Impacts of Illegal Mining on Human Being, the Case of Huye District

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Abstract— *The current study was about the impacts of illegal mining on wellbeing of people. More specifically the study intended to:*

(i)   identify illegal mining practices in Huye District;

(ii)   Assess the social, economic and environmental impacts of illegal mining on wellbeing of people of Huye District.

(iii)   Find out solutions to social, economic and environmental impacts of illegal mining on environment and wellbeing of people of Huye District.

Keywords— Huye District, Illegal Mining impact on Human.

I.   INTRODUCTION

Mining has been a most concern activity for economy's growth Worldwide. UNEP (2009) says that mining is an activity that involves digging of surface and subsurface for the purpose of exploiting and processing the minerals for just various uses. Gibson (2018) reveals that extracted minerals can be copper and nickel; precious metals like gold and silver; iron; uranium; coal; etc.

Mining can be legal or illegal depending on the status of rights owned by the miners. More specifically, Gibson et al, (2018) said that illegal mining refers to violations of both specialized laws and regulations for mining that protect the environment and human welfare. UNEP (2009) added that illegal mining for the most world countries is characterized by the lack of land rights, mining licenses and transportation permit.

Mineral resources belong to the government; and therefore they must be exploited by the miners with the legal rights regarding to the laws and regulations (Phillipe, 2019). Many specialists and policymakers confirm that illegal mining are seriously connected to the poverty for people living nearby the mineral areas; and this is mainly due to soil erosion, destruction of farms and crops thereby small agricultural harvest.

In Peru, researches indicate that illegal mining lead to heavy metal and chemical poisoning of environments (Fashola et al, 2016), and the erosion of soils (Dissanayake and Rupasinghe, 2017); hence, USAID in the partnership with Peru works towards this, through the rehabilitation of the affected land, preventing the expansion of illegal mining as well, into protected areas and other forested lands.

In USA illegal mining has been considered as a destructive agent. In light of this; Amazonian communities, their forests and ecosystems have been destroyed by illegal miners; and this lead to the signature of a Memorandum of understanding in 2017 between USA and Peru to combat illegal gold mining (Jene, 2019); this ensures long life of environmental ecosystems.

In India, illegal mining takes place in abandoned mining sites and its effects appear all over the whole region where human being encounters serious problems (Mari Hayman, 2013). UN (2018) reported that illegal mining leads to the blood diamond; that's conflict diamonds between rebels and international recognized governments. Mari Hayman (2013) says that blood diamonds are used to fund military actions in opposition to those governments. World diamonds council (2016) argued that the sale of blood diamonds support drug trafficking and terrorism which are deadly in nature.

In South Africa, illegal mining is a criminal and highly dangerous activity. The most concerned minerals are diamonds, chrome and coal (Mineral Council report, 2017). UN (2018) claims that illegal mining in South Africa deserves a whole range of negative social impact across the board; these are like death of illegal miners, volunteers in rescuing those who have been trapped underground. And this presents major threats to African governments in safeguarding their population (Mining Review Africa, 2019).

In DRC, much mining has been done illegally with a high level of child labor and workplace injury (Hanah, 2019). Sylvain (2018) said that some armed groups in DRC finance their operations through the illegal mining, thereby destructive conflicts in the region.

In Rwanda, illegal mining is carried out to extract cassiterite, Wolfram and Coltan. Rwanda Mines Petroleum and Gas Board (2018) asserted that people died, others get injured due the illegal mining activities. John Kanyangira (2019) suggested that security in mining sites must be granted to rescue the mining operators. RIB (2019) says that illegal mining is risky to people's lives.

In Southern Province areas where illegal mining is practiced include in Huye District; and minerals extracted are like coltan and Cassiterite. In Huye District, illegal mining is conducted in Rwaniro Sector where the minerals like coltan and cassiterite are mostly extracted (Viviane Irabizi, 2019).

II.   MATERIALS AND METHODS

2.1   Research design

The design of a research is the combinations of methods you have chosen for empirical part of your study (Kenneth, 1978).Grinnell et al (1990) define research design as the comprehensive process of the study and the problem formulation through dissemination of findings. Under this research, descriptive research design was used to assess the impacts of illegal mining on the human being in environment in Huye District as the case study.

2.2   Descriptive research design

Descriptive research design was used in the current study. This was to provide essential information in need. It is however made by the qualitative and quantitative research approaches.

2.3   Qualitative research approach

Qualitative research approach seeks to provide an understanding of human experience, perceptions, motivations, intentions, and behaviors based on description and observation. Qualitative research is descriptive approach in which the researcher is interested in process, meaning, and understanding gained through words or pictures (Ramanath, 2010). The process of qualitative research is inductive in which the researcher builds abstractions, concepts, hypotheses and theories from the information gathered.

