



# Cloud Seeding to Reduce Air Pollution

[Source: HT](#)

## Why in News?

Recently, the proposal for [cloud seeding](#) as a measure to combat air pollution in Delhi has gained attention due to the acute air quality crisis with the [Air Quality Index \(AQI\) exceeding 450](#).

## What is Cloud Seeding?

### ▪ About:

- Cloud seeding, a [weather modification technique](#), enhances precipitation by dispersing chemicals like **silver iodide, potassium iodide, or dry ice** into clouds, which serve as nuclei for water droplet formation, leading to rainfall.
- This process facilitates the **formation of ice crystals in clouds**, which can lead to artificial rain.
  - The technique is being considered as a potential solution to combat severe air pollution, particularly during periods of high **Air Quality Index (AQI)** readings.

### ▪ Types of Cloud Seeding:

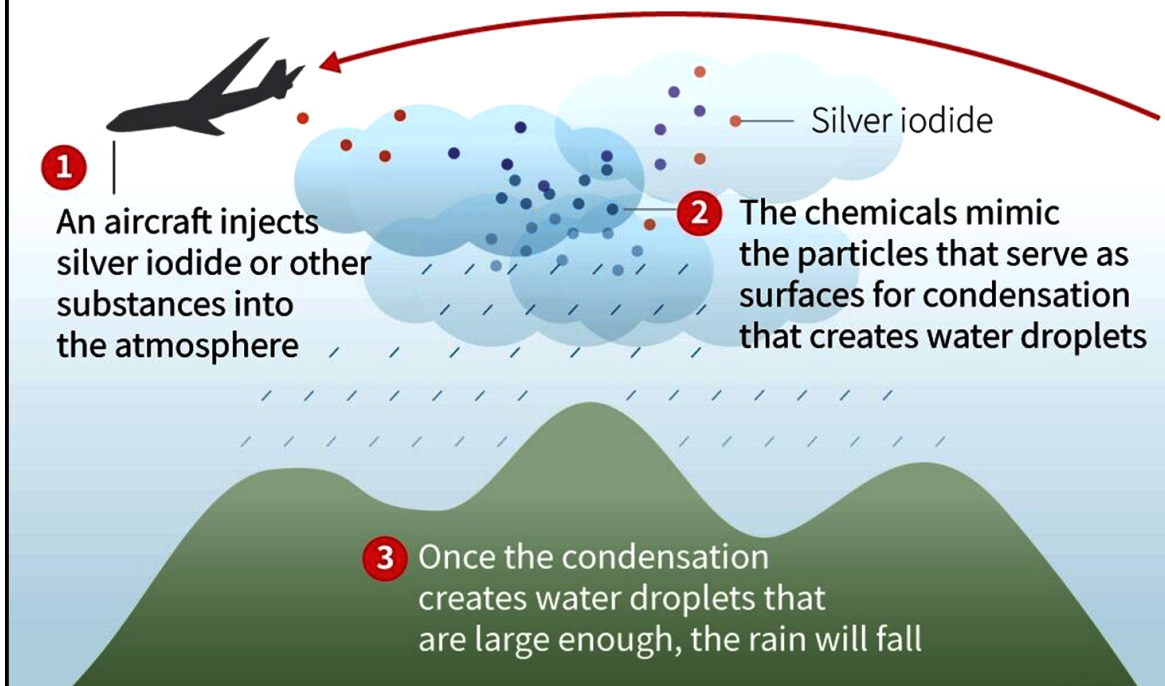
- **Static Cloud Seeding:**
  - This method involves introducing **ice nuclei**, such as **silver iodide or dry ice, into cold clouds** that have supercooled liquid water droplets.
  - The ice nuclei can trigger the formation of ice crystals or snowflakes, which can grow at the expense of the liquid droplets and fall as precipitation.
- **Dynamic Cloud Seeding:**
  - [Dynamic cloud seeding](#) is a technique to artificially stimulate rainfall by enhancing vertical air currents, thereby promoting the formation and growth of rain clouds.
  - The process is considered more complex than static cloud seeding because it depends on a sequence of events working properly.
- **Hygroscopic Cloud Seeding:**
  - This method involves **spraying fine particles of hygroscopic materials**, such as **salts** through **flares or explosives** into the base of warm clouds.
  - The particles can act as cloud condensation nuclei and increase the number and size of the cloud droplets, which can enhance the reflectivity and stability of the clouds.
- **Glaciogenic Cloud Seeding:**
  - It involves **inducing ice formation in supercooled clouds** by dispersing ice nuclei such as silver iodide or dry ice, leading to ice nucleation and precipitation.

### ▪ Applications of the Technique:

- Cloud seeding is **also used to enhance winter snowfall and increase mountain snowpack**, supplementing the natural water supply for nearby communities.
- Cloud seeding can also be done to **prevent hailstorms, dissipate fog, induce rainfall in drought-prone regions**, or reduce air pollution.

# Cloud seeding

Traditional method of rainmaking, in use since the 1940s



## What are the Challenges in Implementation of Cloud Seeding?

- **Environmental Impact:** As artificial rain falls, seeding agents like silver iodide, dry ice or salt will also fall.
  - Residual silver discovered in places near cloud-seeding projects is considered toxic. As for dry ice, it can also be a source of [greenhouse gas](#) that contributes to [global warming](#) (carbon dioxide).
- **Temporary Relief:** While cloud seeding may provide **short-term relief from air pollution** by washing away particulate matter, it does not address the root causes of pollution such as vehicular emissions and industrial discharges.
  - **Example:** Cloud seeding in Lahore, improved AQI from "poor" to "moderate." However, the effects were short-lived.
- **Availability Issues:** Cloud seeding **requires the presence of moisture-filled clouds**, which are not always available or predictable.
  - Specific cloud characteristics, including liquid water content and vertical motion, were used to identify clouds with potential for rainfall.
- **Costly:** It involves processes such as delivering chemicals to the sky and releasing them into the air by flare shots or aeroplanes, which involves huge costs and logistic preparation.
  - **Example:** Cloud seeding in Delhi requires Rs 13 crore to cover the entire aerial area of 1,300 square kilometers.

# Cloud seeding works if done correctly

Cloud seeding experiments were carried out in Solapur city, which gets less rainfall, from June to September in 2018 and 2019

- There was 18% increase in rainfall over a 100 sq.km area in Solapur city due to cloud seeding

- Approximate cost of producing water through cloud seeding was 18 paise per litre. The cost can drop by over 50% if indigenous seeding aircraft are used

- 20-25% of cumulus clouds produce rainfall if cloud seeding is done correctly

- Cloud seeding alone cannot mitigate droughts but can help produce additional rainfall that can partially address water requirements

- Calcium chloride flare was used for seeding the clouds. The seeding was done at the base of the warm convective clouds and at a time when the clouds were growing

- The study was carried out for two years to understand the microphysics and characteristics of convective clouds that can be targeted to enhance rainfall

- The work provides elaborate protocols and technical guidance to plan and conduct cloud seeding in India

**Not all:**  
As microphysics of clouds vary widely, not all clouds produce rainfall through cloud seeding



## UPSC Civil Services Examination, Previous Year Questions (PYQs)

### Prelims

**Q. In the context of which of the following do some scientists suggest the use of cirrus cloud thinning technique and the injection of sulphate aerosol into stratosphere? (2019)**

- (a) Creating the artificial rains in some regions
- (b) Reducing the frequency and intensity of tropical cyclones
- (c) Reducing the adverse effects of solar wind on the Earth
- (d) Reducing the global warming

**Ans: (d)**