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# Statistical Assessment of Access and Usage of Water, Hygiene and Sanitation and Natural Resources Focusing on Gatse and Kole Zale Kebeles, SNNPR Ethiopia

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**Abstract:** For the rural area residents to have a sustainable access of quality water, centers and awareness for hygiene and sanitation, and fair distribution of natural resources are the basic needs and requirements to stay there and focusing on their day to day farming activities. For this, there should be appropriate administration and information on these aspects and continuous assessment by the concerned bodies. The main objective of this study is to assess how these facilities and resources are managed and used by the residents of rural area. For data collection two kebeles, Gatse and Kole Zale from Arba Minch Zuriya Wereda and Bonke Wereda of Gamo Zone, respectively, are considered. A total of 96 respondents are selected based on simple random selection and the collected data were analyzed using SPSS version 20. Descriptive analysis (tables and charts) and chi-square analyses are employed to assess the overall situations in each kebele and within kebeles. Most of the respondents are in age group from 28 to 50 years (Gatse (80.4%) and Kole Zale (60%)), and in both kebeles more than 70% are illiterate. Majority of Respondents in Gatse (80.4%) and in Kole Zale (66.7%) reported that they have access to water and main source of drinking water in these kebeles are reported to be protected spring (Gatse 29.4%) and unprotected spring (Kole Zale 53.3%). For hygiene and sanitation it is reported that residents in Gatse kebele use water only (70.6%) and water and soap (29.4%) to wash their hand while residents in Kole Zale kebele use water only (33.3%) and water and soap (64.4%) to wash their (also their family members') hand. For natural resources majority of the respondents in Gatse kebele reported that they have access for forest, farm land and grazing land (66.7%, 94.1% and 51%, respectively) while respondents in Kole Zale kebele reported they have access for forest, farm land and grazing land (77.8%, 100%, and 44.4%, respectively). Based on the reports and summary statistics we can conclude that water accessibility and hygiene practice are in good condition in Gatse Kebele while residents in Kole Zale Kebele have relatively high access for Natural Resources. Also we can conclude that there is no association between villages/kebeles where the residents live and access of quality water, forest, grazing land and farm land.

**Keywords:** Statistical Assessment, Chi-square, Water, Hygiene and Sanitation, Natural Resources, Gatse, Kole Zale, Gamo Zone, Ehtiopia

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## 1. Introduction

For all human beings it is important to have access and proper usage of natural resources and also keeping hygiene and sanitation of themselves, the environment and these resources and facilities is vital day to day activity [1, 2]. The available resources and facilities are limited [3] and are highly exposed for wastages so we need to have some information how these are used and managed by the rural

area residents. For rural area residents (in Ethiopia, over 84% of the total population live in rural areas [4, 5]) there are different natural and man-made limitations like low income, high illiterate rate and unskilled, less access for health and education centers, less access for natural resources, less access for sanitation facilities [6, 7] etc and because of these they lack access to appropriate, low-cost and locally available of quality water, sanitation and hygiene needs, skill developing centers and natural resources [4, 8].

For developing countries like Ethiopia, most of the rural areas are facing such kind of problems [9, 2] even though there are some changes and progresses in solving these kinds of problems [10], which are related to urbanization development, as far as it is concerned with the residents' satisfaction and developing good governance/administration system [11].

To have a sustainable access of quality water [5], Natural Resources [12] and also to aware residents about hygiene and sanitation it is required to have a well organized data and information so that the decision makers and donators can have a clear insight about all the above issues [13, 14]. The question is that is there equal access of water, equal understanding of hygiene and sanitation and equally accessible of natural resources among the residents and also between different kebeles of Gamo Zone.

So, the main objective of this study is to statistically assess the access and usage of these facilities and resources by the residents of Gatse Kebele from Arba Minch Zuriya Wereda and Kole Zale Kebele from Bonke Wereda, both weredas are found in Gamo Zone of Southern Nations, Nationalities and Peoples' Region of Ethiopia.

Also this study can be used as a base line for further study and for the administrators in the kebele, wereda and also in Gamo Zone for improvement, expansion and management of all the facilities in the kebeles so that the strategies aimed by the government will be predicted and met [9, 15].

