

LIGHTNING DISASTER IN NEPAL

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ABSTRACT

Thunderbolt is the big sound of lightening in the sky. It is explained in our religious scripture by saying Bajra or Bajrapat. The word 'Bajra' is a Sanskrit word which means the light of sky or diamond. And the meaning of Bajra is the war compendium. Our villagers believe that when the sky thunders this Bajra takes the place. It is related to an immediate changing of temperature in the clouds. When two opposite direction clouds collide each other's then energy comes out as a shining and the light falls towards the earth with a thunder. When we put cold water on the hot pot, at that time jhwainyasound and energy take the place. Likewise, the process of changing temperature takes the place as the light at lower level of the atmosphere. Thunderbolt is clearly introduced in Bed, Ramayan, Mahabharat scripture before 4000-1200 years ago rather than the research of Benjamin Franklin. Lightning is a natural atmospheric phenomenon. In general, the thunderstorm activity also peaks during the pre-monsoon seasons. It is found that the atmospheric water vapour accumulated from the Bay of Bengal region along with temperature instability orographic lifting which could mainly be responsible for generating thunderstorm activities over Nepal and also the north-eastern part of India during the pre-monsoon period.

INTRODUCTION

When two or more clouds rub with each other then they get charged. If they meet or collide with other clouds having different charges, then a loud sound is produced with the emission of light. In the village, it is named as "Bajra" or Bajrapat. It is not possible to reach the ground level when it occurs at sufficiently high altitude. If the clouds strike or collide with each other at a near distance from the earth's surface then there is maximum chance of lighting. It is a natural phenomenon of atmosphere. In other word, it is the electric current flowing from the sky to the Earth's surface during raining or wind blowing season. In different seasons, when the fast moving winds from opposite directions get collide with each other, then the rain starts to fall with the flow of electric current from cloud to cloud or cloud to the land in the atmosphere. This phenomenon is called lightening. It is a suddenly happening process (adiabatic process). It is an electric explosion. It is a perfect natural disaster among the various disasters. Its sound can be here in all possible directions at a distance of 20 kilometer away from the

source. Since all lightening produce electric currents they all are dangerous. Some types of lighting don't produce sound in the sky. They are called silent lighting.

In another word, it is a type of electric current flowing from the sky to the land during wind blowing and rainy seasons. In different seasons, during the raining time the fast moving winds from opposite direction get collide with each other and the electric current of high voltage flows to the land. This process is introduced as lightening. It is a suddenly happening electric explosion. It is a perfect natural calamity among the various natural calamities. During lightening, the electric current flows from cloud to cloud or cloud to the land its sound can be here up to 20 kilometer away. All lighting produce the electric current with high voltage, they are all dangerous for us. Sometimes we can see lightings in the sky without sound. They are named as hot electricity.

Benjamin Franklin was the first person who had proved that lighting is an atmospheric electric current. In Nepali term it is termed as the "Chatyang".

Although it seems beautiful it is very dangerous activity for human society.

On the basis of science, when two clouds get rubbed with each other, then one cloud becomes positive charged while other cloud becomes negative charged. If two clouds having different charges collide and electric current is produced with the loud sound and flash of light in the atmosphere. Sometimes, two opposite charges developed in a cloud and get collide to produce lightning. If the produce electric current during lightening moves from one cloud to another cloud it is not dangerous for but if it flows from cloud to the land it becomes very dangerous for human beings and living beings. Lightning is a climate-related, highly localized natural phenomenon, where electrical charges generated due to cloud/air movement or dust storms and volcanic eruptions or other turbulent atmospheric conditions get discharged to the earth through a conductive path with

Disastrous direct and indirect effects (Dehn+Söhne 2007; Narasimhan and Bhagavanulu 2007; Tillman and Tillman 2010). Most lightning strokes are generated within the cloud and hence prevention is beyond human control.