2.4   Quantitative research approach

Quantitative research approach emphasizes objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques. Quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon (Ramanath, 2010). This study will adopt Quantitative research approach.

2.5   Sampling design

2.5.1   Study population

A population is the mass of units of analysis about which, the researcher was measure his or her variables (Kenneth, 1978). According to Panneerselvam (2005), a study population refers to the total group of people from whom the information is needed. The study population comprises 230 persons of people around the mines in Kamwambi and Nyaruhombo cells, Rwaniro sector, Huye District.

2.5.2   Sampling techniques

Basically, sampling techniques are divided into probability and non-probability sampling. Probability sampling provides an equal opportunity for each and every element of the population being selected. This method utilizes some form of random

selection. But non- probability sampling does not involve random selection (Ramanath, 2010). In this context, purposive sampling and convenience sampling techniques was used to determine the representative sample size.

2.5.3   Purposive sampling

Purposive sampling is a sampling technique in which researcher relies on her own judgment when choosing members of population to participate in the study. Purposive sampling is a non-probability sampling method and it occurs when "elements selected for the sample are chosen by the judgment of the researcher. Researchers often believe that they can obtain a representative sample by using a sound judgment, which was result in saving time and money (Ramanath, 2010). The researcher used purposive sampling technique since she has deliberately decided to consider only people respondents with the needed information about the topic being investigated.

2.5.4   Convenience sampling

The population or universe represents the entire group of units which is the focus of the study. Thus, the population could consist of all the persons in the country, or those in a particular geographical location, or a special ethnic or economic group, depending on the purpose and coverage of the study (Black, 2010).

The researcher was used convenience sampling technique while collecting information related to the impacts of illegal mining on human being in environment. The technique has been chosen because the researcher was collected the information from only available respondents depending on the time and space.

2.6   Sample size

A sample is a portion of the population selected to achieve the objectives of the research. Then, the sample size of the current study was calculated using the Slovin's formula.

If you take a population sample, you must use a formula to figure out what sample size you need to take. Slovin's formula is essential to figure out what sample size you need to take, which is written as

$$n = \frac{N}{(1 + Ne2)}$$

Where n = Sample Size,

 N = Total population,

 e = Error tolerance,

Assume that a confidence level of 90 percent (which give a margin error of 0. 1 was used).

$$n = \frac{N}{(1 + Ne2)} = \frac{230}{(1 + 230 * (0.1)2)} = 69.69 = 70 \; Respondents$$

The sample size was computed using the formula of Slovin and the study population made of population nearby the mining areas.

2.7   Study Area Description

This part focuses on presentation of Rwaniro Sector, Huye District as the study area, the precise area where mining activities present.

The current study has been conducted on illegal mining found in Rwaniro Sector, Huye District and Southern Province, Rwanda.

Huye is one of eight Districts that make up Rwanda's Southern Province. It has a total surface area of 581.5 square Kilometers. It has fourteen sectors and 77 Cells with a total of 509 Umudugudus in total. The district has a population of 314,022 inhabitants with an average of 540 inhabitants per square kilometer. Like some other Districts, Huye District has minerals being extracted for economic purpose. However, the main minerals exploited in this District are Coltan and Cassiterite; and they are found in Rwaniro Sector (The New Times, 2017). Gatare Francis (2018) exhorts the government officials specifically in Huye Districts to join efforts in combating illegal mining which appears to the sector; and cause disastrous deaths due to illegal mining practices.
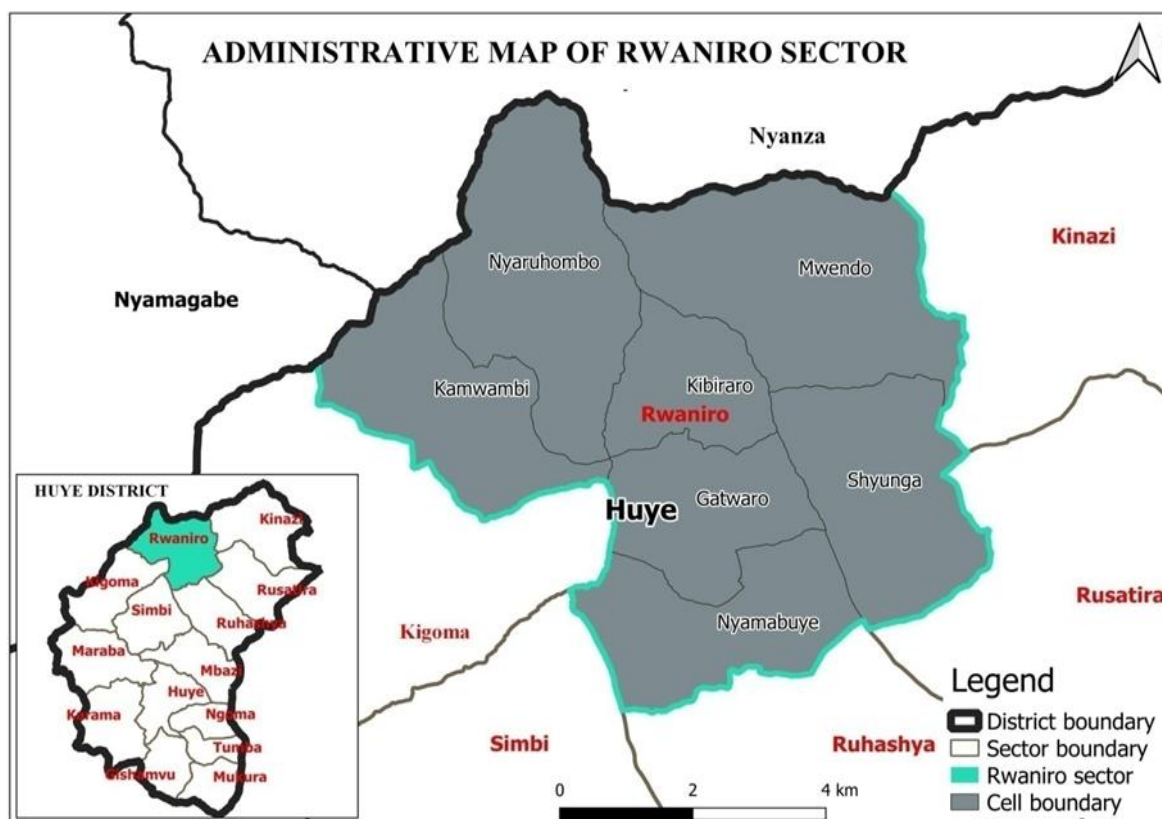
FIGURE 1: Map of Rwaniro sector, Huye District
Source: Author by using ArcGIS