The significance of this study is that all the stakeholders (communities, government and NGO's) will have appropriate information and baseline for their next actions regarding the main issue of this study.

As there are a number of different Weredas in the Gamo Zone and different Kebeles in each weredas, for the purpose of this survey the scope is limited to only two kebeles from two weredas in the Zone.

## 2. Methods

For the purpose of this survey, one kebele from each Wereda, Arba Minch Zuriya Wereda and Bonke Wereda, is considered. Arba Minch Zuriya Wereda and Bonke Wereda are among the many other Weredas found in Gamo Zone of Southern Nations, Nationalities and Peoples' Region (SNNPR) of Ethiopia. Gamo Zone is found about 440 km south of Addis Ababa, capital city of Ethiopia. The target populations for this study are all households residing in these two kebeles and during the data collection process the household representative was considered for answering the questions based on the questionnaire prepared for this survey.

Based on simple random selections of the respondents/households, a total of 96 households were randomly selected; 51 households from Gatse Kebele and 45 from Kole Zale Kebele.

Socio-demographic characteristics, Water, Hygiene and Sanitation and Natural Resources were taken as the variables for information gathering from both Weredas and for comparison purpose simple descriptive statistics analysis

based on percentages, tables, graphs and for inferential analysis chi-square analysis are applied.

### Chi-Square Analysis

#### Test of Independence/Association

When we have counts from a sample, they're usually arranged in cross tabulations or contingency tables. An  $X^2$  test assesses whether the perceived dependence in sample data may be a fluke, the result of random variability rather than real dependence. The possible values of one variable determine the rows of the table, and the possible values of the other determine the columns. We denote the population proportion (or probability) falling in row  $i$ , column  $j$  as  $\pi_{ij}$ .

The total proportion for row  $i$  is  $\pi_i$  and the total proportion for column  $j$  is  $\pi_j$ . If the row and column proportions (probabilities) are independent, then  $\pi_{ij} = \pi_i \pi_j$ .

Sometimes research hypothesis specifies the existence of some form of dependence, that is, it is not true that  $\pi_{ij} = \pi_i \pi_j$ , in every cell of the table. The test statistic for association test is computed using the formula:

$$\sum [(observed\ value - expected\ value)^2 / expected\ value] \quad (1)$$

$$Expected\ Value = (row\ total \times column\ total) / grand\ total \quad (2)$$

This computed test statistic value is compared with the critical value, based on the significance level and degrees of freedom, for decision making. The null and alternative hypotheses for test of association are defined as:

$H_0$ : The row and column variables are independent (no association)

vs

$H_1$ : The row and column variables are dependent (associated)

## 3. Result and Discussion of the Study

### 3.1. Arba Minch Zuriya Wereda Gatse Kebele

#### 3.1.1. Socio-demographic Characteristics of Respondents

Most of the respondents (80.4%) are in the age group from 28 to 50 years old and only few (7.8%) are in the age group from 20 to 27 years.

With respect to their gender and religion, most of them (88.2%) are male and 43.1% of the total respondents are Orthodox followed by Protestant (41.2%). 96.1% of the respondents are married and only 2.0% are single.

For the educational level, 74.5% are illiterate while 13.7%, 7.8% and 2.0% of the respondents had level of 1 - 4, 5 - 8 and 9 - 10 grades, respectively. All (100%) are permanently residing in the kebele for the last years.

#### 3.1.2. Water, Hygiene and Sanitation, Natural Resources

##### i. Water

Majority (80.4%) of the respondents have access for sufficient quality of water in their kebele. Main source of drinking water for the community is Protected Spring (29.4%) while only 2% reported Pipe Water; and main source for cooking, hygiene and washing clothes are Protected Spring (27.5%), River Stream (62.7%) and River Stream (82.4%),

respectively. The quality of drinking water is rated as Clean by most (35.3%) of the respondents and only few (3.9%) rated it as Dirty. 94.1% of the respondents reported that there are at least one water sources while 58.8% said there are 4 and above in their village. There are at least one functional water points in the village as reported by 64.7% of the respondents. 27.5% of the households reported that there are well managed and maintained water points in their kebele. 64.7% of the households reported that the daily consumption of water by all members of the household is between 20 to 40 liters and 19.6% reported less than 20 liters of daily consumption. Usually adult women (64.7%) are responsible to fetch water for the whole family. Commonly used containers for fetching and storing water are Jerry Cans (98.0%), for both cases. Most of the families (70.6%) collect water from the source which is less than 500 meter from their dwelling house. Only 7.8% of the respondents pay on average 1.00 birr for one jerry can of 20 liters water.

