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Research Article

Communities' awareness on environmental and social impacts of stone quarrying and its associated factors in Farta Woreda, Northwest, Ethiopia

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Abstract

Stone quarrying has a considerable impact on land, water, air, natural resources, and social welfare. The objective of this study was to assess communities' awareness of the environmental and social impacts of stone quarrying in Farta woreda, Northwest Ethiopia. The study used a cross-sectional research design. The 359 sample respondents were randomly selected. Both quantitative and qualitative data were collected using household surveys, interviews, focus group discussions, and field observation methods. A binary logistic regression model was done to identify the independent variables of communities unaware of the impacts of stone quarrying. 62.7% and 57.38% of the surveyed households had aware of the impacts of stone quarrying social and environmental, respectively. Age of households heads from 31 - 40 (AOR = 1.272, 95% CI = (0.598-2.708), from 41 -50 age (AOR = 2.152, 95% CI = (0.947- 4.889), from 51- 65 age (AOR = 3.207, 95% CI = (1.405-7.321), Educational level of household heads, elementary school (1-8) (AOR = 2.985, 95% CI = (1.523-5.852), secondary school and above (AOR = 3.794, 95% CI = (1.841-7.820), Income of household heads from 10000 to 20000 birr (AOR = 2.254, 95% CI = (1.236 - 4.109), Income less than 1000 birr (AOR = 2.493, 95% CI = (1.419 - 4.380) were associated with unaware community on the impact of stone quarry. To solve present and future environmental and social problems, the study woreda Environmental Protection Offices should enhance communities' awareness through awareness creation and environmental education program.

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Introduction

Stone quarrying is a kind of open excavation surface mining from which rocks are extracted. It is an unprotected excavation from which fairly gigantic and deep deposits of hard or soft rocks are extracted (Coppin and Bradshow, 1982). Therefore, stone quarrying is one of the major environmental causes that facing our world. So that, it is the impacts of the natural environment and social welfare including both high-income countries and low-income countries (Lameed and Ayodele, 2010). Quarrying of natural stone, including sand, gravel, and

crushed rock, represents the main source of construction materials used throughout the world. The demands and production of stone quarrying are increased from time to time, following urban construction development, particularly in developing countries. However, operations of quarrying, whether minor or large scale, are disruptive to the environment and risks for societies (Endalew et al., 2019). Quarrying of stones frequently creates land-use conflicts, loss of vegetation, sound pollution, truck traffic, visually unpleasant landscapes, and water and air pollution (Wells, 2000).

According to Ross (2001), the stone quarrying activities are affecting environmental sustainability which is a risk to the general economic sustainability with regards to the prevailing environmental guideline and its implementation; the environmental problems are more aggravated because of the overall absence of monitoring and evaluation, lack of rehabilitation, restoration or post-mining programs for the decrease of adverse environmental influences. Darwish et al. (2011) also stated that, in many of the developing countries, at the time of closure of quarrying activities, most quarries are left-hand without any restoration since most of them are left open (Nyakeniga, 2009).

In Africa, mining and quarrying are major economic activity in many Africa countries. Stone quarrying activities are work-intensive; it makes job opportunities for building manufacturers; applies natural and domestic materials. However, this economic activity is the cause of socioeconomic and environmental adverse impacts of stone quarrying are the key cause of conflicts among quarrying firms and the societies existing nearby the mining neighborhoods (Lad and Samant, 2014). The attention of the societies around quarry area on matters associated with quarrying and post quarried land state is vital as it impacts their association with quarrying firms and the post quarry status of the quarried land site (Lad and Samant, 2014).

Stone extracting practices in Ethiopia have increased from time to time utilizing urban expansion and unemployment rate increments. Stone mining is one of the important sources of income for households in areas near to many cities. Stone quarrying tends to make a notable outcome on plant species and soil properties in Ethiopia (Belay et al., 2020). Resulting in the fast urban growth of Debre Tabor city, widespread infrastructure development projects, and building of housing construction development plans are the major pressures to booming in building material supply, most of these materials largely excavated from the Farta woreda rural kebeles. According to Farta woreda TVED (Technical Vocational Enterprise Development) office in the team of mines resource development, there were over 175 quarrying projects undertaken in Farta woreda, Hiruy Abargay, Tsegure Adiko, and Weyibila-Selamico kebeles. In those kebeles there have been quarries used to produce cobblestone, crashed gravels, and constriction material that contributes to the construction of paved roads, houses, bridges, canals and brings both social and economic importance. Nevertheless, the quarry areas in the study woreda had excessive problems which can be characterized by lack of stone quarrying plan, absence of environmental attentions, insufficient mining procedures and absence of restoration measurement planning program, lack of proper implementation of environmental and social safeguarding policies, strategies, lack of proper protection, flow-up, monitoring and evaluation activities such and like drawbacks are which aggravate significantly remove environmental quality and social problems in the study woreda.