2.8　Data Collection Procedures

2.8.1　Types of data

During this study, the researcher collected primary data through self-designed questionnaire.

2.8.2　Categories of data

For this study, the data collected were categorized in two categories. The researcher seeks to collect ordinal data. Ordinal data were collected through a questionnaire addressed to the population around the mines in the District under study.

For primary data collection, the researcher was used a structured questionnaire. Regarding secondary data, the researcher was used reports from Huye District.

2.8.3　Pre- testing

The pre-testing is the trial run of the questionnaires on a small sample of respondents to identify and eliminate potential problems (Maholtra, 2006).It has a role in ensuring the research instruments as a whole functions well in order to eliminate variation understanding and interpretation of the questionnaire in terms of ambiguity (Bryman and Bell, 2007). Before finalizing a questionnaire to be used to collect data, a pre-test has to be done to eliminate several mistakes that cannot be easily identified. Conducting a pre-testing study gives an advanced warning to the researcher about where the main research could fail, where research protocols may be followed and even whether the proposed methods or instrument are appropriate or complicated (Van & Hundley, 2001). For the purpose of this study, the questionnaire was pre-tested with 10 respondents. Thereafter changes were made about the wording, sequence and language of the questionnaire.

2.8.4　Pilot study

A pilot study is like a small version of the full study. In this phase, the questionnaire was piloted with 10 selected respondents from Muhanga District Mines which is not part of the study. Changes were made to the questionnaire in order to prepare the main survey instrument. The pilot study was initially undertaken to determine the reliability of the questionnaire. Statistical methods were used to calculate the reliability of multiple item measures.

2.9   Data Analysis Procedure

2.9.1   Data processing and analysis

2.9.1.1 Data processing

Raw data was transformed into meaningful interpreted report using different techniques. In order to get qualify information; there were needed for standard checking so that the researcher could end up with realistic data, which clearly reflected the depicted situation.

Stand checking was done through editing; coding and tabulation. This was done in order to reduce detailed data to manageable proportions.

2.9.1.2 Editing

According to Sekaran (2003), "editing is the process whereby errors in completed interview schedules and questionnaires are properly analyzed, scrutinized and verified in order to avoid errors and repetitions". This type of data processing made the analysis simple and easy to the researcher.

2.9.1.3 Coding

According to Kenneth (1978), coding refers to "assigning a symbol or a number to a response for identification purposes. The purpose of coding in research is to put forward by Panneerselvam (2005) who argued that it is to "classify the answers to questions into meaningful categories as so to bring out their essential pattern"

2.9.1.4 Tabulation

Tabulation is the process of summarizing raw data and displaying the same in the form of statistical tables for further analysis. In a broader sense, tabulation is an orderly arrangement of data in columns and rows (Kothari, 2004).