#### ii. Hygiene and Sanitation

Most (70.6%) of the respondents/families use water only for hand washing while 29.4% use water and soap for hand washing for the reason that to remove dirty/make clean when they are dirty and 31.3% of the respondents wash their hands with soap at least two times in a day. Most (94.1%) adults go to/use household latrines for defecation. 92.2% of the respondents usually walk less than 50m to the latrine. 66.7% of the respondents are at least satisfied with their current defecation place while only 6 of the respondents (11.8%) are unsatisfied. Most (74.5%) children usually go to/use household latrine for defecation. The mostly reported place for wastage and babies' faeces disposal used by the families are garbage pit/bury and latrine, respectively. Most Adults (94.1% and 92.2%) and children (80.4% and 78.4%) in a family always use latrine for defecation in Dry Season and in Rainy Season, respectively. Households' members with no latrine go to/use relatives' latrine (13.7%), field/forest (9.8%) and public latrine (2.0%). Only 31.4% of the respondents reported that their latrine is fairly structured while 66.7% said it is not.

#### iii. Natural Resources

##### a. Forests

66.7% of the respondents have access to forest and majority of the forests in the village reported are owned by Government/Public. Majority (29.4%) of the respondents reported that forests are commonly used for the purposes of fuel wood and 25.5% said forests are used for construction. Almost all (98.0%) of the households are using fuel wood as energy source for their consumption. The most common places from where the households get/obtain fuel wood /charcoal for energy consumption are private plantations (60.8%) and communal forest (9.8%). Current status/condition of forest in the village compared to before 10 to 15 years is improved as reported by 43.1% of the respondents but 25.5% said that it is degraded. Agricultural Expansions are frequently reported possible reason for the overall degradation of forest resources currently observed in the village as compared to previous times and soil erosion

acceleration and shortage of grazing are the most reported possible consequences of overall degradation. None of the respondents use fuel saving stove for their consumptions.

##### b. Farm Land

94.1% of the households have access to farm land and the average hectare per household owned is 0.66 hectare and it is reported that most (88.2%) of the households use farm lands for crop production purpose. As reported by the households, 92.2% of households' farm lands are rain fed and only 2.0% of the respondents' farm lands get water from irrigation. 29.4% of the respondents reported that there is land degradation in their village and the main first, second and third reasons for these degradation reported are overgrazing, deforestation and expansion of farm lands in to marginal area, respectively. For maintaining soil fertility 49% of the respondents reported that they use modern fertility. Also 68.6% said that they practice terracing conservations/measures for solving soil erosion.

##### c. Grazing Land

Almost half (51%) of the respondents reported that they have grazing land and the average hectare per household owned is 0.125 hectare; majority (35.3%) of the households reported that the current access to grazing land is not sufficient for their available livestock. Comparing current access to grazing land with the previous one to two years ago 31.4% of the respondents said that it is almost the same now days while 19.6% reported that it is degraded now. The main factor for this degradation is reported to be overgrazing by most respondents. Only 7.9% of the households said that they get fodder/grazing for their livestock from crop residuals, communal grazing land and private forest. 64.7% of the households reported that there are conservations/restricted areas in their locality and majority of these areas are restricted by Government.

##### d. Climate Change

Only 19.6% of the respondents had heard about climate change and they think/believe that drought, expansion of desertification, heavy rains, decreasing in crop yield and food shortage are the most recognized impacts of climate change. For climate change adaptation diversifying crops planting is the most reported practice by the respondents.

##### e. Storage

Except by one respondent, the most commonly type of storage used by the households is traditional storage; only two of the respondents had heard about plastic storage bags and none of the households use these plastic storage bags at home.

