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CLOUD SEEDING AND ITS EFFECTS IN THE ECOSYSTEM STRUCTURE

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Abstract
Clouding seeding has been a subject of debate among people of all cultures and all endeavors, but for scientists, this is not an issue of debate though the problem still remains on why the scientists cannot make or scientifically produce rainfall from the clouds during the dry season in all areas or even hold back falling of snow in most places, but only during the raining season they can make the rain to fall. Rainmakers from different cultures again sometimes are able to retain or disperse rainfall from clouds which are intending to fall as they claim. Some other times they claim that they are able to make the rain to fall either heavily or sparsely through their ritual processes which are mostly known to them. And these have been practiced from ages to ages as we can see or take a clue from scripture where some known prophets were able to shut down heaven and there was no rainfall for years. This write-up tried to investigate the effects and implications of cloud seeding or artificial rainfall in our environment. Having known that the rainfall from cloud seeding is not natural but forced rain this implies that the normal natural process was not followed by nature itself thereby disrupting the atmospheric and ecosystem structure. From the findings of the research carried out through observation and gathering of primary sources, it is known that the ecosystem is grossly abused continually and on daily basis especially the biosphere. Though there are some advantages in the cloud seeding but its disadvantages outweigh the gains of the cloud seeding.
Keywords: Cloud seeding, Environment, Ecosystem, Rainmakers, Culture

Introduction

There are various opinions concerning the cloud seeding both from scientists and non scientists as regards to the view, whether it is possible or a mere fiction that rainfall can be produced artificially from atmosphere by introduction of certain elements or through other means. Cloud seeding has been described and seen to be possible by different scholars and scientists but questioned from many angles on how it takes place and being only produced mostly during the raining season, while it is a bit too hard to hold back the falling of snow from atmosphere.

Generally, cloud seeding is not new in many communities or societies of the world, while to some societies it is new in the sense that it is not possible to manipulate the cloud to produce rain. In Africa it is seen as normal or a gift from the gods, while some oppose the rain-making as not possible. The aim of the write-up is to investigate the different propositions as given by some scientists and some cultural beliefs that claimed that cloud seeding is possible against those who claimed its impossibility. Above all to see its positive or negative effects or impacts on the climatic change that is going on the world today.

In a nut-shell cloud seeding according to Chauhan (2013) is a deliberate attempt or deliberate introduction into the clouds of various substances that act as a condensation nuclei or ice nuclei in an attempt to induce precipitation for various purposes. However, the practice has been questioned by some meteorologists and atmospheric scientists concerning its effectiveness. According to Chauhan the first experiment with cloud seeding was conducted in 1946 by American chemist and meteorologist Vincent Schaefer. The cloud seeding has been done or performed through or with the use of aircraft, rockets, cannons, and ground generators with substances like solid carbon dioxide (dry ice), silver iodide at temperatures below freezing points. In clouds, at temperature above the freezing points calcium chloride particles provide the condensation nuclei around which raindrops form.

Cloud seeding can be seen as a way of improving our activities in the world but the question is, has it any implication on the surface of the earth or in the atmosphere or with regard to living organisms on earth? Again in cloud seeding is it possible during the dry season and can the atmosphere retain rainfall if it has reached its saturation point? This is important because many believe in the art or process of holding back raindrops in the atmosphere from reaching the earth surface by spreading the saturated cloud with wind being generated through any means, while some do not believe its possibility (Kanu 2021). A glance through the scripture can also show its stand or belief on cloud seeding. The prophet Elijah we read of in the 17th chapter of First Kings, when he came before the king and said "as the Lord God of Israel liveth, before whom I stand, there shall not be dew nor rain these years, but according to my word". Again in the letter of saint James (5: 17), he confirmed the above shutting of the sky for Elijah prayed earnestly for it not to rain, and no rain fail for three and a half years. Then he prayed again and the sky gave rain and the earth gave crops.

According to Ezeani and Onyiloha (2016) the mother earth has been declared to be ill as a result of manipulation of atmosphere, which includes global warming,

dirty air, cloud seeding, toxic wastes and these make the environment to be unsafe for living things on earth. This paper seeks to describe and explore the effects of the cloud seeding from different points of view especially from scientific, cultural and s0cial perspectives. Again to view its possible threats towards the environment in general and climatic change taking place today.