Most studies were conducted research relating to the overall influences of stone quarrying on both environmental and social in different parts of the country. For instance: Hilson (2002) studied small- scale mining and its socioeconomic impact in developing countries, Langer (2001), studied potential environmental impacts of quarrying stone in karst, Melaku (2007) studied impact assessment and restoration of quarry site in the urban environment in Augusta quarry, Eshiwani (2014), conducted on effects of quarrying activities on the environment in Nairobi, Kenya (Abate, 2016; Ming'ate and Mohamed, 2016), also studied on impacts of stone quarrying on environment and livelihood of the local community in Addis Ababa peri-urban areas and Mandera County, Kenya respectively. However, such assessments did not identify the determinant factors that affect communities' awareness of the impacts of stone quarrying on both environmental and social welfare. additionally, none of these studies analyzed the influences of stone quarrying using both descriptive statistics and inferential statistics. Therefore, this study was conducted to assess the local communities' awareness of the physical environment and social influences of stone quarrying in Farta Woreda, South Gondar Zone, Northwest, Ethiopia.

Materials and Methods

Study area description

Farta woreda is found in the South Gondar Administrative Zone of the Amhara Region State, northwest Ethiopia. Being part of the South Gonder zone, Farta woreda is bordered on the South by East Esta, on the Northwest by Libo Kemkem, to the West by Fogera, to the East by Lay Gayient, to the North Ebnat (CSA, 2007). The woreda capital, Debre Tabor tows, is located 102 km Northeast of Bahir Dar and 667 km along the Northwest of Addis Ababa. The absolute location of Farta woreda is located at the 11º32'00"N-12°03'00''North latitude and 37°11'00"E-38°16'00" East longitude and the elevation of Farta district is ranging from 1500 to 4135 m above sea level. The mean

minimum annual temperature and the mean maximum temperature of the study area ranges between 9.4ºC and 22.2ºC, respectively and the average annual rainfall is 1507.5 mm with 1.9 mm and 439.2 mm minimum and maximum rainfall, respectively (FWARDO, 2019). According to the information obtained from the South Gondar Zone Administration Plan Commission Office (2020), Farta woreda consists of 37 rural kebele administrations (The smallest administrative unit in Ethiopia), the total population of the woreda was 281,280, from here 143,440 were men and 137,840 were women.

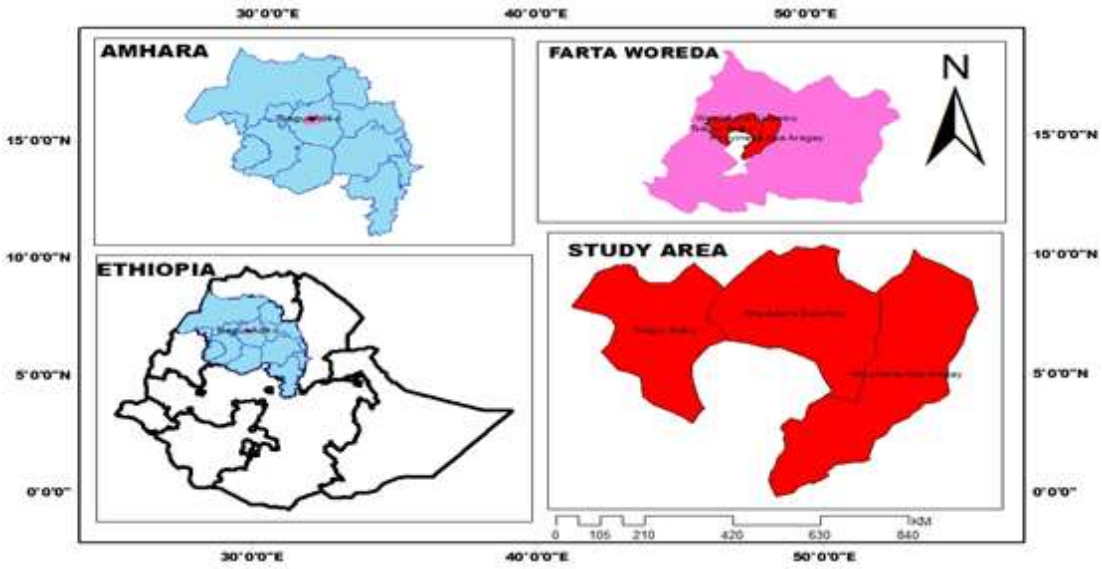

Figure 1. Map of the study area.

