Impact of volcanic activity on the environment

The research examines the impact of volcanic eruption on the environment and on society. The work aims at exploring four different types of volcanic eruption, the negative and positive impact of volcanic eruption and the health and safety measures during and after volcanic eruption.

A total of thirty questionnaires were sent out to friends, staff and students of Cambridge education group, twenty responded with useful information which has influenced the content of this research. The questions includes, have you ever experienced volcanic eruption in your country, the positive and negative impact of volcanic eruption.

The comment they made within the defined range was critically analysed by the author by making reference to secondary sources . It was found that the eruption in Iceland was a composite volcanic eruption which lead to closure of several airports around the world.

Volcanic eruption has a devastating effect on our society and could lead to loss of lives, income and properties.

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INTRODUCTION

The name volcano has its origin from the word Vulcan, a god of fire in Roman mythology. Most people instantly think that a cone shaped mountain with smooth steep slopes, perhaps with a snow covered peak and a ring of smoke rising skyward. The description is accurate but applies to only one type of volcano which is the stratovolcano. Although there are other types that differ in many ways from stratovolcano, some volcanoes are composed of long,

gentle slopes often covered with fertile soil while some have no vertical structure instead composed of a depression hundreds of yards deep and extending over several miles.

The shape of volcanic structure is clear indication of the type of activity carried on by the volcano . A volcanoes type of activity is also related to the chemical and physical properties of magma produced. Mauro R(2003)

1. 1PRODUCT OF VOLCANISM

Volcanism in Iceland results from divergent plate movement across the Mid-Atlantic Ridge and excessive production of magma in the North Atlantic Mantle plume" Freysteinn (2006)

The product of volcanic eruption are lava, gases and fragmented material such as ash which is derived from molten rock called magma . Magma is a molten matter of silicate composition. Silicon is the main constituent of most minerals and rock in the Earth's crust and also contains dissolved gases which is less dense than solid rock and tends to work it way upwards through fissures . lava is a magma that has erupted at the surface. The term lava applies both to the molten material and to the rock that forms after magma has cooled and hardened. Schminike (2004)

1. 2 BACKGROUND OF STUDY

In the 9th century AD, the Vikings settled in Iceland and established a council that documented its first historical volcanic eruption . The heroic tale was written in the 12th and 13th centuries after a third of the population died from smallpox and in 1783-1784, Laki eruption killed a-fifth of the remaining

population by famine. Iceland gained sovereignty from Denmark in 1981 and completed independence in 1944

Recently, the Eyajallajokull volcano which is known as the iseland-mountain underglacier, situated in the southern Iceland erupted spectacularly on the 14th of April 2010 , after having been dormant for almost 5000years . During this eruption , the subglacial eruption produced a large ash plumes that drifted over Europe and forced an unprecedented closure of airspace in Europe and other countries . The Iceland owe its existence to a large volcanic hot spot sitting on a mid-ocean ridge . The plate boundary between the American and Eurasian tectonic plate crosses Iceland from the south to the north and spreading process can be directly measured and observed on land . Chimu (2010)

1. 3AIMS AND OBJECTIVES

Volcanic eruption in Europe can cause severe damage in localized areas. This can be seen in Iceland, a country prone to volcanic eruption. Volcanic eruption has the ability to irreparably damage plant and animal ecosystems and also human social environments. This report seeks to explore the types of volcano, the positive and negative impact of volcanic eruption.

This report will also show the health and safety measures during and after volcanic eruption.

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2. 0 LITERATURE REVIEW

The Authors below has discussed the phenomenon on the previous volcanic eruption on different locations. This has been incorporated by the author in view of the recent volcanic eruption in Iceland.

According to Grattan et al (1991) historical document from A. D , 1783 demonstrated that volcanic gases emitted in an eruption in Iceland did have a severe effect on both the physical and human environment within Europe.

The Laki volcanic eruption in southern Iceland in 1783, resulted to high release of haze which were felt all over Iceland . The damaging effect led to destruction crops and vegetation, cultivated crops and vegetation were burnt and withered by acid precipitation. Caseldine (2009)

Mount Pinatubo is a volcano that stands 5770 feet, which is located in Philippine along the coordinates 15oN, 1200E. The eruption in Mount Pinatubo on the 15th of July was the second largest most violent volcanic activity in the twentieth century after being dominant for over 500 years . The action led to the release of nearly 20 million tons of pyroclastic debris which actually resulted to the destruction of more than 200, 000 acre of land and also gave rise to major casualties and damage. This includes the death of more than 700 people and destruction of more than 200, 000 homes. Yacove (2003).