### 3.2. *Bonke Wereda Kole Zale Kebele*

#### 3.2.1. *Socio-demographic Characteristics of Respondents*

Most of the respondents (60%) are in the age group from 30 to 50 years old. With respect to their gender and religion, most of them 80% are male and 40% of the total respondents are Pagans. From the total of 45 respondents, 44 are married and only one is widowed.

For the educational level, 71.1% of the respondents are illiterate and 28.9% of the respondents had level of 1 – 10

grades. All (45) are permanently residing in the kebele for the last years.

### 3.2.2. Water, Hygiene and Sanitation, Natural Resources

#### i. Water

Majority (66.7%) of the respondents have access for sufficient quality of water in their kebele. Main source of drinking water for the community is Unprotected Spring (53.3%) and for cooking, hygiene and washing clothes main sources are Unprotected Spring (44.4%), River Stream (68.9%) and River Stream (84.4%), respectively. The quality of drinking water is rated as Somehow Clean by most (48.9%) of the respondents and 15.6% of the households rated it as Dirty. 95.6% of the respondents reported that there are at least one water sources while 57.8% said there are 4 and above in their village. There are no any functional water points in the village and also well managed and maintained water points in the kebele. 64.4% of the households reported that the daily consumption of water by all members of the household is between 20 to 40 liters. Usually adult women (62.2%) are responsible to fetch water for the whole family. Commonly used containers for fetching and storing water are Jerry Cans, as reported by 95.6% and 88.9% of the households, respectively. Most of the families (53.3%) collect water from the source which is less than 500 meter from their dwelling house while 3 households travel 1 to 3 km for collecting water. No one pays for collecting water in this kebele.

#### Hygiene and Sanitation

33.3% of the respondents/families use water only for hand washing while 64.4% use water and soap for hand washing for the reason that to remove dirty/make clean when they are dirty and before meal and 40% of the respondents wash their hands with soap 2 to 3 times in a day. Except one household, the rest 44 households reported that adults go to/use household latrines for defecation; and these 44 households usually walk less than 50m to the latrine. 48.9% of the respondents are at least satisfied with their current defecation place while only 4 of the households are unsatisfied. Most (64.4%) children usually go to/use household latrine for defecation. The mostly reported place for wastage and babies' faeces disposal used by the families are composing and latrine, respectively. Most Adults (97.8% and 91.1%) and children (71.1% and 64.4%) in a family always use latrine for defecation in Dry Season and in Rainy Season, respectively. Households' members with no latrine go to/use field/forest (6.7%), relatives' latrine (4.4%), public latrine (2.2%) and neighbors' latrine (2.2%). Only 28.9% of the respondents reported that their latrine is fairly structured while 71.1% said it is not.

#### ii. Natural Resources

##### a. Forests

77.8% of the respondents have access to forest and majority of the forests in the village reported are owned by Government/Public. Majority (29.4%) of the respondents reported that forests are commonly used for the purposes of construction (28.9%) and fuel wood (24.4%). Most (95.6%)

of the households are using fuel wood as energy source for their consumption. The most common places from where the households get/obtain fuel wood /charcoal for energy consumption are private plantations (31.1%) and market (17.8%). Current status/condition of forest in the village compared to before 10 to 15 years is degraded as reported by 42.2% of the respondents but 28.9% said that it is improved. Agricultural Expansions are frequently reported possible reason for the overall degradation of forest resources currently observed in the village as compared to previous times and soil fertility decline, soil erosion acceleration and shortage of grazing are the most reported possible consequences of overall degradation. None of the households use fuel saving stove for their consumptions.

##### b. Farm Land

All of the households have access to farm land and the average hectare per household owned is 0.7804 hectare and it is reported that most (71.1%) of the households use farm lands for crop production purpose. As reported by the households, 44 (97.8%) of households' farm lands are rain fed and only one of the respondents' farm lands get water from irrigation. 64.4% of the respondents reported that there is land degradation in their village and the main first, second and third reasons for these degradation reported are deforestation, lack of conservation practices and overgrazing, respectively. For maintaining soil fertility 42.2%, 24.4% and 22.2% of the respondents reported that they use modern fertilizer, crop rotation and use of manure. Also 33.3% said that they practice terracing conservations/measures for solving soil erosion.