Lighting does not occur in all clouds in the atmosphere. In the initial stage of formation of cumulonimbus cloud in the atmosphere, lightening occurs the formation of cumulonimbus cloud is due to the process of the movement of water molecules to the sky by evaporation method. These molecules form a cloud which moves from one place to another due to the presence of air. This movement of the cloud causes the collision and they get charged. There are many layers of clouds in the atmosphere. When a layer of a cloud moves on the surface of another layer they get charged. The water in different layers has different temperature. If the cloud has large amount of water, the layer of the cloud becomes thick. This thick and dense layer of the cloud is called Kapsi rain cloud (cumulonimbus cloud). Since it is very thick and dense light coming from the sun can not to enter this type of clouds so it appears black. Therefore, it is also known as "black cloud" when the black cloud appears in the sky the possibility of raining with lighting is maximum.

METHODOLOGY

Both quantitative and qualitative approaches based on social-science research methodology are used in this study. The data source used in this study was from the National Lightning Hazards Database, Minister of Home Affairs Nepal, (MoHA), National

Emergency Operation Center which includes lightning-related reports from 77 districts in Nepal. Similarly, key documents and reports (published and unpublished) on magazines and Journal and disaster related offices were obtained from relevant ministries and departments. This was complemented by open access online documents retrieved mostly from the worldwide web.

ATMOSPHERIC PROCESSES

Generally, the cloud is at a height about 10 kilometer from earth's surface. On the upper part of cumulonimbus cloud, ice, snow, hail and hard solid matters are present while the lower part contains large drops of water. Due to various activities in the atmosphere the solid matters fall down while water drops goes up as vapors. At the time rising water vapors cooling slowly and formation of cloud, there is friction and collision between the liquid and solid water particles. Due to the friction between them, charges are developed there. There are different layer of cloud in the sky, each layer of cloud have different temperature, so water particles are in different temperature. While, there are maximum amount of water vapors in the cloud, layer of cloud is going thick and dense. This type of thick, condensed and fleshy layer of clouds are called cumulonimbus cloud. There is no enter and can't to pass through the sun rays in cumulonimbus clouds. As a result the atmospheric environment is made gloomy and darkness, so it is also called black cloud. The cumulonimbus is the thunderstorm cloud. This latter cloud has a flat top, called an anvil head, as well as a relatively flat base, and it becomes darker as it grows higher and thicker and thus blocks the incoming sunlight. Lightening causes more destruction at the time of having raining and fast wind blowing. The process of fast heating and fast cooling of the land causes adiabatic Heating and Cooling of the clouds in the sky. These rising and falling parcels of air or movement of clouds help to rub and collide between them. As a result, lighting occurs by flowing the electric current to the land. During each lighting, electric current flows to and fro about 5 times in between the land and the sky. The cumulonimbus is the source of many atmospheric concerns including high-speed winds, torrential rain, flash flooding, thunder, lightning, hail, and possibly tornadoes.

According to the researchers and scientist concerned with lighting, the number of accidents related to the lighting goes on increasing with the global warming and climate change. The cumulonimbus cloud is situated at a height above the range from 6

kilometer to 10 kilometer from the Earth's surface. Sometimes this cloud lowers at height range 2kilometer to 3 kilometer. At that time, the distance between the cloud and the land is shorter. That is why, there is more chances of lighting on the land. Generally, the cumulonimbus cloud is spread at a more height along a line and the lighting occurs inside the cloud. This lightening cannot reach the land.

How does lightning occur? The process of fast increasing and fast decreasing of temperature on the lower surface of the atmosphere causes the movement of clouds at the lower surface. This moment causes the friction and collision between two or more clouds, as a result the lighting occurs.