In the morning of May 18th , 1980 Mount St Helens erupted a pyroclastic material which constituted a hot pumice and ash. Approximately 400 meter of the mountainside blew outward that morning. About 60 square kilometres

of the neighboring valley was filled with debris. The explosive eruption of Mount St Helens caused the death of over 50 people . Allan (2003)

Kilauea is lacated between the southeast and it is the spot where all active volcanoes in the entire Hawaiian chain occurred, perhaps the world`s most active volcano . Kilauea`s frequent eruption makes the crater a great study site for volcanologists. In Hawaiian tradition Kilauea is also the home of Pele, the Hawaiian volcano goddess. During the nineteenth century the eruption occurred more often and have contributed to the Kilauea`s reputition, both as a geologic site of wonder and as spiritual site of significance to some residents of Hawaii Allan(2003)

The stramboli volcano in Italy is archytype for strambolian activity (carniel and lacop 1996) another feature of this volcano is the presence of continous volcanic tremor (Ripepe and Gorder1991) . About twice a year the volcanic eruption that occurred showed paroxysmal activity that effected tourist visiting the volcano(Jaquet and caniel 2001)

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3. 0 METHODOLOGY

This research has been conducted by the author through the use of primary and secondary sources . Primary data were achieved by survey, interviewing people both verbally and online on the account to the recent volcanic eruption that occurred in Iceland and previous eruption in other countries. A total of thirty questionnaires were issued out to students, tutors, administrators and an expert on the field of structural geology. The

information received were critically analysed and incorporated into the report.

Secondary sources were evaluated from two different research trends which are quantitative and qualitative analysis. These analysis were established by making reference to books from the library, journals, articles and also e-books such as goggle scholar , goggle books were utilised . Data collected from these material were re-examined by comparing, evaluating both information from primary and secondary data

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4. 0 VOLCANISM

The frequency, magnitude and kind of volcanic eruption are likely to change in the future. The earth has been formed about 4. 6billion years ago with consistent occurrence of volcanic eruption. Each year about one-tenth of the active volcanoes on earth erupt. One in every six of the active volcanoes on earth has led to loss of lives and properties as a result of this activity , cities and region has been devastated.

Disastrous volcanic eruptions are characterised by rapid onset of their climatic phase and by a wide variety of eruptive behaviour and effects. High and low temperature particularly mass flows of different types, such as debris, avalenche, pyroclastic flows and debris flows but also including atmospheric transport of ash for hundreds of killometres , during a dynamic eruptions, huge masses of gasses are released into the stratosphere , forming aerosol that globally effect the climate and the ozone layer for

years. Volcano are certain to increase in future the reason are manifold. Schimike(2004)

4. 1. CAUSES OF VOLCANIC ERUPTION

A volcano is composed of three basic elements. A vent through which volcanic material erupt. A conduit which is the passage that allows magama to reach the surface of the earth and a reservoir or magma chamber deep in the earth crust. All volcanic eruption are not alike, some eruption are quiet with lava slowly oozing from a vent . Other eruption are very violent with lava and other materials being injected hundred miles into the air. Gases from within the earth interior mix with huge quantities of dust and ash and rise into the air as a great dark clouds that can be seen from many kilometres away. Some dark coloured lava is thin and runny and tends to flow as well.

Explosive eruption are caused when lava in the vents hardens into rock. Steam and lava build up under the rocks when the pressure of the steam and new lava becomes great, a violent explosion occurs as a result of internal pressure within the rock. Gases and rock shoot up through the opening and spill over or fill the air with lava fragments. A volcanic eruption have been known to knock an entire forest , furthermore an erupting volcano can trigger tsunamis, flashfloods, earthquakes, mudflow and rockfalls. After Floyd (2000)

4. 2 TYPES AND COMPOSITION OF VOLCANOES

There are different kinds of volcanoes which are classified based on the shape of the volcano , the materials they are built of and the way the

volcano erupt . The author will explain four different types of volcano which are grouped as:

1. Strato volcanoes

2. Cinder cones volcanoes

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3. Shield volcanoes (which are also called shields)