##### c. Grazing Land

44.4% of the respondents reported that they have grazing land and the average hectare per household owned is 0.3225 hectare; majority (35.6%) of the households reported that the current access to grazing land is not sufficient for their available livestock. Comparing current access to grazing land with the previous one to two years ago 37.8% of the respondents said that it is degraded now days while 13.3% reported that it is improved now. The main factor for this degradation is reported to be overgrazing by most respondents. Only 17.7% of the households said that they get fodder/grazing for their livestock from crop residuals, communal grazing land and private forest. 64.4% of the households reported that there are conservations/restricted areas in their locality and majority of these areas are restricted by Government.

##### Climate Change

Only 14 (31.1%) of respondents had heard about climate change and they think/believe that drought, expansion of desertification, heavy rains and decreasing in crop yield are the most recognized impacts of climate change. For climate change adaptation diversifying crops planting is the most reported practice by the respondents.

##### d. Storage

The commonly type of storage used by all households in this kebele is traditional storage and none of the respondents had heard about plastic storage bags and none of the

households use these plastic storage bags at home.

**3.3. Discussion**

From Table 1, we can see that from both kebeles 71 respondents reported that they have access for quality water; 69 reported that they have access for forest; 93 replied they

have access for farm land and only 46 of the respondents reported that they have access for grazing land. While comparing between these two kebeles, relatively there is high access for water (80.39%) and grazing land (50.98%) in Gatse Kebele but there is high access for forest (77.78%) and farm land (100) in Kole Zale Kebele.

*Table 1. Cross tabulation of Access of Facilities and Kebele of Residents.*

			Village where the Respondents Live		Total
			Kole Zale	Gatse	
Access of Facilities and Resources	Access to Quality Water	Count	30 (66.67%)	41 (80.39%)	71
	Access to Forest	Count	35 (77.78%)	34 (66.67%)	69
	Access to Farm Land	Count	45 (100%)	48 (94.12%)	93
	Access to Grazing Land	Count	20 (44.44%)	26 (50.98%)	46
Total			45	51	95

From Table 2, we can see that the available farm land is used for different purposes by the residents in and within the kebeles. Accordingly, from both kebeles 77 respondents reported that they used the farm land for crop production, 6 reported for grazing, 4 reported for vegetable gardening.

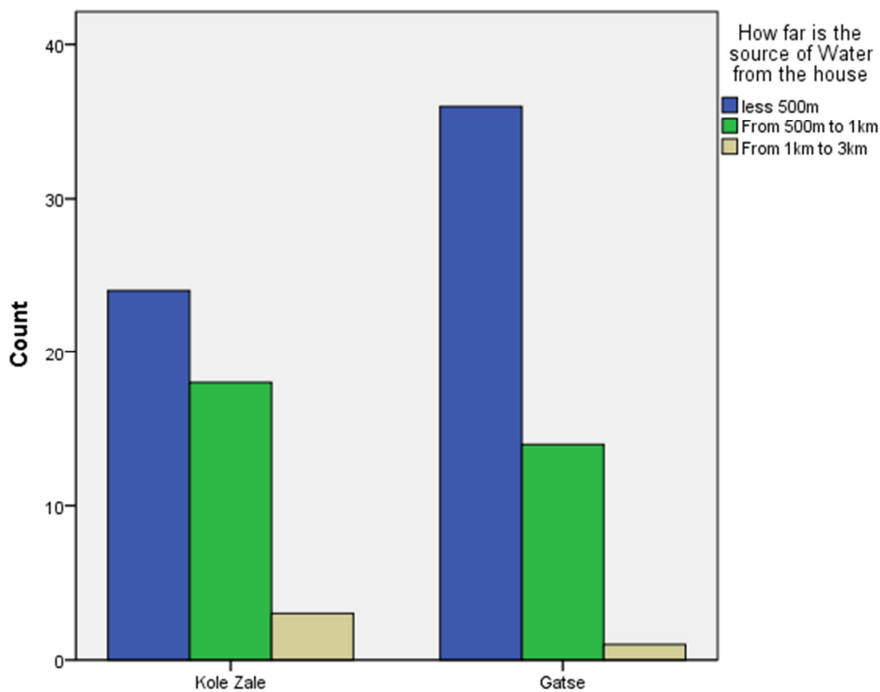
Within Kole Zale kebele, almost 71% reported they are using the farm land for crop production and the rest reported for grazing, settlement, forest and vegetable gardening. Within Gatse kebele the farm land is used only for crop production (88%) and the rest reported for vegetable gardening.