Cloud Seeding and its Formation

In many countries or places of the world, the rainfall is being experienced almost throughout the year, while in some it sparsely rains which necessitated production of artificial rainfall or cloud seeding. Rain is essential for life of living things on earth without which the environment and its living organisms cannot survive. Again water cycle plays a very important role in the formation of rainfall where by water moves from the river and streams all the way up to the sky forms a cloud there and then comes back as rainfall. Without this water cycle or hydrological cycle, it will or may not be possible for environmental lives. So water cycle according to Toppr (2021):

> … begins at sea, where water is warmed by the sun. This causes the evaporation of seawater. Thus seawater turns to water vapor and the steam. This vapor rises as hot air tend to be light. With the height, water vapor becomes cooler. This cooling causes the water vapor to condense as it cannot store water droplets. When the vapor condenses, clouds are formed. This cloud receives more and more vapor until it cannot store any more. After saturation of the cloud, precipitation starts. Based on the temperature, precipitation has many forms. Thus it can include rain, hailstones, sleet or snow. The rain flows into rivers and streams bringing down the water back to the sea where the cycle begins again. (p. 5).

The formation of rainfall has been from natural process through the increase or decrease of atmospheric temperature. Hence we have different forms or types of rainfall or precipitations. Many scholars enumerated different kinds of rainfall but Byju's (2021) enumerated three types of rainfall based on its origin, conventional rainfall, orographic or relief rainfall and cyclonic or frontal rainfall. Again types of rainfall based on intensity include light rain, moderate rain, and heavy rain. According to Toppr (2021) relief rainfall is common in places with mountain and sea. It is made of moisture-laden wind which blows from the sea up to the high mountain and it is cooled at the height of the mountain and cloud is formed. The saturated cloud at the windward side of the mountain with water vapor begins to precipitate on the side of the mountain. Sometimes most people

regard it as mountainous rainfall. It rains very little at leeward side because the cloud has lost most of its moisture.

Conventional rainfall occurs frequently on hot days usually giving cumulus cloud and thundery showers. This happens when the sky will suddenly get darker with grey cloud. Without any warning the heavens open and it begins to rain. But before this the sun must have heat the ground which causes the air to warm and become very hot. Then the air rises upwards and becomes cool. Then it condenses to form cumulus cloud. Frontal rainfall according to Toppr (2021) occurs when a warm, tropical air mass comes in contact with a cold, polar air mass. Here the air is in the warm front then it rises over the cold front. The air is automatically cooled and condenses to form a stratus cloud and when saturated it begins to precipitate. This is in a nutshell a formation of natural rainfall as observed by most scientists (Kanu 2021).

Beyond these types of rainfall which is natural process of showering or water cycle on the surface of the earth, cloud seeding is more of artificial or induced rainfall in a particular place and for particular purposes. Cloud seeding according to Pelley (2016) is a weather modification technique that improves a cloud's ability to produce rain or snow by artificially adding condensation nuclei to the atmosphere, providing a base for snowflakes or raindrops to form. Put in another form cloud seeding is type of weather modification that aims to change the amount of or type of precipitation that falls from clouds by introducing some substances into the air that serves as cloud condensation which alter the microphysical processes within the cloud. Though its effectiveness according to Pelley is debated but the usual objective is to increase precipitation either for its own sake or to prevent rainfall from occurring in days or hours. Hill and Ming (2012) stressed that the most common chemical used for cloud seeding may include silver iodide, potassium iodide and solid carbon dioxide. Researches going on also include table salt as becoming popular. This may be dispersed by aircraft or dispersion devices. As of today there are many other ways through which cloud seeding can be done which include electric charges emission instruments, infrared laser pulses and so on.

Cloud Seeding in African Culture

Rainmaking is not a new phenomenon in African traditional culture or religion, various communities in Africa have two, three or at least one rainmaker living among them and they are called by various names depending on the communities. As of today, many believed that rainmaking ritual or process is part and parcel of Africa's ancient wisdom or religion because rainmakers are

taken as one of the custodians of the African society. In all, it is always difficult to divulge the act or process involved in rainmaking among the Africans. And this has made it impossible either to improve on it or maintain the process for future use and even put in a scientific way. According to Onuigbo (2009) the act of rainmaking is a special kind of gift to cause, control or make rain not to fall. These rainmakers are called various names like in Sudan they are called keepers of rain and those who pray rain in Uganda they are called askers of rain and those who cause rain to fall in Kenya are called the seers or watchers of rain or followers of rain, in South Africa the Lovedu queen is renowned as the greatest rainmaker.