The overall area of the woreda is about 118,789 hectares. Alike to other countryside areas of Ethiopia, both livestock keeping and crop production are the main agricultural economic sectors in Farta woreda. The major types of crops grown in study woreda are counting bread wheat, barley, teff, potato, faba bean, linseed, and noug. The common types of livestock in the area include cattle, sheep, and poultry (FWARDO, 2019).

Study design and approaches

The study used a cross-sectional study design by combing both quantitative and qualitative study approaches. The use of both quantitative and qualitative study methods provides the opportunity to reduce shortages and drawbacks that come from using a single study approach.

Sampling techniques and sample size determination

This study used both probability and non-probability sampling techniques were used to select the target area and sample respondents of the study. In the South Gondar zone, Farta woreda was selected purposively as a target area because of the environmental and social problems of stone mining practices. Farta woreda has 37 rural kebeles. To accomplish the objective of this study and to obtain significant representative samples, 3 rural kebeles (the lowest administrative units of Ethiopia) were selected at study area by purposive sampling techniques from the total of 37 rural kebeles because which are well known by major quarry sites for the production of cobblestones, construction stone, and crashed gravels compare with other kebeles. The three-sample rural kebeles are namely Hiruy Abaregaye, Weyibela Selamico, and Tsegure Adico. Encompassing all populations in the study area kebeles is impossible because of cost, time, and measurement procedure limitations. Therefore, the sample size was determined by using the statistical formula of Israel (1992). Statistically presented as:

$$n = \frac{N}{1+N(e)^2}$$

where n is the sample size the study uses, N is the total households' size in all kebeles, e is the maximum level of precision 5% (0.05), and 1 is the possibility of the event happening.

$$n = \frac{3535}{1+35 \quad (0.05)^2} = 359$$

Then, the 359 sample households were distributed to each selected kebele by using the probability proportional to size (PPS) technique to make an equivalent representation of the respondents in each respective kebeles by using the next mathematical formula:

$$ni = \frac{n \times Ni}{\sum Ni}$$

where n is the sample size of the study uses, ni is the households of the ith kebele, and Ni is the total number of households of the i^{th} kebele (Table 1).

After distribution, 359 total sample sizes into selected three rural kebeles. The sample households were selected by using, simple random sampling technique from sampling frames were found for each kebele by taking the list of all household heads from the kebele administration offices.

Table 1. Total sample households of the study area.

Kebeles	Total household	Sampled household
Hiruy Abaregaye	1,673	170
Weyibela Selamico	1,004	102
Tsegure Adico	8,58	87
Total	3,535	359

Source: South Gondar Zone Administration Plan Commission Office (2020).

Data collection methods

The study employed fully primary data collected through household survey, focus group discussion, field observation, and interview, which have carried out the study to end. The household questionary survey is the key data gathering tool to determine the awareness of local communities on the environmental and social impacts of stone quarrying. The household survey questions were prepared in both closed-ended and open-ended question forms on the foundation of the purposes of the study and disseminate to the sample respondents. The household survey questionaries were made in English language and then transformed into the local language Amharic and then interpreted into English at the time of data processing and analysis. It is administered by the authors and data collectors because it involves a large number of respondents. The survey questionary was used to gather numerical data on the perception of communities on the impacts of stone quarry on individual employment status and on the physical environmental condition of the locality and factors that affect community awareness on the impacts of stone quarrying on the environment. To preserve the rationality and consistency of the data the survey questions were wisely reviewed by professionals in mines experts, environment protection experts, EIA (Environmental Impact Assessment) experts, and environment and natural resource experts in the woreda Agriculture Office of the study area. Based on the comments and suggestions giving by the professionals and households' simple modifications were made by canceling and amending questions having unclear and complex ideas.