*Table 2. Cross tabulation of Purpose of Farm Land and Kebele of Residents.*

		Purpose that the farm land is used					Total	
		Crop Production	Grazing	Settlement	Forest	Vegetable Gardening		
Kebele	Kole Zale	0	32	6	1	3	3	45
	Gatse	5	45	0	0	0	1	51
Total		5	77	6	1	3	4	96

From Figure 1, we can see that relatively more residents from Gatse kebele are expected to travel less than 500m to the source of water while more residents from Kole Zale

kebele are expected to travel more (from 500m to 1km and from 1km to 3km).



*Figure 1. Village where the Respondent Lives.*

From Figure 2, we can see that more residents from both kebeles reported that the forests in the kebele are owned by the government and more respondents in Kole Zale said they

are using forests for different purposes other than fuel and construction while respondents in Gatse reported they are mostly using forests for fuel consumption.

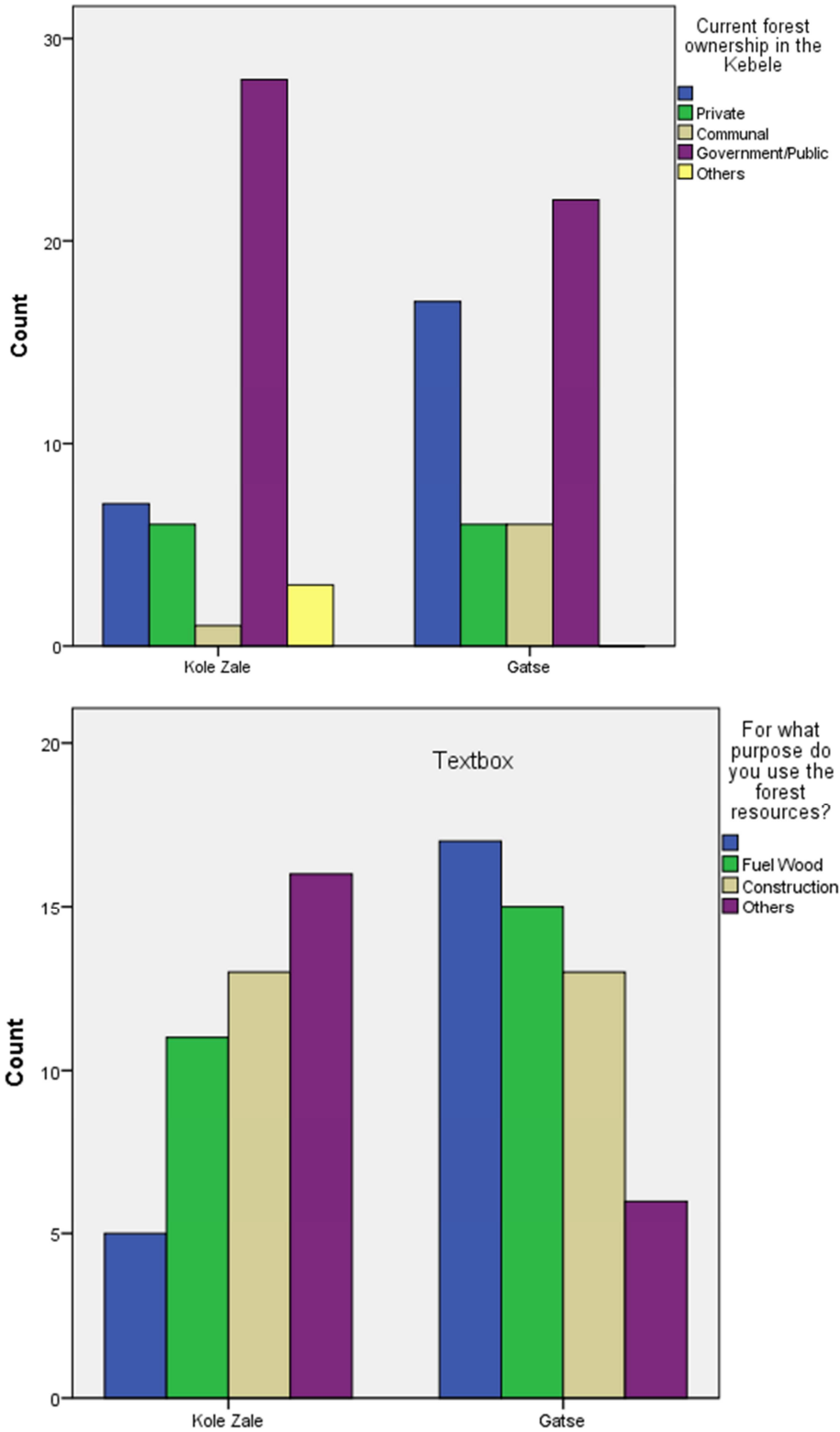


Figure 2. Village where the Respondent Lives.

Chi-square Tests for Association

For the test of independence/association we test the hypotheses that associate villages where the respondent lives with each of access for quality water, forest, grazing land and farm land separately and the results from each independent

test are summarized in Table 3.

$H_0$ : Villages where respondent lives and Access for Quality Water are Independent

Vs

$H_1$ : Villages where respondent lives and Access for Quality

Water are dependent

Similarly the hypotheses for Forest, Grazing Land and Farm Land are formulated and the tests are based on (2-1) x (2-1) df and the selected significance value is 5%. The null hypothesis is rejected if the calculated chi-square value is greater than the critical chi-square value at 5% level of significance and with 1 degree of freedom.

From Table 3 we can see that for each test the calculated  $X^2$  value is less than the critical value  $X^2_{0.05,1} = 3.841$ . So the decision and conclusion for each test are we fail to reject the null hypothesis and conclude that Access for Quality Water, Forest, Grazing Land and Farm Land are independent of the Villages where the respondent lives (that is there is no association between kebeles and access for above listed facilities).

