Social Implications of Weather Modification

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"Can you shout orders to the clouds and make them drench you with rain?...And if you command lightning to flash, will it come to you and say, 'at your service?'

-Job, Chapter 36, verses 25 and 26


For centuries, as man has suffered from either too much or too little rain, disastrous hail storms, or severe blizzards, he has dreamed of controlling the weather. Since WWII, developing scientific knowledge and technology enabled man, in some cases to modify the weather. Building on the research of Schaefer, who in 1946 discovered that clouds seeded with dry ice could produce rain and/or snow, present technology and knowledge is directed toward: 1) Seeding winter storms to increase snow pack over mountains in order to generate additional spring and summer stream flow; and 2) Seeding to suppress hail, lightning, fog, and hurricanes. Thirty of the fifty states have some form of legislation dealing with modification of weather. (Chagnon 1973a) Only South Dakota has an operational program for seeding the entire State. In 1973 the program was operative in 42 counties and was funded with state and local monies. (Williams, 1973)

The public has become aware of these operational weather modification programs and has begun to ask questions about control and support of the programs as well as raise questions about possible damage cloud seeding may do to the environment. However, little knowledge is available about human response to weather modification, due in part to the fact that about 4 per cent of the weather modification research funds are all that have been directed to the study of how the human society responds to this program.
Haas (1973b) developed a social process model for planning weather modification programs (see Figure 1). Major components of the model are: the planning group initiating the program; funding agencies, public vs. private; legal systems, political systems; opinion leaders; emergent interest groups; established interest groups and citizens, and citizens. The model is of value to the sociologist studying the human response to weather modification as it identifies areas where research is needed. Because of growing public interest in weather modification as an innovation, program planners need to determine what the public knows about weather modification and what level of support will be given for the programs. It is also important to monitor the human sector in order to determine when and where changes in attitudes and/or support for the programs occur.

Recently, there has been an increase in the number of sociological studies dealing with attitudes, knowledge, and support of weather modification programs. Saarinen (1966) in the mid-1960's studied attitudes of Nebraska residents toward weather modification programs. Sewell and Day (1966) in 1965 studied attitudes of U.S. and Canadian residents toward weather modification and governmental involvement in weather modification programs. Haas and others (1971, 1973b) at the University of Colorado conducted field studies in Montana, Colorado, South Dakota, New York, and Florida. One study in Colorado for the National Hail Research Experiment (NHRE) used experimental and control groups, as well as pretesting (PRT) and posttesting (PST) of groups in order to observe changes in attitudes, knowledge, and support. Larson (1973) conducted a field study of attitudes of farmers and ranchers in Eastern Montana. A similar study was conducted by Lanham (1973) in an 8 county area in North Central South Dakota. The investigation was expanded in 1973 using (Lanham, 1974) unstructured interviews of members of a selected panel in a county seat community that served as district headquarters for
Figure 1

SOCIAL PROCESS MODEL OF THE RESPONSE TO PLANNED WEATHER MODIFICATION PROGRAMS

INNOVATOR SYSTEM:

COMPONENTS: Policy makers, representatives in contact with public

LINKING SYSTEM:

MASS MEDIA

CLIENT SYSTEM:

CITIZENS: Attitudes, opinions, perceptions, information, etc.

OPINION LEADERS: Newspaper editors, local officials, etc.

ESTABLISHED INTEREST GROUPS: farm, agri-business, civic groups, etc.

EMERGENT INTEREST GROUPS

FUNDING AGENCIES: HSF, etc.

LEGAL SYSTEM: Court injunctions, damage claims, other legal action

POLITICAL SYSTEM: Governor, state/federal legislative committees, individual legislators, referenda, etc.

Source: J. Eugene Haas,
a South Dakota Weather Control Commission cloud seeding program. A current study of North Dakota residents is being conducted by the ARE Team of North Dakota State University, Fargo.

This report summarizes the research findings from sociological studies pertaining to respondent knowledge concerning weather modification, supporting sentiments for the programs, and environmental concerns about weather modification.

Knowledge of Weather Modification

One of the major components of the Social Process Model is the citizen, or client of the weather modification program. Research has been designed to assess how much the citizen knows about weather modification. It is important to determine the knowledge level in an area where weather modification programs are to be conducted because citizens are called to make some type of decision about the programs. Decisions can be made on the basis of adequate, inadequate, or false knowledge about weather modification.