4. Lava dome volcanoes

3. 2. 1 strato volcanoes

The stratovolcanoes are also known as a composite volcanoes. Magma moves to the surface from its source miles below the crust and often changes in composition. There are different types of magma which are associated with different types of volcanoes. Basaltic magma, which comes from deep within the mantle undergoes little chemical changes during the process of volcanism. During this process some amount of fluid allows the magma to let-off its gas safely. The resulting landforms are cinder cones and shield volcanoes. In stratovolcano, magma`s chemical composition may change to a more viscous type. The chemical composition will eventually be responsible for the creation of volcanic rocks which are different from basalt. The three most common rock types found in strato volcanoes , with variations in their composition are rhyolite, decite and andesite. Andesite has similar composition to basalt but has more percentage of silica content than basalt , however Rhyolite on the other hand , is more identical in composition

to its parent rock while Decite is the middle in terms of composition. The rock types serve a purpose in composite eruption because it tells geologists the source of magma and the phase of eruption. The composite volcano are composed of virtually all the material a volcano can eject from a vent and the materials discharged piles up to form steeply sloping cone of the volcano. Prisciantelli (2004)

4. 2. 2 CINDER CONE VOLCANOES

Cinder cones are one type of volcano or volcanic landform. They are associated with subsurface contact which amounts to their volatility. Magma on the top of a chamber is loaded with gas during the process of volcanic activity. The pressure from the gases subsequently necessitate to the explosiveness of the eruption while at the bottom of the chamber the pressure is less and magma tends to flow through a break in the cone. Furthermore when gases are thrown in the air during eruption the lava shatters and hardens to small cinders and ash which piles up around the vent. In addition the cinder cones are usually steep-sided and the top of the cone has a bowl shape which are small in size.

The typical behaviour of a cinder cone is an eruption from a vent in the earth, concurrently, cinders are being accumulated to form the cone , followed by a possible break at the base of the cone from which lava flows. The cinder is used for construction and also seperated by snowplows during winter to improve driving on icy roads. Prisiantelli(2004)

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4. 2. 3 SHIELD VOLCANOES

The shield volcanoes are another type of volcanic structure but are much broader than cinder cones, generally covering large areas. Lava constantly flows through the vent and they do not produce cinders, ash like the cinder cone volcanoes. The shield volcanoes are not as explosive and destructive as composite and cinder cone volcanoes . However they are harmful to anyone they come in contact with and also their lava flow covers a wider range of distance . The lava has multiple flows while one is hardening the other tends to begin and run over the top of the initial flow. In this manner, the volcano builds outward into a broad slope, its structure is high and wide and often covers many mile during this activity. The slope is more gradual than that of the composite or cinder cone volcano. Shield volcanoes has a similarity with that of the cinder cones in terms of basalt lava composition. The rock type of the shield volcano is andesite and the fluid flow is different from the basaltic flow. Pisiantelle(2004)

4. 2. 4 LAVA DOMES VOLCANOES

Lava domes volcanoes are less common and are also known as volcanic domes and plug domes which are steep-sided, bulb-shaped mountain that forms when viscous felsic magma and occasionally intermediate magma, is forced toward the surface. When pressure below the chamber is great , the felsic magma tends to move gradually. This is as a result of the sticky magma that are contained in a chamber.

Some cited examples of a lava domes volcanoes was an occurrence in Washington which began in the year 1980 on Mount St. Helens. A number of lava domes were buried in the crater of Mount St. Helens and most of these

were destroyed during subsequent eruptions. Since 1983, Mount St. Helens has been characterised by occasional growth and renewed eruption in 2004. More so in June 1991, a lava dome in japan, the unzen volcanoe collapsed under its own weight which caused debris to flow and also hot ash that killed 43 people during the eruption.

