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Cloud Seeding Research Methods

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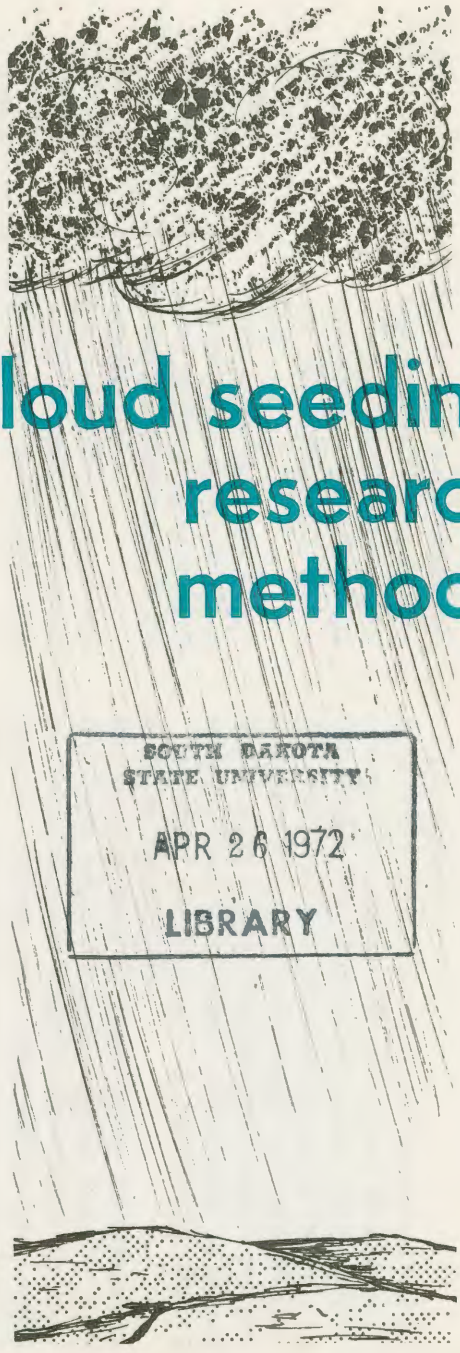

cloud seeding research methods

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Cooperative Extension Service
South Dakota State University, Brookings
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FS 560
3rd in a Series

cloud seeding research methods

(Would It Have Rained Anway?)

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When cloud seeding is done, with what should the results be compared? Early seeding operations attempted to compare results with the "normal" rainfall—the long time average. Scientists, however, were quick to discredit this procedure because weather is so changeable that "normals" are rather meaningless for any given year. Comparing seeding results with normals did not prove or disprove that seeding caused more or less rain to reach the ground *from that particular cloud on that particular day.*

Scientists believed that some research method was needed that paralled the principles used in most crop research—the so-called "randomized and replicated" method.

Randomized and Replicated Method

To clarify the procedure, let us review how an agronomy researcher might set up an experiment to determine if the use of a given agricultural chemical influenced wheat yields. He might set up his experiment as shown in Figure 1.

Control
Plot 1
Control
Plot 2
Control
Plot 3
Control
Plot 4
Control
Plot 5
Control
Plot 6

Figure 1.

The researcher would put his plots on land having uniform soil and would plant the same seed on all six test plots and the six control plots. However, he would not use the chemical on the control strips.

The researcher is now in a position to do three things essential to good research. He has:

1. Something dependable with which to compare his results. The untreated control plots provide this.
2. Enough duplications in the form of the six plots to allow unavoidable errors to cancel each other. This is replication.
3. An opportunity to remove any bias he might have by being able to select which three plots he will use to get yield data by a flip of the coin or some other chance method. This is randomization.

Weather Modification Research Methods

This is all quite simple for the agricultural researcher, but for the weather modification scientist just *getting good research* poses staggering problems. For example, the agricultural researcher can get his replication by planting six plots or any number he wants in exactly the same way, but the atmospheric scientist cannot make clouds. He must work with what nature makes available. How close to the seeded (target) area should the control area(s) be? Upwind or downwind? How can he go about randomizing the research to remove any intentional or unintentional bias that he may have?

The atmospheric scientist had to do "research on how to accomplish good weather modification research" and this is what he has done.

A University of Chicago research team first tried and perfected a method that approached the method used in crop research. The researchers could not make their own clouds so they sought out pairs of clouds that appeared similar, checked their similarity with airborne radar controls and numbered them cloud **No. 1** and cloud **No. 2.** Then they opened a sealed envelope previously prepared on the ground by persons unknown to them which said *"seed cloud No. 1, do not seed cloud No. 2"* or vice versa. After following these instructions, they sought out and checked another pair of clouds and again followed sealed orders as to which to seed.

Repetition of this process on many cloud pairs accomplished replication as the six wheat plots did for the agricultural researcher. The sealed orders provided the randomization, since for each pair the airborne scientists never knew which cloud would be seeded until the envelope was opened, therefore they could not be guilty of a biased selection. This method, with some variations, is now the commonly used research technique.

Research on selection of meaningful control areas for comparison purposes was done in several places, South Dakota included. Conclusions reached were that control areas should be large in geographical extent and need not contain a dense network of rain gauges. Also, if there are *natural* climatic differences between control and target areas, these must be accounted for by applying a ratio that compensates for the differences.

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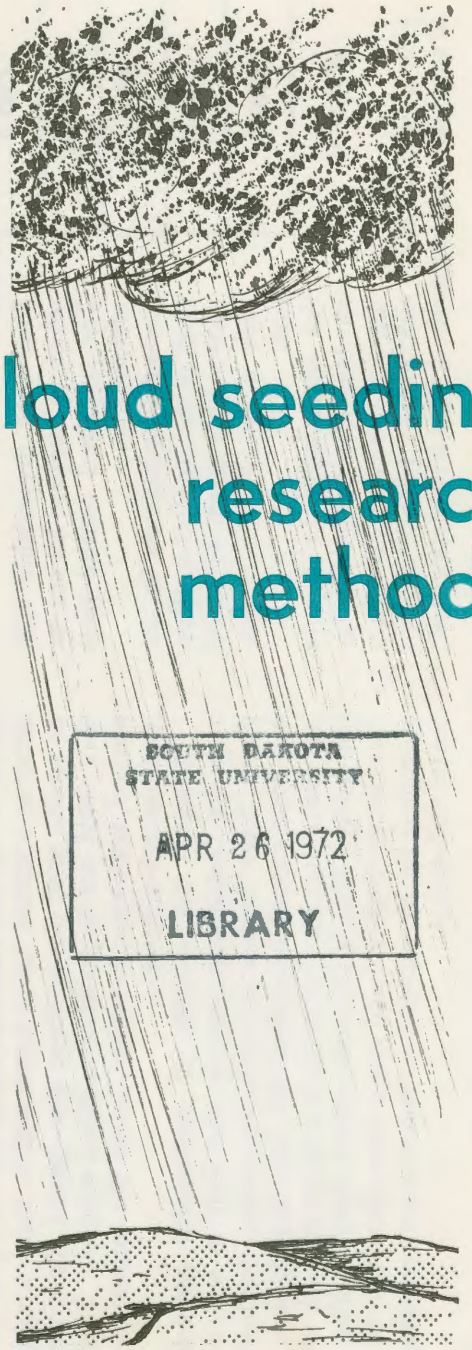

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