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WEATHER MODIFICATION: CLOUD SEEDING

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INTRODUCTION

Water is the most significant natural renewable resource and is essential for all life on earth. The primary traditional sources and supplies of water in many parts of the world include ground water, rivers, and reservoirs. Due to shifting land uses and rising populations, these resources are under danger from rising demands. Drought stress and over usage of water resources result in shortages and an increase in the price of drinkable water. Water resources have been progressively declining in many parts of the world. In order to boost water supplies, numerous nations are pursuing weather modification initiatives which are located in semiarid parts of the world. Several nations, including India, Indonesia, Malaysia, Thailand, and the UAE, engage in weather manipulation efforts.

Although influencing and altering the weather seems like something from the far future, numerous nations are now attempting to do so by employing a method known as cloud seeding. One of the methods for changing the weather is cloud seeding, which is just a way to encourage a cloud to generate rain. In addition to cloud seeding, additional terminology including rainmaking, artificial weather modification, and man-made precipitation augmentation are also employed. It includes simulating the precipitation process in the clouds in order to boost it by spraying tiny particles into the top section of clouds, such as dry ice and silver iodide aerosols.

CLOUD GENERATION

Water vapour, which is produced when ground surface temperatures rise, is what causes clouds. The vapour is raised by temperature differences on various peaks, and as it ascends, it cools. Air carries several kinds of particles, and when vapour comes in contact with those particles, the particles collide. In a process known as condensation of nuclei, vapour condenses around the air molecules. Larger water droplets are produced as a result of this process, but because they are light in weight, they continue to fly and form the familiar clouds that surround us. Certain atmospheric conditions are necessary for this process, and relative humidity is one of those factors. High relative humidity is needed for cloud formation, ideally between 60% and 100%.In order to understand why this is significant, consider that relative humidity is the partial pressure of vapour over the total pressure of vapour. The partial pressure is the number of water molecules in a medium, whereas the total pressure is the capacity of that medium. As a result, if the medium has a high molecular content, the relative density will also be high; nevertheless, if the medium has a lower molecular content than it does, the relative density will be low. To put it simply, if there are a lot of droplets, clouds will probably form.

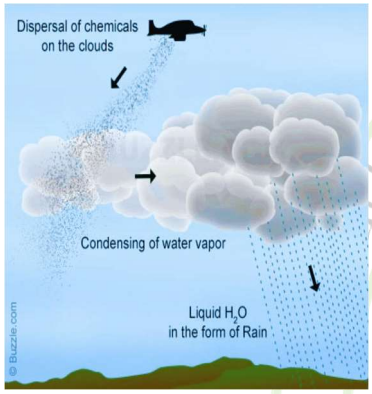
CLOUD SEEDING APPROACHES

Cloud seeding aids in boosting condensation on nuclei by introducing more particles into the system. The three methods used in cloud seeding are as follows. Based on the nature of the targeted clouds as well as the weather conditions, each strategy is applied. There are three methods of cloud seeding.

i)Hygroscopic cloud seeding.

ii)Static cloud seeding.

iii)Dynamic cloud seeding.



i) Hygroscopic cloud seeding:-

The term "hygroscopic" refers to a substance's propensity to absorb water from the surrounding atmosphere. In this context, it is extremely important to have this quality in the context of cloud seeding for condensation purposes. On warm-based clouds, hygroscopic cloud seeding is used. This technology employs salt minerals such as sodium, potassium, and magnesium. These salt minerals are thought to be the embryos from which raindrops emerge. They increase the size of the droplets, which accelerates chemical condensation and increases the likelihood of precipitation.

ii) Static cloud seeding:-

Spreading silver iodide, sometimes known as dry ice, into clouds is the static cloud seeding method. Unlike hygroscopic cloud seeding, static cloud seeding is performed to cold-based clouds with temperatures ranging from -10 to -25. Thus, glaciogenic elements must be included in this research because they increase the densities of ice crystals in clouds by either creating new crystals or freezing cold droplets. Furthermore, as the name implies, static cloud seeding does not entail air motion because all conditions are steady during the procedure. There are restrictions on the atmospheric conditions that must exist for static cloud seeding to be done. As a result, this practise cannot be applied everywhere, and obtaining successful results in one region does not guarantee that the same would occur in another, unless the climatic circumstances are repeated.