Methods of data analysis

The study used both quantitative and qualitative data analysis methods. The qualitative methods of analysis were used to analyzed qualitative data which were gathered by both structured and semi-structured interviews and field observation. A Quantitative method of analysis was used to analyze numerical data which were gathered from households by using household survey questionnaires. The collected data were analyzed using both descriptive and inferential statistical tools. Descriptive statistics such as frequency and percentage were employed using a table. Whereas, from inferential statistical tools, binary logistic regression was employed to identify the determinant factors that affect communities' awareness of the impacts of stone quarrying on the environment, to show the effect of predictor variables on the dependent variables by explained in terms of odds ratios. Accordingly, SPSS (Statistical Package for Social Sciences) version 20 software was used to compute the descriptive and inferential statistics.

Model description for binary logistic regression

According to Gujarati(1995), the model for determinants of communities' awareness on impacts of stone quarrying can be defined as:

$$P(Y_i = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_i x_1)}} - - - (1).$$

For simple description, the likelihood that a given respondent is who did not the aware influence of stone quarry on environment and society is expressed as:

$$P(Y_i = 1) = \frac{1}{1 + e^{-Z_i}} - - - -(2)$$

where, P (Y_i=1) is the probability that a respondent who aware impact of the stone quarry on the environment and society, Z_i= the function of a vector of explanatory variables), e- represents the base of natural logarithms, and equation (2) is the collective distribution function. If P (Y_i=1) is the possibility of awareness to impact of stone quarry on environment and social, then 1- P (Y_i=1) represents the probability that the respondent selects to did not aware the impact of stone quarry and is expressed as:

$$1 - P(Y_i = 1) = 1 - \frac{1}{1 + e^{-Z_i}} = \frac{1}{1 + e^{Z_i}} - - - - - (3)$$

$$\frac{P(Y_i = 1)}{1 - P(Y_i = 1)} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i} - - - - - - - - - (4)$$

Equation (4) simply is the odds ratio; the ratio of the probability that a respondent will be aware of to impact of a stone quarry on the environment and society to the probability that it will not be aware to impact of stone quarry on the environment and society. Taking the natural log of equation (4), we obtain:

$$L_i = 1_n \frac{P(Yi=1)}{1-P(Y=1i)} = Z_i - - - -(5)$$

Li is the log of the odds ratio which is not only linear in the explanatory variables but in the parameters also. Thus, introducing the stochastic error term (UI), the logit model can be written as:

$$Z_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + - - + \beta_n x_n + U_i - - - (6)$$

In equation 6, the terms βi are parameters to be estimated, and X_1 to X_n are explanatory variables such as: are age, sex, family size, marital status, education, income, distance from quarry site, government policy, the interest of landowners, increase construction sector respectively. Where β_o is the constant term and β's are coefficients to be estimated.

Variables description for model estimation

Dependent Variables: The dependent variables for the various physical environment and socio-economic impact options were created for this study. The dependent variable is dichotomous it was be coded as "1" if the households' aware that particular impact options and "0" otherwise.

Independent Variables: are age, sex, family size, marital status, education, income, distance from quarry site, government policy, the interest of landowners, increase construction sector, respectively.

Table 2. Definition and measurement of variables.

Variables	Category of Variables	Description and Measurement of independent variables	Expected Sign
Dependent Variable			
Awareness of households	Dummy	1=yes(aware), 0=No (do not aware)	
Independent Variables			
Sex	Dummy	1= Male; 0= otherwise	
Age of households	Categorical	0=20-30,2=31-40,3=41-50, 4=51-65	+
Martial states	Categorical	0=Single,1=Married,2=Widowed, 3= Divorced,	-
Family size	Dummy	0=Under 4, 1= Above 4	-
Educational status of household heads	Categorical	0= No formal Education, 1= Elementary (1-8), 3=>Secondary	+
Income of household heads	Categorical	0=≥10000,1=10000-20000, 2=<10000	+
Distance from quarry site	Categorical	0=≥500m, 1= 200-500m; 2= <200m	+
Interest of landowners	Dummy	1= yes; 0= otherwise	+
Increase construction sector	Dummy	1= yes; 0= otherwise	+

Results and Discussion

Communities' awareness on physical environment and social impacts of stone quarry