There are many layers inside the black clouds (cumulonimbus cloud). The difference of temperature between two layers is large. So, they move with different velocities. Due to this process, there is vertical wind blowing inside the cloud. This moment causes the friction between different layers. As a result, positive and negative charges are developed there. Initially, there is lighting inside the cloud at the upper part in the sky. This type of lighting is named as intra cloud lighting. It does not destroy the human beings and living beings on the land. When the moving wind inside the clouds lowers to the land, then it becomes stream of wind which called storms. If lighting occurs in the sky, the temperature of the atmosphere increases and the atmosphere gets heated. As a result, the volume of the atmosphere gets increased. In this moment, a loud sound is produced, called thunder. It is necessary to understand that the lighting and thundering take place at the same time in the sky. When the lighting and thundering take place rapidly in the sky, the wind blows very fast on the land, then there is maximum possibility of lighting on the land which causes the extreme destruction. At that time, rain starts to fall and the wind produced from clouds blows on the land. Simultaneously, and electric current produced during lighting comes to the land. So, there is maximum chance to hit the wet person by lightening during the raining time.

In hilly regions of Nepal, there is maximum chance of lighting. It causes more loss of human lives and destruction of physical properties. Since the cumulonimbus cloud is near distance from the land lightening frequently takes place in these regions. It is necessary to understand that lighting equally takes place in plain region too. It occurs according to the situated land structure. In the plain region there is more

probability of lighting where the surface of the land and the atmosphere are heated simultaneously. In Nepal, positive type of lighting occurs, which causes a great loss of health and wealth due to the large flow of electric current

The Eastern part of Nepal is situated near from the Bay of Bengal. Around the Bay of Bengal, there is a great moment and change of atmospheric clouds. This causes the more chances of lightening in the Eastern part. During the pre-monsoon season there is maximum destruction from the lighting in that region. Since the temperature of the Bay of Bengal and that of atmosphere near it increases simultaneously in the raining season, there is also great chances of lightening according to the concerned specialists.

The number of accidents or events related to the lightening goes on increasing with the starting point of summer season (hot months). It is also found that the number of accidents or events related to the lighting goes on decreasing with starting point of winter season (cold months). In Nepal, the places having maximum chances of lighting are Jhapa, Pokhara, and around the Narayani river. After then, Makwanpur, Nawalparasi, Dhading and Mahabharata regions are also facing the more events of lighting.

How to get protected from lighting?

The modern science have not yet invented the instruments to predict the lightening. But different possibilities and scientific reasons of lightening has been discovered. To protect ourselves from lighting, the current flowing from atmosphere to the land should be diverted toward the land. The tall houses, Telecom tower, electricity poles should be connected with good conductor and the positive charge and negative charge (*Electrical earthing*). The process of transferring the immediate discharge of the electrical energy directly to the earth by the help of the low **resistance wire** is known as the electrical earthing. The electrical earthing is done by connecting the non-current carrying part of the equipment or neutral of supply system to the ground.

Human lives can be saved from dangers of electrical accident by earthing. Proper earthing provides an alternative and easy path for leakage or faulty current to flow. It ensures that any exposed conductive part of the appliance does not reach a dangerous level of potential or voltage that endangers the user's life. Earthing system is also known as grounding system. It is done in order to ensure safety by connecting an electrical installation with Earth's conductive surface. Earthing helps by providing an alternative path for the current to flow so that electric shocks can be avoided. Mostly, the galvanized iron is used for the earthing. **The earthing provides the simple path to the leakage current.** The short-circuit current of the equipment passes to the earth which has zero potential. Thus, protects the system and equipment from damage.

The electrical system earthings are of two types. They are neutral earthing and Equipment Earthing system. The neutral earthing system is directly connected to earth by the help of the GI wire. It is also called the system earthing. Such type of earthing is mostly provided to the system which has star winding. For example, the neutral earthing is provided in the generator, transformer, motor etc. Equipment Earthing is provided to the electrical equipment. The non-current carrying part of the equipment like their metallic frame is connected to the earth by the help of the conducting wire. If any fault occurs in the apparatus, the short-circuit current to pass the earth by the help of wire. Thus, protect the system from damage. Earthing is essential because of these reasons: The earthing protects the personnel from the short-circuit current. The earthing provides the easiest path to the flow of short-circuit current even after the failure of the insulation. The earthing protects the apparatus and personnel from the high voltage surges and lightning discharge.

