



***CLOUD-SEEDING IS NOT THE
SOLUTION TO TAIWAN'S RAINFALL
PROBLEMS***

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This article reflects on the workshop, “[Anticipating Future Debates on Climate Intervention](#),” convened by the Center for Global Security Research (CGSR) at Lawrence Livermore National Laboratory (LLNL) on March 14-15, 2023. The workshop addressed a number of climate intervention strategies, and the related technical and government issues, to combat climate change. The participants homed in on carbon dioxide removal and solar radiation management (SRM) (commonly known as solar geoengineering), as well as cloud seeding and weather interventions. The workshop used the currently existing cloud seeding and weather intervention mechanisms used by countries across the globe to discuss how these strategies might be useful to serve as a starting point to debating other climate interventions, primarily SRM.

This article utilizes the discussion of cloud seeding and weather interventions to the local context in Taiwan, which regularly experiences country-wide droughts and uses cloud seeding in an attempt to increase rainfall. For the past several years, counties throughout Taiwan, specifically in southern Taiwan, have experienced significant drought due less powerful typhoons that would normally fill up reservoirs and create enough runoff in the high

mountains to sustain the country. One of Taiwan's [largest reservoirs, near Tainan](#) in the country's south, is at 11 percent capacity. The government also pays some farmers, [particularly rice farmers](#), not to grow the crop given the amount of water needed to grow it.

The droughts have gotten [so bad that major publication outlets](#) now track the levels of various reservoirs on a daily basis. These droughts force cities and counties [to limit the amount of water](#) its resident and use. Depending on the severity of the drought, some cities cut off the water supply from homes twice per week as a part of a water-rationing regime. Such practices occurred when I lived in Taiwan in 2014-2016.

Fast forward to 2023, and Taiwan has continued to experience these extreme droughts. The major difference between 2015 and today is that the world focuses more on Taiwan, and particularly its world-leading advanced semiconductor manufacturing industry. Now, during times of extreme drought, as is occurring in spring 2023, reports highlight the [water-intense process of manufacturing semiconductors](#). In an effort to reduce its water use, Taiwan Semiconductor Manufacturing Corp. constructed its own [water recycling facility](#) and cut water use by 10 percent. In September 2022, TSMC brought the facility online, and the company claims to use “[each drop of water 3.5 times](#).”

Despite these cutbacks, the prominence of TSMC [has created a bitterness](#) among the rice farmers who are forced to let their land dry up as they do not think that these major companies are doing enough to save water.

In an effort to increase rainfall, Taipei has instituted a cloud-seeding regime to enhance rainfall and to fill up the nearly empty reservoirs. In March 2023, [Hsinchu, Miaoli, and Taoyuan counties](#) used ground-based cloud-seeding generators in advance of expected rainfall in order to maximize the amount of rain from the storm. The [two different mechanisms](#) used were pyrotechnic flares and ground-launched chemicals. As these techniques were used, some cities elevated the four-tiered water alert system [from “yellow” to “orange,”](#) meaning that “industrial water users would see a reduction in the amount of water supplied to

them and households would face reduced water pressure.”

[In addition to the ground-based mechanisms](#), Taiwan’s air force uses its C-130 aircraft to conduct cloud seeding from the sky. Some government officials have even used the power of prayer to the sea goddess Mazu to pray for rainfall.

Despite all of these efforts to increase rainfall, the country still faces extreme drought. These band-aid solutions—particularly cloud seeding—have not had the desired success. One cloud-seeding attempt in January 2023 [resulted in little rainfall](#). According to [reports](#), only 0.1mm of rainfall occurred after the cloud-seeding commenced, compared to the 0.3mm the day before.

These developments are not unexpected. As discussed during the [Anticipating Future Debates on Climate Intervention](#) workshop, cloud seeding is not a silver iodine bullet to fix all drought and rainfall issues. The technology was developed in the aftermath of World War II, but the science behind its potential success is not confirmed. Ground-based cloud-seeding has less chance of success than air-based efforts due to issue with the dispersion of the chemicals. As the workshop report suggests, “Once a cloud is seeded there is currently no way of knowing what the cloud would have done without seeding. Because of variability of weather, cloud seeding experiments do not provide a large enough sample to achieve statistically significant results.” And that is true in Taiwan—the technology is used during times of drought, but it is largely ignored when the reservoirs are full because there is no perceived need to increase the rainfall via cloud-seeding.

The number of unknowns regarding not only the success of cloud seeding in producing rainfall, but also in its secondary and tertiary effects, requires more research. As the workshop report emphasizes, “There are scientific concerns and unknowns with the efficacy of seeding and measuring impact, and societal and environmental effects are also potential worries. The possible liability of downstream effects from precipitation enhancement, like flooding, are difficult to quantify and calculate the risk. Similarly,

understanding the environmental and health impacts of silver iodide as a seeding material, particularly as it accumulates in runoff or seeps into soil, is an important area of future research.”

As Taiwan continues to experience drought, government officials may continue to face pressure to implement cloud seeding by local communities, particularly the vocal rice farmers in southern Taiwan. Farming communities in parts of the United States facing similar drought circumstances have expressed support for local governments into implementing cloud seeding in an effort to increase rainfall. The same can very likely occur in southern Taiwan. As rice farms continue to dry up and the farmers are paid by the government not to farm, the farmers could very well organize and pressure the county governments into doing more to improve their livelihoods. After years of drought, the farmers are fed up and have a large target to blame in TSMC.

Cloud-seeding is likely not the short- or long-term solution to Taiwan’s rainfall problem. While cloud-seeding should not necessarily be completely abandoned, government officials should prioritize other solutions that can have an immediate impact. [Increasing the price of water](#) to reduce waste has been identified as one solution. Improving old water infrastructure to reduce leaks and waste is another. [Dredging reservoirs](#) to increase their capacity, and [building additional](#) reservoirs are also solutions that can increase the amount of water stored during rainstorms. Taiwan’s major water consumers, such as TSMC, should continue to develop water-saving processes and build recycling facilities and its own reservoirs to further reduce the amount of water it takes from the reservoirs. The less of a burden that these water-intensive companies place on the public, the more water will be available for citizens to use during times of drought. Taiwan’s current drought may subside with time, but such relief has only proven to be temporary over the last few years.

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