Influences of stone quarry on physical environment

The natural environmental impacts of stone mining are the reduction of agricultural land, impacts of dust pollution, loss of biodiversity, land degradation, and changing the beauty of the landscape. The survey result indicates that the majority 57.38% of respondents had awareness towards influences of stone mining on the natural environment and only 42.62% of the respondents have not aware of the impacts of stone quarrying on the natural environment (Table 3). Based on this survey result data, a decrease of agricultural land (63.8%), impacts of dust pollution (62.7%), biodiversity loss (68.2%), land degradation (56.5%), and change of landscape (65.7%) are the effects of stone quarrying on the natural environment. Therefore, stone quarrying activities are one of the major causes of degradation of the natural environment both the quality and quantity due to the extensive expansion of stone quarrying. This survey outcome is in line with results on the field observation. It was observed that the majority of plants and animal species living in stone quarrying sites were destroyed from their habitats and even the remaining living things still they are vulnerable. Plant species by their local and scientific name including, Degta (*Calpurnia aurea*), Atatie (*Maytenus arbutifolia*), Bisana (*Croton macrostachyus*), Shola (*Ficus*

sycomorus), Bahirzaf (*Eucalyptus globulus*), Chifirege (*Sida schimperiana*), Kuliqal (*Opuntia vulgaris*), Gesho (*Rhamnus prinoides*) and other grass species were frequently stated species to have been affected by the quarry operations in study kebeles (Figure 2). Furthermore, animal species are known by their local and scientific names Kebero (*Canis latrans*), Tota (*Chlorocebus pygerythrus*), Jibe (*Crocuta crocuta*), Midaqo (*Sylvicapra grimmia*), and Qoqe (*Coturnix coturnix*) and others are expected by the community to have escaped away due to the expansion of quarrying activities in their respective areas. This outcome is in line with many researcher findings (Mouflis et al., 2008; Lameed and Ayodele, 2010; Dejene, 2016) who noticed that quarry excavation has reduced both quality and quantity of originality natural environment and it has destroyed natural resources like, land, water, vegetation, wild animals' species, and biodiversity (Figure 3).

Figure 2. Reduction of agricultural land and dust from quarry effects on plants leaves [Author's Field Photo, 2020].

Figure 3. Loss of biodiversity from stone quarry sites [Author's Field Photo, 2020].

Impacts of stone quarry on society

Some of the social impacts of mining are fatal accidents, physical injury, health effects, and noise. The survey result indicates that 62.7% of the respondents have awareness of the impacts of the stone quarry on social welfare and only 37.3% of respondents have not aware of the impacts of the stone quarry on social welfare (Table 3). The survey result indicates that physical injury and fatal death (68.5%), impacts on health (9, 66.3%) and impacts of noise (72.4%) of the respondents were reported, these are the major influences on communities nearby the sone quarrying sites and the workers of stone quarrying. Physical injury and fatal death are the common impacts of stone mining in the study area. Due to stone quarrying activities create steep rock cliffs and

deep gaping pits on the surface those cliffs are the case of accidents for physical injury and fatal death on the stone workers (Figure 4). According to the data obtained from FGDs (Focal Group Discussions), before two years 7 stone quarry workers died, and above 10 workers were physically injured in the study area. Therefore, during rainy seasons, the abandoned depths collect water it causes hazards to kids,' old peoples, and live stocks. This is in line with the findings of Abate (2016), who noticed other impact of stone quarrying is on the surrounding residence. Likewise, the participants of interviews indicated that during cutting of land and transportation process; there was some amount of dust in the air with in those quarries site. Consequently, these dusts are affecting the heaths of communities near to quarrying sites.

Figure 4. Steep rock cliffs and deep gaping pits (Author's Field Photo, 2020).

Table 3. Socio-environmental impact of stone quarrying activity.

Variables	Category	Frequency(n)	Percent (%)
Impact of stone quarry on physical environment	No	153	42.62
	Yes	206	57.38
Environmental effects of stone quarry	Decrease of agricultural land	229	63.8
	pollution (dust particles)	225	62.7
	Loss of biodiversity	245	68.2
	Land degradation	203	56.5
	Change of landscape	236	65.7
Impact of stone quarry in social welfare	No	134	37.3
	Yes	225	62.7
Social effects of stone mining operation	Physical injury and fatal death	246	68.5
	Impact of health effects	238	66.3
	Impact of noise	260	72.4

Source: Household survey data, 2020.