In Africa God is referred to as the Rain-Giver or Giver of Water though people assume that they are rainmaker, hence people know that rain comes from the sky and not people make rain. Some assume that rainmakers only pray to God while others insist that it is through the process of some rituals being performed. According to Onuigbo (2009) the rainmakers' duty is to ask for rain from God. They do not make rain they only pray for it, perform rituals for it and as far as possible tell people when it will rain, this means that they look to God to produce rain. Mbiti (1969) buttressed the above view that in many parts of Africa it is reported that both people and rainmakers know for certain that only God can make or produce rain. Therefore, rainmakers play the role of intermediaries among the people.

The actual process of precipitation or rainmaking in African culture is through rituals or other ceremonies accompanying rainmaking which is community affair sometimes. Mbiti (1969) affirmed that:

> Part of the rainmaking rite involves bringing a skin full of water to the rainmaker, which he drinks publicly. The rainmakers among the Udhuk nearby perform complicated rituals using red, white, and blue rainstones. Formerly the Akamba used to bury a child alive, as part of the ceremony or sacrifice for rain when severe droughts struck the country. Katab rainmakers address their prayers directly to God, but if rain comes they offer thanks to their most remote forefathers. (pp. 179-180).

Beyond the above method of ritual or ceremonies of rainmaking, there are other methods of rainmaking; Parrinder (1962) confirmed that:

> Many methods of producing rain are tried, but most of them are based on the principle of similarity, that is to say that they perform

> some action like rain, in the hope that the elements will imitate it. Green branches are burnt, in order to produce great dark clouds which, it is hoped, will attract the rain clouds. Or the rain-maker crouches under a blanket over a fire, and his running sweat symbolizes the coming rain. Or the rain-maker fills his mouth with the water, and squirts it into the air, with the object of inducing the rain to fall in like manner; like Elijah pouring out the water. A European writer in Togoland says that going on trek at the beginning of the rain season, he took with him a boy who was supposed to have the virtue of stopping the rain falling. This power depended on the boy never washing. All went well and the weather was dry until the last day, when the boy got so hot and dirty that he took a bath, and immediately the rain fall. This was an application of the principle that like attracts like, water attracts rain. (pp. 88).

This somehow proves that the process of rainmaking in African traditional culture is an art and at the same time a hereditary phenomenon, in the sense that in some societies, the knowledge and the powers of rainmaking are handed down from one generation to his/her near relatives. But ultimately God is the Giver of water as we noted earlier. Not only men are rainmakers, women are also rainmakers as we have stated earlier about the rain-queen of Luvedu of South Africa.

It is worthy of note that Mbiti (1962) included the use of some objects in the art of rainmaking in African traditional religion. He states that:

> The actual practice of the rainmaker involves the use of sacred objects especially 'rain-stones' some of which are rare and others are believed to have fallen from the sky. Burning of rain-leaves or other combustibles is another method, whereby the smoke from them is thought to 'capture' the rain from the sky and bring it down. Other rites involve the use of water in various ways, such as ceremonial sprinkling of water on the crowds or at the place of the rainmaking ceremony, drawing water from special or sacred wells, or collecting perspiration and spraying it in the air. (pp. 181).

Above all, no one has ever tried to make the rain to fall during the peak of the dry season, this shows that those in the art of rainmaking are well versed in reading or monitoring of weather conditions, and may spend long periods acquiring their knowledge. According to Mbiti the rainmakers obtain this knowledge from rainmakers, observing the sky, from studying the habits of

trees, insects, and animals from common sense. Finally, rain is regarded by Africans as a sacred phenomenon, for it is explicit expression of the goodness and providence of God. It is seen as the eternal and mystical link between past, present and future generations. This explains the reason why most Africans observe days of rest to mark the start of the rain season and greet the season again with ceremonies of thanksgiving and prayers for fruitful planting and harvest of crops. Bahlsen (2014) also commented that water (rainfall) is important on earth without which there will be no life, this explains why it is being worshipped and regarded as sacred in most of the African communities. Bahlsen commented on importance of water, of which there will be no life on earth if there is no water on earth. Going further he reiterates that:

> There is no life as we know it on earth without water. Astronauts may explore the moon and other stars of the universe looking for life, or traces of life, or the possibility of living there, but are set to fail- unless there is water, or traces of water.... Yet, there is a real danger if we ignore the natural force to which we owe our lives, and the lessons from natural disasters including floods, draughts, pollution of air and water, scarcity of food and water, and climate change are real. The people who worship the water goddess are deeply aware of the precariousness of the pre-condition of life, and many of their age-old survival strategies are valuable and worth learning from…while the people are keenly aware of the local bodies of water as economic assets, their culture also respects these waters as sacred and observes the water's own rules, rather than attempting to dominate it. (pp 147-148).

Beyond this, the economic aspects of water (rainfall) is well known and its other benefits hence it is being honored, worshipped and regarded as sacred among the African communities. This also explains why some communities preserve and take care of their lakes, rivers and entire water environment. Some regarded these waters as divinities due to spiritual function attached to them.

Environmental Implications of Cloud Seeding

Clouding seeding if we recall involves artificial way of getting rainfall or stopping of it, on the surface of the earth through the introduction of certain chemicals or substances to the atmosphere scientifically or through rituals or rites as the case may be. Nature is always tampered with, in the course of human

activities either it improves it or it degrades its nature. The fight against the environmental destruction does not seem to yield reasonable positive results. The desire to explore the resources of the earth continues to go on uncontrollably and this keeps creating more troubles or problems to the environment. Though Ezeani and Onyiloha (2016) maintained that care of the environment has been a major social, political and ethical issue because of environmental pollution, again because of wastages and the threat to human lives and other living things on the surface of the earth. Concerning the climate changes taking place in different form, it is believed that it is what the humans give to the environment is what they get back from it. This means that actions of human beings cause environmental changes and environmental changes cause changes in human life and behavior.

Clouding seeding is really a harmful process to the nature (living things) or human environment, when one considers the force being applied to get the rainfall or stop the already condensed precipitation which is about to fall back to earth. This process has its serious adverse effect which may not be known immediately but it keeps building up its effects waiting to unleash its effects. Cloud seeding is believed to be causing reduction in the contents of atmospheric make-up. According to Eugene (2005) the atmosphere is known to be the life blanket of the earth, the essential ingredient for all living things. It extends 500kms above the surface of the earth and is composed of many gases. It is this atmosphere that provides air in order to support life, protects the earth from the radiation from the sun and regulates the climatic conditions on earth. The atmosphere is mainly composed of Nitrogen (78.09%) and Oxygen (20.95%). Again Chuka (2019) listed five layers of the atmosphere which include troposphere which contains 80% of the atmospheric mass and water vapour, the stratosphere, which contains the ozone layer, the mesosphere, the ionosphere and the exosphere. These layers and gases are destroyed in the course of introducing substances to form rain or stop it from reaching the earth. Hence we hear of intense radiation in some parts of the world.

Today, the whole world is suffering from dreaded pandemic corona-virus disease (covid-19) which is an infectious disease being caused by the SARS-CoV-2 virus. In most countries of the world, many deaths were recorded while some recorded few deaths. These deaths can be explained from the fact that there is reduction in the atmospheric ingredients in many parts of world which are meant to absorb certain dangerous gases leaked in the air. In Africa the effects of corona-virus disease is very slow unlike in the first world countries where great

number of deaths are recorded. This can be attributed according to some scholars mainly from the effects of climatic changes taking place mainly in the more industrial parts of the world.

In some parts of Africa, there are instances or times when the dry season and rainy season are not taking place when it ought to take place, this is due to climatic changes taking place because of environmental changes by the action of man in the environment. Clouding seeding may be one of the causes of the variations in the seasonal changes which are being experienced from time to time in the environment. This always amounts to low production during the harvesting of crops, apart from low harvest being experienced, many animals tend to be dying because bad weather conditions. This also explains the reason why there is migration of cattle herders or animal from place to place because of bad weather. Infact it affects farmers greatly in their outputs of various crops. On the other hand, cloud seeding helps to provide rainfall where and when it is needed for crops and animals. It ensures the survival of organisms and other activities.