During the 1960s distribution of population in Nepal was very sparse. Population concentrated in Hilly region than Tarai. During that time Protection from thunderbolt was followed our Vedic and Indigenous knowledge. Our ancestor, local and local traditional medicine practitioner (Vaidhya), local pedantic and priests was launched awareness programmed. Vedic knowledge and experiences were strictly followed to safe and protection from thunderbolt. Our forebear and progenitor informed new generations, there is danger to build house along the forests, top of the hill and mountains, near these tree Bar (*Ficus bengalensis*), Peepal (*Ficus religiosa*), Sammi

(*Ficus rumphi*) and other different tall trees. During the 1970s and 1980s the population of Nepal is growing rapidly than our settlement pattern is going uncontrolled in Himalayan, Hilly and Tarai ecological Belt and houses are building haphazardly. We forget our protective indigenous intellectual knowledge. As a result, in present perspective lightning is being natural disaster. There is necessary to safe thunderbolt and risk reduction measures and techniques for atmospheric electricity, we should launched awareness programme within family to family, village to village, every local level government and national level. Thunderbolt is common during pre monsoon and monsoon seasons. This season whenever black lump of cloud seen in the sky, thunder noise after a lighting flash everybody stay within the home. Similarly where is frequently a flash of lightning with a simultaneous crash of thunder there is no allow to go to forest and near tall tree, during the grass and firewood collection everybody escape from forest, Herdsman, goat man and cowboy are grazing their beasts in Jungle they are immediate to run away from the forest area. We follow above Prevention remedies we will safe from risk of lightning. On the other hand, there is different way of life in urban and rural market centers. The people of these places have strictly to prevent for use electrical household equipment during the fuggy black cloud atmospheric condition. During the lightning flash in the sky do not bath in the electrical geezer, similarly whole door and windows are to be shutdown in the thundering. If we, follow above heedful activities, we safe surely our life and wealth from thunderbolt.

Every year twenty four thousand people died from thunderbolt. There is majority of all lightning is negatively charged in the world. Near about 95% negatively charged lightning events happened worldwide. These charged are no harmful. Remaining 5% of positively charged lightning strikes on the grounds that are more lethal. Those types of thunderbolts which have positive charged strike on the ground there is great loss and damage in the social environment. Positively charged lightning strikes are more lethal, fatal and destructive. The atmospheric environment of Nepalese territory, where originated 34 % positively charged, cloud strikes to the ground. So Nepal is high risk zone during the pre monsoon and monsoon seasons. Thunderbolt is climatic risk and is unexpected crisis. Other types of natural disasters like floods, landslides, soil erosion and firing, there is a lot of loss of people and wealth. On the other hand one thunderbolt events has a single digit people loss and

injured. To compare other natural disaster, Single lightning event kill only 2-3 person, therefore it remain in shadow. Lightning related undesirable and harmful events, obstruction, and trouble are happen on solitary place and remote area of the human settlement, high hill, sparsely populated high mountain area. As a result there is no accesses event information to related government office in the past. Mass Medias were also ignorant. This situation is still experienced in Hilly and Himalayan Hamlets of Nepal. Consequently, loss of lightning events has commonatmospheric disasters. Present Federal Democratic Republic of Nepal(Central or Federal Government, Provincial Governments and Local Governments) has no given high priority such kinds of regular natural disaster. Lightning events seems in somewhere in premonsoon time in the country but it is regular disaster event from June to September. If we calculated the annual events of thunderbolt in Nepal this becomes a major natural disaster. According to record of Ministry of Home Affairs Nepal every year killed 150 people by lightning accidents. Similarly every year 226 peoples are injured by thunderbolt. Therefore Federal governments of Nepal make team of weather experts in National levelthen locate the spatial distribution risk area of lightningin the map. The risk places are well introduced for the local people. The risk places of the country there should be fitting the modern

equipments and every household has managed safety tools and training from this event. Likewise, beginning of the pre monsoon and monsoon we should prepared the thunderbolt risk area map of the event affected places. These places are publicity by leaflets and pamphlets, and broadcasting in the Mass Media. Above mention work for awareness are launched every related local level government we definitely reduction human lives and damage of physical properties from thunderbolt. It is a great challenge to our country to protect thousands of human lives casualties and destruction of physical properties worth millions of rupees from frequent thunderbolt disasters.