The research findings suggest, in general, that the citizens have little knowledge about weather modification programs. (Larson, 1973; Haas, 1973; Lanham, 1973) Further, they suggested that when the citizen has knowledge of weather modification, he has knowledge of dramatic events such as the seeding of clouds over the Rapid City area during the 1972 flood, or the visual sighting of clouds being seeded to suppress a hailstorm. Larson (1973) found that 70 per cent of the Montana farmers and ranchers reported they had inadequate knowledge about weather modification to make decisions about the programs. Lanham (1973) found that respondent's knowledge of weather modification was low. Further, he found that knowledge was related to attitudes toward the programs; as knowledge increased, the citizen respondents' attitude toward modification programs was more positive. Haas (1973b) found that the public knew little about the NHRE program in Colorado; however,
interaction between respondents and NHRE personnel and the visual awareness of NHRE equipment were associated with high levels of knowledge. Lanham (1974) reported that most panel members were not knowledgeable about the weather modification programs when interviews were conducted a month after the initiation of the program. The level of knowledge did not increase in the succeeding two months during which interviews were conducted. The local weekly paper published adequate information when the program started, as well as subsequent stories during the seeding season. Four weather modification pamphlets published by the Cooperative Extension Service of South Dakota State University in 1972 were available through the County Agent's office. Larson (1973) found that County Agents were named as the most important sources of information about weather modification.

There is some public interest as to the feasibility of cloud seeding. Haas (1973b) suggested that whereas two-thirds of the Colorado residents in his study believed man could never completely control the weather, they felt it was important to search for ways to control the weather. Also, the public perceives seeding for rain increase to be more successful than for hail suppression (Larson, 1973; Lanham, 1973; Haas, 1973b). However, perceptions about success for rain generation as compared with hail suppression may be due to climatological differences during the seeding season. Lanham (1974) found that the panel saw hail suppression programs to be more successful in Day County than rain increase programs. This perception may be due to two things: 1) the lack of seedable clouds in the summer, (when weather patterns were similar to the drought of the 1930's); 2) visual awareness of planes actually seeding a damaging hail storm over the community. Because the cloud was seeded, panel members reported the hail that fell was "soft" and not damaging as similar clouds in other years would have produced.
In summary, research findings suggest:

1. The public has little knowledge about weather modification programs.

2. Where public information programs have been conducted, level of knowledge increases.

3. Public perceptions about the relative success of rain increase and hail suppression efforts differ.

Support for Weather Modification

Support for weather modification has been studied by examining attitudes of the public toward the program in general, program control and program financing. Sociological research has provided a profile of persons amendable to innovations. (Rogers and Shoemaker, 1971) They are younger, have more years of formal education, are members of white collar occupation groups, participate more in organizations, and have above average incomes. The sociological studies (Haas et al., 1971; Sewell and Day, 1966; Saarinen, 1966) confirmed that those who hold favorable sentiments to weather modification as an innovative program share these characteristics similarly.

Attitudes have been used as predictors of behavior. Consequently, if a person has a positive attitude toward weather modification, then it is predicted he will support modification programs.

Sociological studies (Larson, 1973; Lanham, 1973; and Haas, 1973) have found: 1) positive attitudes toward weather modification programs; 2) minimal differences in the attitudes of farmers, small town residents, and urban dwellers toward modification programs in South Dakota (Lanham, 1973); 3) greater support for experimental than for commercial cloud seeding programs (Larson, 1973); 4) residents of arid sections in Nebraska had more favorable attitudes than other state residents (Saarinen, 1966); and 5) citizen respondents and their friends would vote for a cloud seeding program (Lanham, 1973).
Researchers have examined attitudes toward weather modification from the religious value perspective of the person. For example, opposition to cloud seeding in Pennsylvania developed because the public perceived that tampering with the weather was wrong and intruded on God's domain. Other findings, however, indicate that most residents do not see weather modification as a violation of their religious belief system (Lanham, 1973; Larson, 1973).

One question might be asked about "risk" as a factor explaining favorable attitudes toward weather modification. Strodtbeck and De Santi (1967) found positive attitudes toward weather modification because moisture was in short supply, and the respondents perceived that it worth the risk to seed the clouds. Similar findings were observed when Saarinen (1966) compared arid and humid regions in Nebraska. But regional differences were not found by Sewell and Day (1966). Interest in weather modification may be high in humid regions, as recent legislation has been passed in Illinois to support and control weather modification (Chagnon, 1973a) and New York (New York Times, 1974). It is also interesting to observe that support for the South Dakota program was as high in the southeast region of the state as it was in the northwest region, which have an average yearly rainfall of 17.5 inches and less than 10 inches, respectively.