2.9.2   Statistical treatment of data

In this study, both Excel and SPSS were used in processing and analysis of data for the presentation of findings, analysis and interpretation. The presentation focused on the research questions. The kind of statistical treatment depends upon the nature of the problem, especially the specific and the nature of data gathered. For this purpose, Karl Pearson coefficient was used to analyze the relationship or correlation between the variables under study.

Description and formula: In order to determine how strong the relationship is between two variables, a formula must be followed to produce what is referred to as the coefficient value.

The coefficient value can range between −1.00 and 1.00. If the coefficient value is in the negative range, it means that the two variables are negatively correlated, or as one value increases, the other decreases. If the value is in the positive range, it means that the two variables are positively correlated or both values increase or decrease together.

$$r = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{[N \sum X^2 - (\sum X)^2][N \sum Y^2 - (\sum Y)^2]}}$$

Where: X and Y are variables, N: Sample size.

TABLE 1
INTERPRETATION OF PEARSON CORRELATION COEFFICIENT

1	r = +/-1	Perfect Correlation
2	+/- 0.9 ≤ r< +/- 1	Strong Correlation (Very High)
3	+/- 0.7 ≤ r< +/- 0.9	High Correlation
4	+/- 0.5 ≤ r<+/- 0.7	Moderate Correlation
5	r< +/- 0.5	Weak (Low) Correlation
6	r= 0	Absence of Correlation

Source: Anand, 2010

2.10   Data analysis

Data collected were analyzed using tables, percentages and statistic tools such as Pearson Correlation.

III.   RESULTS AND DISCUSSION

3.1   Results

3.1.1   Introduction

This part covers the results of the study, it started by describing the profile of the respondents and the findings of the research with respect to the following specific objectives: To identify illegal mining practices in Huye District ,to assess the social, economic and environmental impacts of illegal mining on wellbeing of people of Huye District, Rwanda and finding out solutions to social, economic and environmental impacts of illegal mining on environment and wellbeing of people of Huye District, Rwanda.

3.1.2   Respondents Identification

The survey included information on sex, age group, approximation of years of living near mining areas, approximation of years of living near main road used by trucks transporting extracted minerals, frequency of visiting the soil mining area and activities normally done in the soil mining area.
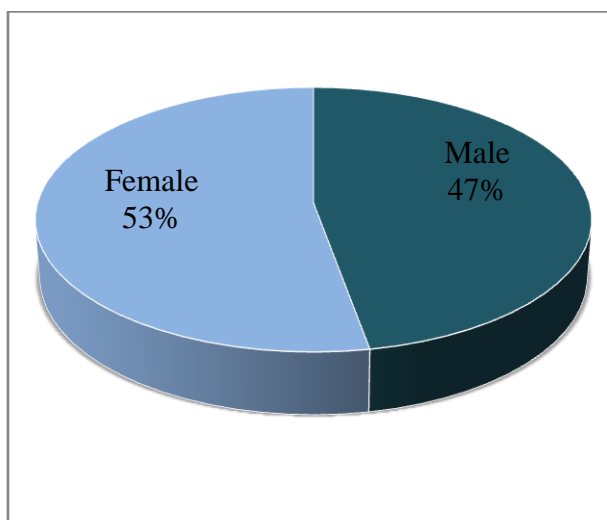

FIGURE 2: Survey by Sex, age group, approximation of years of living near mining areas
Source: Field Survey, 2020

3.1.3   Classification of Respondents by Sex

The survey results as depicted by the figure 3 about classification of respondent. The survey results as depicted by the about classification of respondents by sex showed that 53% of them were female while only 47% were female.
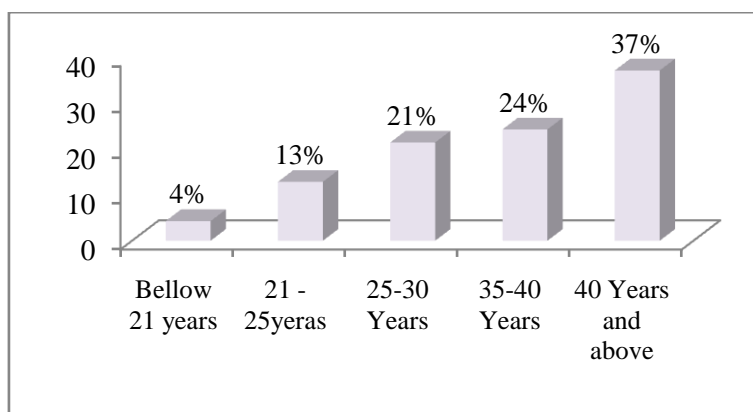