**Table 3.** Chi-Square tests between Villages where the respondent lives.

Vs	Chi-Square	X <sup>2</sup> Value	df	Critical Value at 5%
Access for Quality Water	Pearson Chi-Square	2.949 <sup>a</sup>	1	3.841
Access for Forest	Pearson Chi-Square	1.460 <sup>a</sup>	1	3.841
Access for Grazing Land	Pearson Chi-Square	.409 <sup>a</sup>	1	3.841
Access for Farm Land	Pearson Chi-Square	2.732 <sup>a</sup>	1	3.841

a. 0 cells (.0%) have expected count less than 5.

b. Computed only for a 2x2 table.

## 4. Conclusion

Based on the above Summary Statistics and Chi-square test we can conclude that majority of the residents from both kebeles have access for quality water but only 29.4% of Gatse kebele residents have protected spring water for drinking while 53.3% of Kole Zale residents have unprotected spring water for drinking purpose. Kole Zale Kebele majority residents wash their hand using water and soap but majority of Gatse kebele residents wash their hand using water only. Almost all households in both kebele use household latrine for defecation. There are accesses for Forests in both kebeles and most of these forests are owned by government and most residents in Gatse kebele are using forests for fuel as source of energy but most residents in Kole Zale are using them for construction purpose. Almost all of Gatse (94.1%) and Kole Zale (100%) kebele residents have access for farm land and the average size per household are 0.66 hectare and 0.78 hectare, respectively and mostly these farm lands in both kebeles are used for crops production purpose and they are mostly irrigated using rain water. Residents in both kebeles have access for grazing land and on average per household size is no more than 0.41 hectare. Finally it is observed that access for water, forest, farm land and grazing land is independent of the village or kebele where the residents live.

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