Factors affecting awareness of communities towards environmental impact due to stone quarrying

Before the regression was run multicollinearity, a test had been run to test whether or not the independent variables were linearly related to each other. All the independent variables were checked for the goodness of fit. Variance inflation factor (VIF) was used for testing the degree association between a hypothesized discrete variable and continuous variables respectively. If the P-value is >0.05 the model is fitted. This study output model of Hosmer-Lemeshow test result indicated that a chi-square was 8.977 with a P-value of 0.344. This value is greater than 0.05(50%) indicating that there is no difference between the observed and the predicted model. Thus, the estimated model was fitted. To determine impacts associated with awareness of communities towards impacts of stone quarrying to physical environment binary logistic regression analysis was used. On bivariate sex, age, marital status, family size, occupation, educational status, income, and distance from quarry site of respondents were found to be significantly associated with awareness of communities towards impacts of stone quarrying to the

physical environment. In multivariable, logistic analysis out of the variables analyzed, the coefficients of three variables, namely age of households, education of households, and annual income of households found to be variables that have a significant effect on awareness of communities towards impacts of stone quarrying to the physical environment. The adjusted odds ratio along with 95% Confidence Interval is and P-value ≤ 0.05 was considered to declare factors that have a statistically significant association with factors affecting community awareness towards environmental impacts of stone quarry (Table 4).

Table 4. Associated factors with awareness of households on the impact of stone quarry.

Variables	Awareness of HH head-on impact of Stone Quarry			COR (95%CI)	AOR (95%CI)
	Category	No aware	Aware		
Sex of HH heads	Male	103(67.32)	140(67.96)	1	1
	Female	50(32.68)	66(32.04)	0.971(0.621,1.518)	1.001(0.620-1.615)
Age of HH heads	20-30	28(18.30)	27(13.11)	1	1
	31-40	55(35.95)	52(25.24)	0.980(0.512,1.879)	1.272(0.598-2.708)
	41-50	36(23.53)	57(27.67)	1.642(0.837,3.220)	2.152(0.947-4.889) *
	51-65	34(22.22)	70(33.98)	2.135(1.094,4.168) *	3.207(1.405-7.321) *
Family size	Under 4	42(27.45)	49(23.79)	1	1
	Above 4	111(72.55)	157(76.21)	1.212(0.751,1.956)	1.055(0.562-1.979)
Education status of HHs	No formal education	51(33.33)	29(14.08)	1	1
	Elementary	65(42.48)	110(53.40)	2.976(1.718,5.155)	2.985(1.523-5.852) **
	>Secondary	37(24.19)	67(32.52)	3.185(1.735,5.846)	3.794(1.841-7.820) **
Marital status of HHs	Single	15(9.80)	21(10.20)	1	1
	Married	112(73.20)	164(79.61)	1.046(0.517,2.116)	0.622(0.255-1.519)
	Widowed	19(12.42)	17(8.25)	0.639(0.252,1.622)	1.067(0.339-3.364)
	Divorced	7(4.58)	4(1.94)	0.408(0.101,1.648)	0.522(0.106-2.558)
Income	>10000	53(34.64)	41(19.90)	1	1
	10000-20000	45(29.41)	67(32.53)	1.925(1.104,3.355)	2.254(1.236,4.109) **
	<20000	55(35.95)	98(47.57)	2.303(1.363,3.892)	2.493(1.419-4.380) **

Note: (n = 345), * Significant at P = <0.05, ** Significant at P = < 0.001, COR = Crude Odds Ratio, AOR = Adjusted Odd Ratio, CI = Confidence Interval .

Age of the household heads

The logistic regression model results indicated that the age of household heads was positively associated and significant determinant factors of communities 'awareness towards impacts of stone quarrying on physical environment and social welfare at a 5% significance level. Being other variables remain constant, those households with age from 51-65 years were 3 times more likely to have awareness towards impacts of stone quarrying on physical environment and social welfare when compared to those household heads ages from 20-30 years old (AOR 3.207, 95% CI (1.405-7.321)), household heads age from 41-50 years old was 2 times more likely to have awareness towards impacts of stone quarrying on physical environment and social welfare when compared to those household heads age from 20-30 years old (AOR 2.152, 95% CI (0.947-4.889)) and household heads age from 31-40 years were 1 time more likely to have awareness towards impacts of stone quarrying on physical environment and social welfare when compared to those household heads age from 20-30 years old (AOI 1.272, 95% CI (0.598-2.708)). This indicated that older age groups have more awareness towards environment and social problems than 3 other groups. This outcome is in line with the findings of Abate (2016), which pointed out that the older respondents answered more frequently correct awareness than younger respondents. The older a person is, the more concerned about the environment (Shen and Saijo, 2007). However, this result is in contrast with the findings of (Cottrell, 2003; Arcury, 2010), which pointed out that younger persons are more environmentally concerned than older persons.