FIGURE 3: Classification of Respondents by Sex
Source: Field Survey, 2020

3.1.4   Classification of Respondents by Age group

The results of study as portrayed by the figure 4 about classification of respondents by age group indicated that the majority around 37% were aged of 40 years and above, this category is followed by 35 to 40 years, 25 to 30 years, 21 to 25 years and finally the small number of respondents around 4% were aged below 21 years old.
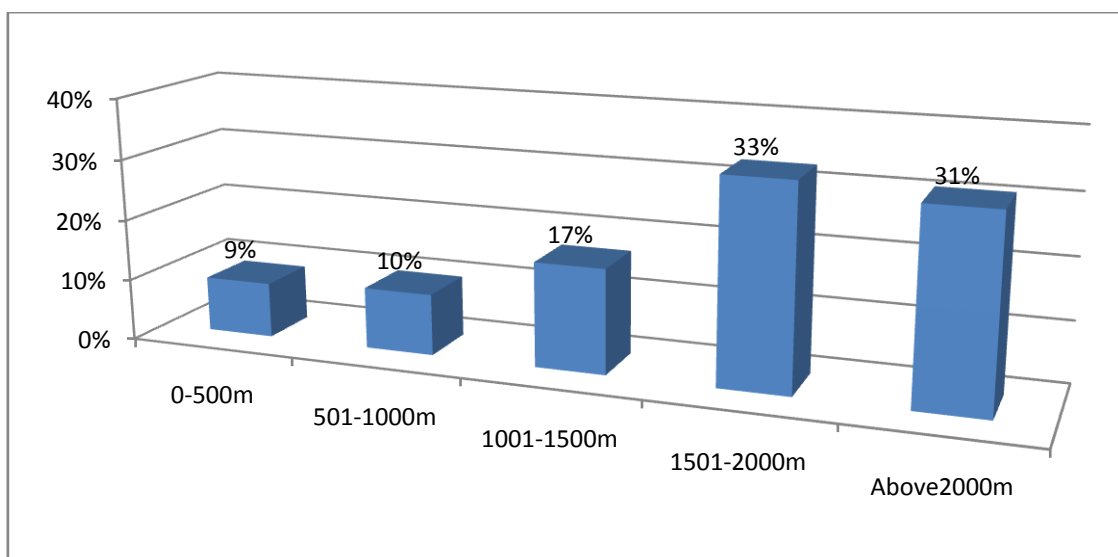

FIGURE 4: Classification of Respondents by Age group
Source: Field Survey, 2020

3.1.5   Approximate distance near mining areas

The illustration of the figure 5 about approximate distance near mining areas showed that the majority of respondents have their habitation with 1501 to 2000m, 31% replied to have their residence above 2000m from near mining areas. Besides these two categories, 36% resides within distance of 1001 to 1500m, 501 to 1000m and below 500m consecutively in ascending way.
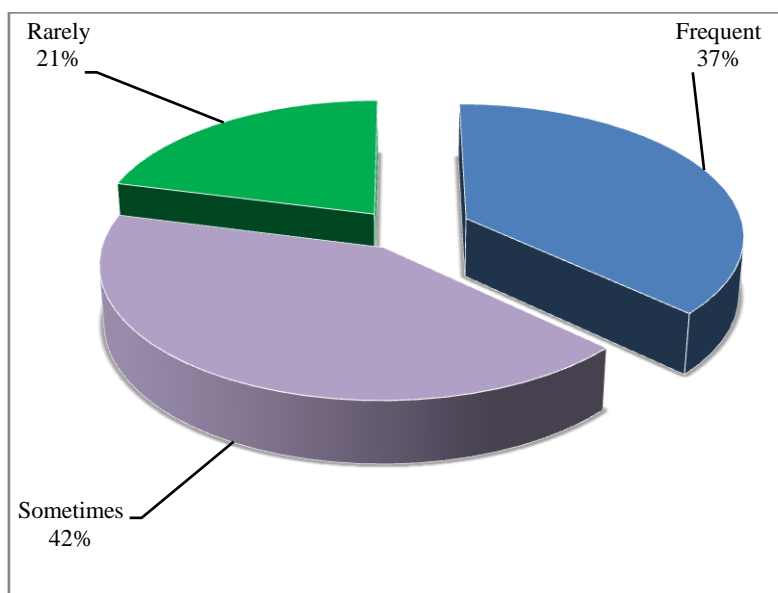

FIGURE 5: Approximate distance near mining areas
Source: Field Survey, 2020

3.1.6   Frequency of visiting the soil mining area

The 42% representing the majority replied that they sometimes visit the soil mining area; this is followed by 37% who make it happen frequently and last only 21% replied that they rarely visit the soil mining area.

3.2   Impacts of illegal mining on human being in environment

In order to assess the impact of illegal practice on environment, the analysis considered the following: Feeling of Respondents about mineral extraction, Disadvantages of illegal mining from the environment to the residents, to the community, Social, economic and environmental impacts of illegal mining on wellbeing of people.