iii) Dynamic cloud seeding:-

The key distinction between static and dynamic cloud seeding that affects the procedure greatly is air motion. The purpose of dynamic cloud seeding is to increase vertical air currents, which allows a considerable volume of water droplets to travel through the clouds, increasing the odds of precipitation. Dynamic cloud seeding, like static cloud seeding, is done on cold-based clouds. The materials utilised are likewise glaciogenic; however, dynamic cloud seeding necessitates a greater volume of materials than the static approach in order to increase the likelihood of precipitation. Dynamic cloud seeding is a difficult technology that contains a long number of processes, each of which must be performed correctly or the entire process must be repeated.

ADVANTAGES OF CLOUD SEEDING

Cloud seeding provides several advantages for governments, including the ability to fix various problems that have arisen through time. The first advantage is that cloud seeding produces rain in locations when rain is desperately required, since it is maybe the only method to provide rain. Cloud seeding seeks to increase precipitation in order to have more condensation fall to the ground. This method assists farm labourers in producing more crops of higher quality. It enables the recharging of groundwater habitats. In locations where there is little

precipitation, silver iodine is used to stimulate rain formation. Rain is necessary to keep the land moist and fruitful for the growth of crops and other vegetation.

Another advantage is that cloud seeding strengthens and improves the global economy. The more farmers enhance the quality and production of their crops, the more money they will earn to sustain their family. As a result, where there is rain, there is agricultural product and growth. Farms that produce more can benefit the local economy and feed the people. Cloud seeding may significantly enhance living conditions in arid areas. Crops in many locations are subjected to harsh weather, which can harm the goods; thus, cloud seeding is used to manage the weather so that crops can grow in ideal conditions. The atmosphere's water vapour will be more controlled as a result of cloud seeding, preventing destructive hail and violent storms. Cloud seeding has a relatively minimal environmental impact and has no long-term consequences on weather patterns.

DRAWBACKS OF CLOUD SEEDING

As with every novel approach, cloud seeding has a number of drawbacks that may limit its use and efficacy. It is critical to understand that cloud seeding does include the use of chemicals in the atmosphere. This implies that hazardous chemicals might be released into the atmosphere. Chemicals employed in cloud seeding have the potential to harm the environment, particularly the plants that cloud seeding is meant to preserve. There has been no significant research into the environmental effects of silver iodine. Silver iodine can produce "iodism," a kind of iodine poisoning in which the patient has symptoms such as a runny nose, headache, skin rash, anaemia, and diarrhoea. It has been discovered that it is extremely harmful to fish, cattle, and people.

If cloud seeding is not adequately regulated or monitored, it might result in unwanted consequences. There is no control over the sort of weather that forms when chemicals are released into clouds. Overabundance of rain is expected in several locations, perhaps causing floods. Places that don't get much rain or none at all frequently don't have the infrastructure to handle so much rain. These locations may become inundated fast as a result of cloud seeding, inflicting more harm than good.

CONCLUSION

Even though it may harm agricultural land, cloud seeding is cost effective. Before utilising cloud seeding, the government and people should establish and implement various water source management measures such as rainwater collecting, artificial replenishment of aquifers, and concurrent use of surface and ground water. Another reason is that cloud seeding has been discovered to be ineffective at the time since it mostly impacts clouds that are already displaying indicators of rain. As a result, it is unknown if it is the cause of the rain. In general, trying to heal drought is a continuing fight, and cloud seeding is the most recent technique employed for this. Determining if a technique is excellent or terrible may be more difficult than you think. The chances for reaching high rates of advancement in agriculture and industrial expansion are strongly related to a nation's availability of water resources, therefore cloud seeding becomes a requirement to address this important condition. Cloud seeding technique is directly related to water resource management.