The lava domes eruptions are among the most violent and destructive. In 1992 on Mount Pele on the island of Martinique, viscous magma accumulated at the highest point of the Pele and eventually pressure increased until the side of the mountain blew out with a huge explosion which led to the high discharge of dense cloud of pyroclastic materials and a glowing cloud of dust called the Nuee ardante (glowing cloud in French). The explosion also led to swirling cloud of white-hot ash and gases with an internal temperature of 700 degree celsius that consumed everything in its path. Subsequently, Nuee ardent passed through

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St. Pierre within two or three minutes , followed by a firestone as an ignitable material which burned and exploded. Approximately 28, 000 resident of the city died during this action. According to Wicander (2008)

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5. 0 THE IMPACT OF VOLCANIC ERUPTION (CASE STUDY: ICELAND VOLCANO 2010)

Iceland has a high concentration of active volcanoes due to unique geological conditions. There are about 130 mountains of volcanic origin, 18

of which have erupted since the colonization. A high amount of volcanism is concentrated along the plate boundary , which runs across the island from the southwest to the north west. In the south and southwest regions of the island we find the Hekla, Eldgja and the Laki craters, also the Arafajokull and Snafellsjokull. Eyjafjallojokull is situated to the north of skoger and to the west of Myradalsjokull . Hooper (2010)

Geologist explain the high concentration of volcanic activity in Iceland by a combination of the island position on the mid-atlantic ridge and volcanic hot spot underneath the Eurasian and North American plates. More so Icelandic eruptions are famous for their massive volume of erupted ashes and for vast lava outflows.

The most common type of volcanoes are the composite volcanoes which spread over vast areas of the country and usually arranged in chains. Over the last 500years Iceland`s volcanoes have ejected about one third of the total global lava output , although the Laki volcano in southern Iceland which erupted in 1783 and was classified as the largest erupted lava since the Iceland`s colonization . The most recent volcanic eruption in Iceland began on the 14th of April at the Eyjafjallokull mountain . Geologist explained during the eruption , that the activity of the volcano increased incessantly, spewing a plume of ash which was approximately 5. 3 miles high into the atmosphere. Thousands of flights were cancelled with millions of travel plans affected. During the incidence it was estimated that shutting down the United kingdom`s airspace alone for a week incurred lost of over 100 million pounds. More so business plans and those involved in importation and

exportation of goods were disrupted. The global cost of the disruption, resulted in a loss of billions of pounds. Hooper (2010)

5. 2 PRIMARY ANALYSES

Questionnaire survey detailed in the report will help to influence some of the content of this report, other influences will be interviews both verbally and online. Although it was difficult to draw conclusions from some of the responses particularly the open-ended response.

This investigation was carried out on friends lectures and also on students and staff of the Cambridge education group , between 4th July to 11th July 2010

A total of 30 people were advised to fill in a questionnaire and out of the 30 people , the number of responses from both online and paper questionnaire at the time of this research totalled 20 and out of the people that responded 18% were males while 12%, were females. The age-group of these participants , 27% were under 40 whereas 3% were above 40.

Question 8, on the questionnaire was, have you ever experienced volcanic eruption in your country. A total of 27% partakers said No, while 3% said yes.

Furthermore , question 10 was , do u think that volcanic activity has a negative impact on the economy of a country. 30% of the respondents said yes and there reasons were, it can affect business activities by giving rise to delay on production services and that volcanic eruption may defer tourist and cause a lot of damages to properties , vegetation and livelihood. Smoke haze will cause or necessitate delays both on residents and visitors going for

tourism and other important activities . Most airports might likely to be shut-down during this activity. More so most manufacturing industries that rely on importation and exportation will put a halt on their activities there by affecting income generation and revenue for the government and private sector as a whole.

Question 12 , was about the positive impact of volcanic eruption. 27% of the respondents said that volcanic eruption, only has negative impact whereas 3% out of the respondents who said Yes, provided information within the defined range. The comments they made were that , many years after volcanic eruption it could aid tourism and also produce interesting geographical and historical features. Furthermore, ash which is a product of volcanism enriches the soil when it is being deposited at the surface of the earth. In addition new rocks are formed from magma and can be used for infrastructural development. The analysis is shown on table 2

5. 3 FINDINGS

The preceding chapters focused on the origin , composition and types of volcanoes. More so, on the procedures and analyses of primary data to meet the requirement of the author.

This chapter will analyse further on the negative and positive impact of volcanic eruption on society in relation to primary analyses. This has been achieved through secondary sources.

Depending on the type of eruption and its location, volcanic eruptions has overwhelming effects through a number of displays. The negative impact includes, the high release of haze during eruption , which leads to

destruction of crops and vegetation from acid precipitation. Caseldine(2009).