Educational status of household heads

Educational level is one of the most explanatory variables related to environmental awareness and attitude because as the level of households' education increased, effective natural resources management practice also increased at the same time and vice versa. Normally, one of the major objectives and the desired

outcome of education is to shape and describe positive human behavior and attitudes. The logistic regression model result showed that the educational status of household heads was positively associated and significant determinant factors of communities' awareness towards influences of stone mining on the natural environment and social welfare at a 1% significance level. Secondary school and above were 3 times more likely to have awareness towards impacts of stone quarrying on physical environment and social welfare when compared to those who are no formal education (AOR 3.794, 95% CI (1.841-7.820)) and elementary school (1-8) were 2 times more likely to have awareness towards impacts of stone quarrying on physical environment and social welfare when compared to those who are no formal education (AOR 2.985, 95% CI (1.523-5.852)). When the education level of the household heads increases the probability of awareness of communities towards impacts of stone quarrying on the physical environment and social problems positively increases. This result is similar to the findings of Elizabeth and Rebecca (2013) which recommends that educational level is contributing to levels of natural environment concern that encompasses beyond equipping the individual with knowledge of environmental issues and people with low or no education to tend to engage in informal economic activities such as stone quarrying. This observation made by this scholar is consistent with the findings on the field observation. It was observed that the majority of the stone quarrying persons had no formal education whereas others were drop-outs of their education and they were come from around rural kebeles.

Income of household heads

Household income is one of the socio-economic determinant factors of communities' awareness of the impacts of stone quarrying on the physical environment and social welfare. Therefore, poor households degrading more natural resources than rich households if other determining factors are the same in both cases. it is also argued that poor households depend severely on land. The logistic regression model results indicated that the income of household heads was positively associated and significant determinant factors of communities 'awareness towards impacts of stone quarrying on physical environment and social welfare at 1% significance level. Household heads annual income from 10000 to 20000 birr were 2 times more likely to have awareness towards impacts of stone quarrying on physical environment and social welfare when compared to those who are annual income less than 10000 Ethiopian birrs (AOR 2.254, 95% CI (1.236-4.109)), and household heads annual income above 20000 birds were 2 times more likely to have awareness towards impacts of stone quarrying on physical environment and social welfare when compared to those who are annual income less than 10000 Ethiopian birrs (AOR 2.493, 95% CI (1.419-4.380). It implies that the income of the household heads increases the probability of awareness of communities towards impacts of stone quarrying to the physical environment and social positively increase. Both the poor and rich peoples do the causes of natural environmental damages, but at, unlike frequency and magnitude. The poor persons are both victims and actors of environmental damage because they are poor and starving will often destroy their immediate environments to survive. This is because of had financial resources to know the impacts of stone quarrying on environmental media (more access to information), rich people are not engaging in quarrying activity and have assumptions for the next generation.

This result is in line with the conclusions of Finer (1994) who forwarded that the poor need to interact with the environment in many ways. These interactions however bring many associated environmental and social problems like land degradation, crimes, diseases, accidents, and other social pathologies that are caused by the societal necessity to meet some basic human needs. This observation made by this scholar is consistent with the findings on the field observation. It was observed that unemployed, landless rural households, and poor youths are the dominant group of people involved in stone quarrying in Farta woreda. Generally, stone quarrying is contributing to regular income to poor households' and wellbeing since there is ready market for stone products in the study area.

Conclusion

The awareness of communities towards social and environmental influences of stone quarrying was poor in the study area. Following the demands of stone increasing time to time, it led to widespread uncontrolled stone mining activities in the study woreda. As a result, quarry activity had created several environmental and social problems such as reducing agricultural land, change of landscapes, land degradation, impacts of dust pollution, reduction of agricultural yields, and loss of biodiversity, noise, health effects, fatal accident, and death. For improved communities' awareness towards both environmental and social influences of stone quarrying and its risk minimization. Farta woreda Environmental Protection Offices should change communities' responsiveness through meaningful awareness creation and environmental education programs. Age of households, education status of households, and income of households were factors affecting the awareness of households towards impacts of stone quarrying to the physical environment and social welfare were found to be associated with unaware impacts of stone quarrying and its risk. So, the South

Gondar Zone Land administration, Land use and Environmental Protection Department, and other concerned bodies should be minimizing these influential factors.

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