3.3   Illegal mining practices in Huye District

The results of the survey as depicted by the figure 6 about some of illegal showed that in-situ mining occupies the first position among illegal mining practices that are performed in the selected mining area, this is confirmed by the fact that it holds 41% of total respondents said insitu; 36% of them use surface mining and 14% undertake mining activities using underground mining, whereas (9%) uses placer method.
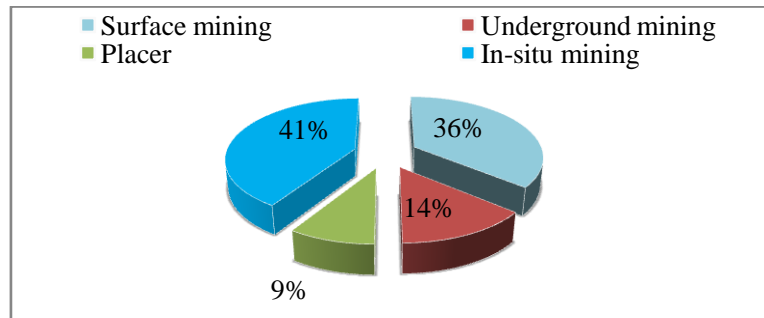

FIGURE 6: Illegal mining practices in Huye District
Source: Field Survey, 2020

3.3.1   Feeling of Respondents about mineral extraction

Most of the time people in surrounding environment say they are skeptical of the quality of the mines, although they often say they have nothing to do with it. They also say that mines often kill people and punish them, but that often ends verbally because it does not prevent miners from continuing to work. For this case, respondents wishes to have owners of mining zone to fast think about the human being in the surrounding area. They suggest things like early expropriation before starting the operations, assuring of people in the surrounding area, establishment of security staff for daily assurance.

3.3.2   Disadvantages of illegal mining from the environment

Residents used said that in addition to the loss of life, illegal mining is damages to the environment through creation of steep slope, leaving workplace with large and open holes that put life of people in a very high risk zone, environmental degradation through water pollution, removal of erosion preventive vegetation, without forgetting the act of shaking house in the surroundings in a very harmful way.

3.3.3   Social, economic and environmental impacts of illegal mining on wellbeing of people

In order to successfully complete the analysis of this survey, it is obvious and compulsory to take a look at the description of social, economic and environmental impacts and then after regression analysis for the test of the claim.
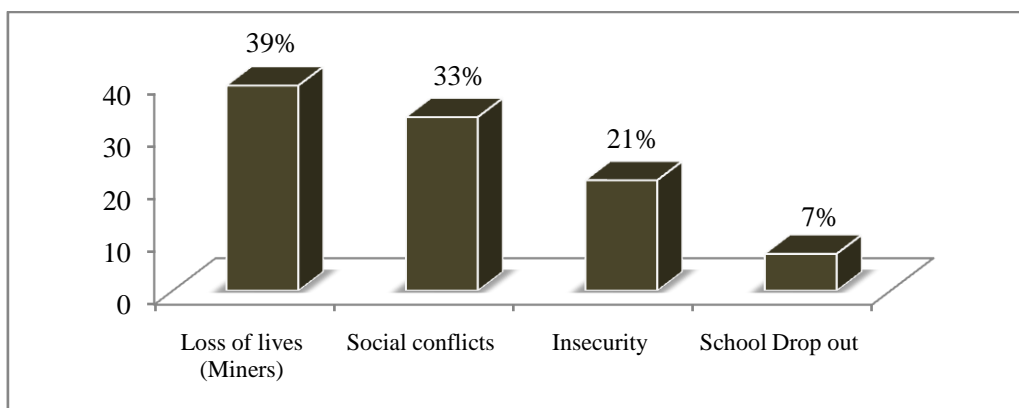

FIGURE 7: Social, economic and environmental impacts of illegal mining
Source: Field Survey, 2020

The perception of respondents as described in the figure 7 about most present social impacts of illegal mining on wellbeing of people indicates that loss of lives occupies the biggest part (39%), this is followed by social conflicts (33%) since the miners fight each other due to the mines they want to accumulate; leading to the several deaths among themselves and around 28% replied the existence of insecurity in the surrounding area and school dropout.