Cloud seeding contributes majorly to the climate change going on in the world today. The climate change according to Chuka (2019) refers to the synthesis of weather in a given place over a period of at least 30 years. It involves the permanent departure of climate patterns from mean values of observed climate indices. The variations range from the periods of extreme minimum temperatures to periods of high temperatures. Many scholars note that this is caused by increase in population and corresponding increase in human economic activities with their consequent impacts on the environment. Cloud seeding generally reduces the constituent elements of weather which include the temperature, humidity, clouds, mist, and so on.

The cloud seeding leads to unwanted ecological changes as we have seen before, like ozone depletion, continued ocean acidification, erratic changes in rainfall patterns and so on. The cloud seeding again requires the use of potentially dangerous substances, when these substances like solid carbon dioxide or silver iodide into the sky, these elements tend to be part of the environment which will later become harmful to human being and other living things. Most of the times, the effectiveness of this process is not assured, this again will be waste of time and creation of environmental hazards. The ozone layer acts as the world's sun glasses protecting all living organisms from the sun's ultraviolet radiation. Chukka (2019) asserts that it is worrisome to notice that the ozone layer has been

found to be depleting and leaking. Cloud seeding plays great role in this ozone depletion which harms the animal and plants on daily basis.

The cloud seeding by its nature alters weather patterns in other regions, this means that when clouds receive seeds that encourage more rainfall in a specific area, then the activity could rob other regions of the moisture that they typically needed. Even when it regulates the weather locally, it changes the pattern of what other regions receive hundreds of miles away. This emphatically means that if one solves a drought problem in one region, then another problem is created somewhere else. Hence artificially changing what atmosphere do naturally by itself, this means that its natural process has been altered which must necessarily lead to something else. With this process, cloud seeding can produce different forms of weather related damages. For example, communities in regions that experience such chronic water shortages are often ill equipped to manage a sudden surge of water availability.

Though there are many advantages of cloud seeding like producing of more precipitation, this helps greatly in agriculture to produce more crops of better quality and this certainly reduces famine and drought. This also allows groundwater ecosystems to recharge. Cloud seeding helps to regulate weather patterns in some locations. This in turn helps in boosting the economy of any society, tourism is also improved when there are more recreational waters enjoyed by people. It can be used in reduction of crop destruction, where the precipitation is unwanted which leads to destruction of things, clouding seeding can be used to change the formation of clouds and makes them less of a threat to the crops and other prone flooding environments.

Conclusion

It is true that the nature presented to human beings a natural environment to improve on it and to take care of it, hence it can never remain the same for ages. Various activities are going in the course of human beings trying to improve on what is given to it by nature. Sequel to the above activities of man, a lot of damages or destruction towards the environment is going on which is being noticed by the irregular conditions of the environment. Ezeani and Onyiloha (2016) ideally put forward that the mother earth has been declared to be ill as a result of dirty air, global warming, polluted waters and toxic wastes. This of course does not promote life but rather diminishes it.

The continuous human tendency to exploit the environment has led to many disasters known and unknown to human beings. Cloud seeding has been one of the ways through which our environment is being brutally attacked, though its advantages may be there but its adversity or disadvantages outweighs the good effects. All the process involved in the cloud seeding is mainly artificially induced process which is not natural, hence the destruction of atmospheric composition continues to take place. Largely human activities are responsible for the changes in the atmospheric composition and its impacts are affecting patterns of life and living conditions of the people.

There is need for cooperate efforts in saving the environment against continuous degradation, as with other global issues or problems, the global environmental problems are so complex and widespread that unilateral measures are not the way out of the problem but cooperative efforts are needed. But the problem still remains that no individual nation can be forced to join in the fight for good environment. According to Chuka (2019) the international system is anarchic in that there is no overarching authority (world government) that can dictate to individual states what they must do or force to cooperate. Though there are international courts and tribunals according to Desombre (2005) but no nation can be forced to appear before them. Hence, many hundreds of international conferences on climate change have yielded nothing but disappointing results and non compliance. Cloud seeding is not yet seen as a problem in the world stage of climatic changes but its effects are hazardous to human life and environment.

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