Thunderbolt is climate related natural disaster. It is a major disaster and destructive events of Nepal. The meteorologists can predicate accurate placeabout storms but scientists and modern technologies are being unsuccessful to real and correct forecasting where have been happened thunderbolts. Scientists are able to locate the only probable place. Therefore major prevention is stay within home in heavy torrential raining time during pre monsoon and monsoon seasons. If somebody are in working places, grazing animals in the forest, firewood collection, during the time there is probabilitystorm raining everybody should go to secure places.

Lightning-related fatality, and injury in Nepal			
S.no	Year	Fatalities	Injuries
1	2011	103	293
2	2012	131	232
3	2013	111	198
4	2014	128	161
5	2015	80	148
6	2016	115	279
7	2017	105	284
8	2018	127	289
9	2019	89	157
	Total	1034	2041

Source: Minister of Home Affairs Nepal, 2019

Lightning kills more people than flood and landslide in Nepal. Lightning continues to be one of the deadliest disasters in the country. In recent years there are increasing trend fatalities from thunderbolt in Nepal. It may be due to the climate change or increasing population. Still, lightning incidents do not get the required attention because they do not kill a large number of people at one time. The nine years data

2011 to 2019(2068- 2076 B.S.) has recorded 1034 death of human life due to thunder strikes. Similarly 2041 people are injuries. Lightning is one of the severe hazards to people and infrastructure in the world. Hundreds of casualties and millions of dollars in damage to buildings, power lines, electrical systems are caused by lightning every year. A worldwide of 24,000 deaths and 240,000 injuries from lightning per year was

estimated (Holle and Lopez 2003). Lightning is near the top of the list of all types of weather-related deaths in Nepal. There is an urgent need for reorientation of perceptions on disaster insurance and government funding and it is hoped that lightning and its victims receive due attention and mitigating relief from the governments.

CONCLUSION

Lightning is a common meteorological hazard in Nepal that leads to fatalities, injures and large amount of economic losses. Based on the Minister of Home Affairs Nepal, National Lightning Hazards Database, lightning-related fatalities, injures, casualties and damage reports from 2011 to 2019 were summarized. Nepal's topography, and the proximity of eastern mountains to moisture from the Bay of Bengal, makes the country more prone to thunderstorms. The other reasons for the country's high fatality rate are that lightning from storm clouds travels much shorter distances to reach the ground in the high mountains. Nepal is also the most densely populated mountainous country in the world. Lack of knowledge, lack of awareness, unsafe building structures are the main causes of fatalities. We want to focus on policies that require the public to take lightning into consideration before building new structures. In other words, We should install earthing systems or lightning protection systems at least in the public buildings like hospitals, schools, waiting lounges or places where large number of people gather. Our settlements are scattered which makes it difficult for installing a big lightning arrester tower which would connect all the houses nearby with wires. Individual houses cannot install such arresters on their own. According to scientists of Nepal arresters can be designed in the country at a cheaper price. Till then, adopting precaution measures is the only option to stay safe. Rugged and fragile geophysical structure, very high relief, high angle of slopes, variable climatic conditions, unplanned settlement, poor economic condition and low literacy rate have made Nepal vulnerable to lightning disasters. Hailstorm causes heavy losses of agricultural crops though human life loss is seldom. Windstorm and thunderbolt causes the loss of human life as well as physical property.

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