3.3.4   Economic impacts

Normally every activity should provide economic impacts at the end of the day and for this study as it is about illegal mining practices; the analysis is referred to negative impacts on economy.
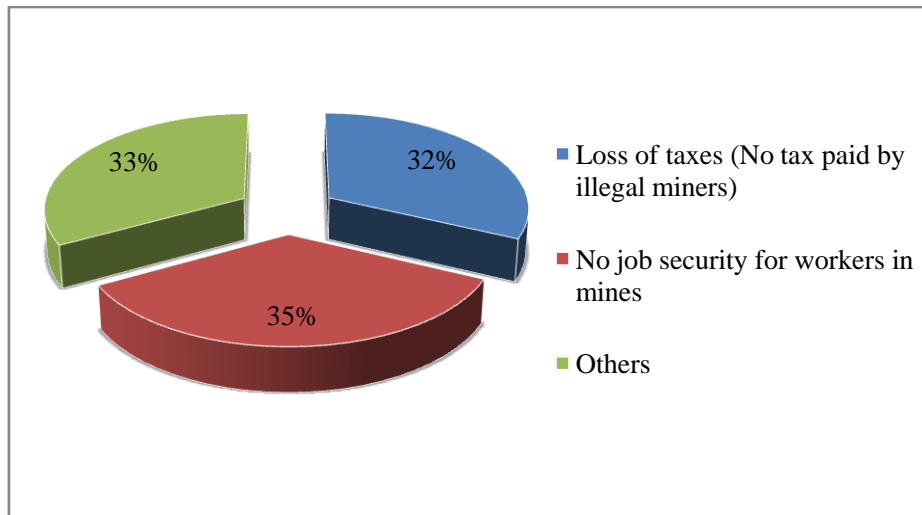

FIGURE 8: Economic impacts of illegal mining
Source: Field Survey, 2020

The results of the study as highlighted by the figure 8 proves that the main negative impact resides on the three impacts with almost equal proportions: Loss of taxes since the illegal miners are not registered as tax payers and this has been confirmed by 32% of the surveyed respondents, 35% confirmed the lack of occupational safety and health during illegal mining while 33% found others impact like careless of their lives and the properties of people living in the surrounding areas.

3.3.5   Environmental impacts

Environmental aspects are elements of an organization's activities, products, or services that can interact with the environment. In this survey the following are the main negatives of miners on environment: Deforestation, Water pollution, Land degradation/soil erosion and some others although they might be many others not related to this study including but not limited to the following: Hazardous waste , Radioactive waste , Mixed waste , Permitted air emissions, Regulated liquid discharges, Storage, use, and transportation of chemicals , Storage, use, and transportation of radioactive materials, Nonrenewable Energy Use/Intensity (Electricity) and Greenhouse gas emissions.
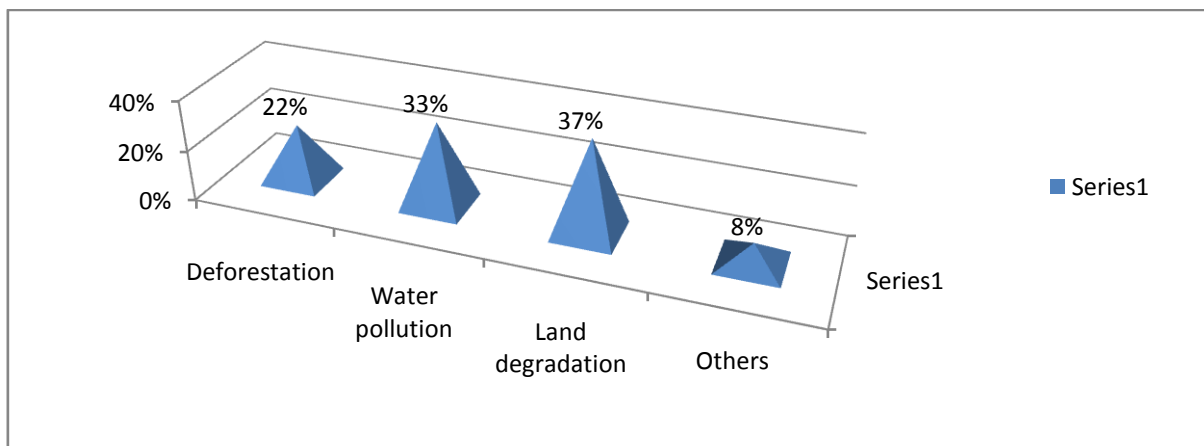

FIGURE 9: Environmental impacts of illegal mining
Source: Field Survey, 2020

The analysis in figure 9 of the data collected among respondents in the surrounding area in which illegal mining took place shows that most and cumbersome problem to resolve locally is land degradation replied by 37% of the surveyed respondents, 33% said the water pollution, 22% make deforestation while only 8% see some other problems.

3.4 Awareness and Reactions of respondents about accident during illegal mining

Hundred percent of respondents have heard the existence of accident during illegal mining through one or more than two of the following channels: verbal communication in the community, radio and social media. Since they are terrible things, most of respondents have had horror reaction.

3.5 Solutions to social, economic and environmental impacts of illegal mining on environment and well-being of people of Huye District, Rwanda

Respondents were asked to show their perceptions on the solutions to social, economic and environmental impacts of illegal mining on environment and wellbeing of people of Huye District; and this is because a lot of negative impacts occurred harming the lives of human being in different ways. However the table below indicates their views.