Pyroclastic resulting from eruption and can cause ample damage depending on the size of the layer deposited. A Thickness which is less than 1mm will act as irritant to lungs and eyes and also lead to closure of airport due to the potential to aircraft and contaminate water within the area. While a layer of ash with thickness between 1-5mm will cause minor damage to buildings and blocking air filters. This can also lead to electricity cuts due to conductivity of wet ash. A layer of ash which is about 5 -10mm will destroy crops and pastures, causing light weight buildings to collapse and also effect rail transport through signal failure. After Gottsamann (2008)

Furthermore, a cited example of the negative impact was the eruption in Laki which is located in southern Iceland in the year 1983 . When lava poured out from a total of 135 newly opened cratars, it was estimated that during this eruption some half billion tons of

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toxic gases was expelled into the atmosphere and killed over 16, 000 people and slughter about 60% of cattle in island. After Gottsamann (2008).

Volcanic eruption deposit materials (ash) on the surface of the earth and after a long period of time due to physical and chemical changes , the ash provides nutrient to the surrounding soil. Volcanic soils are potentially fertile as the ash can contain trace element beneficial to the growth of plant . This can relatively encourage high population and intense agriculture within the

area. Volcanoes are often located in region where there is high agricultural production. Volcanoes, provides strikingly natural beauty which can attract tourist . An example demonstrated is the volcanic eruption which occurred between 1963-1965 in costa rica , called the Irezu volcano. The eruption was reported to be responsible for 4. 3% increase in the number of tourists between 1963-1964 . Indirect economic benefit can also be initiated in response to the indications or threat of imminent volcanic eruption. Further example, was the volcanic activity that took place at Rabaul papua , New Guinea between 1983 and 1985 which led to a number of improvement to infrastructure on that location. This includes advancement of air-strips, road and bridges , water and power supplies , health facilities and communications . However during this growth , food production increased as a number of people cultivated food gardens outside the danger zone. After Gottsamann (2008)

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6. 0 HEALTH AND SAFTY MEASURES DURING AND AFTER VOLCANIC ERUPTION

WHAT TO DO DURING VOCANIC ERUPTION

1. During volcanic eruption, it requires immediate evacuation to a safer location , rock debris , lava flows and ash will make the area around the volcano dangerous to anyone that stays

2. If instructed to evacuate follow the directions of the authorities.

3. Evacuate to an area upwind and higher ground . Flash floods, mud and poisonous gases will accumulate in low lying areas

4. If you are unable to evacuate , seek shelter indoors and make sure all windows and doors are locked to keep ash out .

5. Store all vehicles and equipment inside a garage and leave them, until the eruption has ended.

6. If you must go outdoors use goggle to protect your eyes and use a face mask or hold a damp cloth over your face to aid breathing.

7. Avoid falling volcanic ash , cover your mouth and nose and wear long-sleeves to avoid irritation or burns on the skin.

8. If you are in a vehicle keep the engine switched off. Avoid driving when ash is falling

heavily as driving will stir up more ash that may clog your vehicle`s engine. Bickley (2010)

WHAT TO DO AFTER VOLCANIC ERUPTION

1. Minimise your movement and keep all windows and doors closed.

2. Always ensure the safety of yourself and your family before responding to the needs of

others. Do a headcount to make sure the members of the family are safe and sound.

3. Check for injuries, do not attempt to move seriously injured person unless they are in

immediate danger of death or further injury.

4. Drive slowly and carefully with your lights on.

5. Remove ash from your roof, more than ten centimetres of ash may be enough for your

roof to collapse.

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6. Hose down outside with a little water to dampen the ash . This helps to keep it from

blowing around. Bickley (2010)

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7. 0 CONCLUSION

In the assessement of the impact of volcanic eruption on the society and environment , it was found that volcanic eruption are not alike , some are quiet while some are violent , This action depends on the internal pressure exerted on lava. The pressure necessitates gases and rocks to shot up through a vent and conduit and fill the air with lava fragments. It can be seen that the recent volcanic eruption in Iceland on eyjafjallolojokull province was a composite volcanic eruption which has ejected about one third of the total global lava output over the past 500years . The recent volcanic activity in Iceland occurred within a month and resulted to a loss of billions of pounds around Europe.

The sudden violence of volcanic eruption causes catastrophe and devastation on the environment . This includes destruction of buildings, crops and vegetation. Could also lead to flight and vital activity delayed

The findings also indicate that volcanic eruption has more negative impact on our society and these could affect income generation and revenue for the government and private sector.