but the majority did not observe any side effect of inter-cropping on other crops. Therefore the plant can be intercropped with different crops as a feed, shade and to protect soil from erosion. Mulberry root system occupies a space bigger than its aerial part (Zhang et al., 1996). Mulberry root system has level roots in top soil and vertical roots in deep soil. The distribution area of underground root system is 4–5 times to the projected area of tree canopy (Dai et al., 2009). After establishment of ecological mulberry plantation for water and soil conservation on agricultural land with 40° steep slope, reduction of rainfall runoff is 70% and reduction of soil erosion is 79.7% (Zhang and Song 2004).

Mulberry trees could flourish in deep, porous and fertile soil but also grow in barren soil with poor nutrients (Han,

Table 14. Location of planting, plants intercropped and effect of inter-cropping N = number of respondents.

Parameters	Districts							Over all (N = 140)
	Chuko	Dale	Dilla zuria	Shebedino	Wonago	Wondo genet	Yirgachefe	
Place of planting								
Along a fence	13(65)	11(55)	12(60)	15(75)	8(40)	13(65)	12(60)	84(60)
Intercrop	7(35)	6(30)	4(20)	2(10)	3(15)	3(15)	4(20)	29(20.7)
Homestead	-	3(15)	4(20)	3(15)	9(45)	4(20)	4(20)	27(19.3)
Plants intercropped								
Coffee	2(10)	4(20)	3(15)	1(5)	3(15)	2(10)	2(10)	17(12.1)
Maize	1(5)	2(10)	1(5)	1(5)		1(5)	1(5)	6(4.3)
Chat	4(20)	-	-	-	-	-	-	5(3.6)
Enset	-	1(5)	-	-	-	-	1(5)	2(1.4)
Effects of intercropping								
Very good	1(5)	1(5)	2(10)	-	1(5)	1(5)	1(5)	7(5)
Good	6(30)	7(35)	3(15)	2(10)	1(5)	2(10)	2(10)	23(16.4)
No effects	-	-	-	-	1(5)	-	1(5)	2(1.4)
Not observed	13(65)	12(60)	15(75)	18(90)	17(85)	17(85)	16(80)	108(77.1)

2007). Mulberry trees have very strong vitality. In arid or semiarid desert area with annual rainfall less than 300–600 mm, they still grow well under natural condition. Even in desert area of Xinjiang with annual rainfall below 150 mm, they could also grow and develop (Dai et al., 2009).

CONCLUSION

Land holding per house hold in the study district is small and most portion of it was covered with perennial crops; such as coffee and enset (*Enset ventricosum*). Natural pastures diminish from time to time due to the need of land for crop production. Therefore, land and feed shortages were the main constraints for animal production in the districts. Feed shortage was critical during dry period especially from January up to June. Therefore, farmers overcome feed shortage during dry period by feeding enset leaf, maize leaf and stalk, sugarcane leaf and topes, banana leaf and pseudo-stem and leaf of multi-purpose trees. Majority of farmers in the districts have no access to purchase feed from market; only few number of farmers purchase sugarcane leaf and tops in the dry period to feed their animals.

Mulberry plant was used as animal feed; as a shade for different crops and could be inter-cropped with different crops and used as firewood. However, number of mulberry plants per house hold was limited due to lack of awareness, information and access for planting material. Mostly the plant was planted along their fences and homestead as ornamental trees and a few are intercropped with coffee, enset, maize and chat. Some of the farmers observed the positive effect of mulberry on intercropping. Intake of the plant by animals was very high and mostly preferred by goats than sheep and cattle. The plant was commonly used in dry period and some of the households used it in wet season. Mulberry is one of fast growing plants and easily propagated by stem cutting. Therefore, promoting and disseminating the plant for its wide cultivation as alternative feed resource is very important together with evaluating the bio-mass yield, chemical composition, nutritive value and supplementary effects of mulberry leaf on the production performance of ruminant animals in the districts.

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