TABLE 2
DISTRIBUTION OF RESPONDENTS ON SOLUTIONS TO SOCIAL, ECONOMIC AND ENVIRONMENTAL IMPACTS OF ILLEGAL MINING ON ENVIRONMENT AND WELLBEING OF PEOPLE OF HUYE DISTRICT.

Statements	Frequency	Percentage (%)
Public awareness by RMB agents in collaboration with local authorities	98	57.99
Intervention of security organs to prevent illegal mining	21	12.42
Attracting foreign investors by RMB to carry out correctly mining	50	29.59
Total	**169**	**100**

Source: Primary data, 2019

The table 2 indicates the perceptions of the respondents on the solutions to social, economic and environmental impacts of illegal mining on environment and well-being of people. A close look to the table shows that 57.99% of the total respondents agree with the Public awareness by RMB (Rwanda Mine, Petroleum and Gas Board) agents in collaboration with local authorities; and it was followed by 29.59% who said that RMB has to attract foreign investors to carry out correctly mining by respecting the rules and regulations governing mining activities in Rwanda. Additionally, the respondents representing 12.4 % of the total respondents approved the intervention of security organs to prevent illegal mining as a solution to the illegal mining and its associated impacts; this is for capturing and punishing those who carry out illegally mining activities and this will surely prevent all negative impacts that occur due to illegal miners; thereby the living conditions of people living around mining areas will be improved.

3.6 Discussion

The current study was about the impacts of illegal mining on wellbeing of people. More specifically the study intended to (i) identify illegal mining practices in Huye District; (ii) assess the social, economic and environmental impacts of illegal mining on wellbeing of people of Huye District; and (iii) find out solutions to social, economic and environmental impacts of illegal mining on environment and wellbeing of people of Huye District.

About the identification of illegal mining practices in Huye District; the study findings indicate that in-situ as the first mining practice was confirmed by 41% of the total respondents; surface mining was approves by 36%; while underground and placer mining practices were revealed and confirmed by 14% and (9%) of the total surveyed population respectively. A close look to these findings and reviewed literatures, one can note that findings of Oladiji et al (2010) revels four main mining methods of illegal mining such as underground, open surface (pit), placer, and in-situ mining; and according to Albert et al (2015), each mining method has varying degrees of impact on the surrounding landscape and environment.

Concerning to the assessment of social, economic and environmental impacts of illegal mining on wellbeing of people of Huye District, the study depicts the truth. Socially, loss of lives notably of miners was mentioned by (39%) of the total respondents; social conflicts approved by (33%); and insecurity and school dropout were cited and confirmed by 28% of the total respondents. Economically, the study highlighted the loss of taxes to the government due to the fact that illegal miners do not pay tax as confirmed by 32% of the total respondents; lack of occupational safety and health during illegal mining was approved by the 35 % while 33% found others impact like careless of their lives and the properties of people living in the surrounding areas (figure 8). Environmentally, the analysis indicates land degradation replied by 37% of the surveyed respondents; water pollution as approved by (33%); deforestation and other negative impacts of illegal mining were pointed by 22% and 8% respectively. These findings are closely related to that of Abert and Obed (2015) who conducted their study on Environmental Impacts of Mining in Ghana and reported that illegal mineral exploitation contributes significantly to country's GDP, but it is associated with the serious and varying environmental impacts harming to the human lives. Additionally, Joseph (2008) himself through his study on "Environmental and Health Impact of Mining on Surrounding Communities: A Case Study of Anglogold Ashanti in Obuasi" reported that illegal mining leads to the environmental and health impacts to the surrounding communities; notably land degradation, water pollution, air and noise pollution.

IV.   CONCLUSION

Basing to the third research objective aiming to finding out solutions to social, economic and environmental impacts of illegal mining on environment and wellbeing of people of Huye District; the study reveals the Public awareness by RMB (Rwanda Mining Board) agents in collaboration with local authorities was pointed by 57.99% of all respondents intervened in the research process; attracting local and foreign investors to carry out correctly mining was said by 29.59% whereas intervention of security organs to prevent illegal mining was a concern for 12.4 % of the total respondents. For this, Tariro (2013) recommended a high level decision making forum involving all stakeholders to discuss problems of illegal mining and how to limit negative impacts.

An analysis done on the Hypothesis Testing through modeling and regression of coefficients, says that R = 0.809 representing a very high correlation; and the study was immediately said to have model prediction of the existence Economic, Social and Environmental impacts on human wellbeing, thereby adoption of the null hypothesis. Additionally the existence of the correlation was found statistically significant as its p-value is smaller than 0.05. And this is similar to what Tariro (2013) found in his study "Case Studies of Environmental Impacts of Sand Mining and Gravel Extraction for Urban Development in Gaborone; pit sand and gravel are extracted from open areas creating uncovered deep pits, which caused of accidents to children and livestock, erosion and environmental degradation occur due to continuous mining.

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