The research findings suggest that local residents want to share control over cloud seeding programs (Larson, 1973; Lanham, 1973; Haas, 1973b). Because of this concern for local control, committees have been formed in cloud seeding districts to control where and when seeding occurs. (Williams, 1973) This promotes interaction between scientists, program planners, and the public. However, Haas (1973b) found that few people were aware local committees existed. The South Dakota Weather Modification Law has provisions for such committees, and when Montana farmers and ranchers
were given descriptions of the South Dakota program, they believed that this type of program would be acceptable in Montana. However, more knowledge is needed about public use of the local control committees.

Support for cloud seeding programs comes from voluntary contributions, public funds raised from local taxes, and state and federal funds. Haas (1973b) observed that most residents believed taxes should be levied on everyone in the area to support cloud seeding programs. Lanham (1973) found variant levels of support according to the residence of the respondent, with urban residents the least willing to pay for weather modification programs through voluntary contributions or taxes. Larson (1973) reported that Montana farmers and ranchers believed the benefits of a cloud seeding program would be greater than the cost. Little, however, is known about how much the public is willing to pay in taxes for any type of social program, so comparison of the extent of financial support with willingness to support other types of public programs is not possible at this time.

As indicated, attitudes toward weather modification have been favorable, and most residents would vote to support the programs (Lanham, 1973; Larson, 1973). However, some opposition has emerged. This is not unusual in a society where different groups have different goals. In 1972, a trailer owned by a commercial cloud seeding firm was dynamited in Colorado. (Chagnon, 1973b) A straw poll taken subsequently indicated 80 percent of the residents in the area would vote against a cloud seeding program. This opposition may have been directed more at the corporation in charge of the commercial cloud seeding program. Davis (1967, 83) found evidence in Washington state where seeding for the benefit of the wheat crop was damaging to the cherry crop.
Research related to program support suggested:

1. That local residents want to share control over when and where cloud seeding takes place.

2. Though most residents believe everyone should be taxed to support cloud seeding programs in an area, levels of support differ according to residence, to support the programs. (Lanham, 1973)

3. Little is known about how much the citizen is willing to pay in taxes or voluntary contributions to support public programs, so that it is not possible to compare amount of support.

4. Most people have positive attitudes and would vote for cloud seeding programs, but little is known about how these attitudes may change.

5. Though research provides a profile of those adopting innovations, little is known about the collective adoption of an innovation such as cloud seeding.

6. Conflict may develop over cloud seeding programs because of agricultural differentiation, and the different goals of societal groups.

Environmental Concerns

The final section of this research summary examines the findings related to perception of environmental damage from cloud seeding. Because of the low level of knowledge about cloud seeding, no information is available about different perception of damage from seeding agents. The model has identified emergent interest groups, and one such emergent group may be an environmental action group.

When asked whether cloud seeding would upset the balance of nature, Lanham (1973) found that one-third agree it would, one-third were uncertain, and one-third disagreed with the statement. Larson (1973) indicated that about 70 per cent of the Montana farmers and ranchers in the study believed that there might be unexpected consequences from cloud seeding, but these consequences were not identified. Sewell and Day (1966) found that concern for environmental damage from cloud seeding was expressed by those who saw the greatest number of benefits from cloud seeding.
Because silver iodide is used in such small quantities (it would amount to one ten-millionth of the maximum possible occupational exposure of 0.1 milligram per cubic meter), and the decay rate is so rapid, there is difficulty in detecting silver iodide content in soil. (Teller, 1971, 355-356) It would appear that the use of silver iodide is not adding to the pollution problem (Davis, 1967, 42). However, persons may allege physical damage from cloud seeding. Davis (1967, 43) reported a Pennsylvania logger who believed his skin was burned from contact with trees located in an area which was seeded with silver iodide.

Research findings on environmental concerns suggested:

1. Additional research is needed in order to isolate which seeding agents appear most harmful to the environment.

2. An identification of emergent interest groups in cloud seeding, in particular the role of environmental action groups.

3. Further research into the specific harmful effects of cloud seeding.

Summary

From the research reviewed, several generalizations may be derived. Some degree of caution is to be used as these generalizations are drawn mostly from the studies of three researchers (Lanham, Larson, Haas). Through personal interaction these researchers have cooperated in the design of the basic interview instrument and sample design. Thus, with some common units of measurement the results of the three studies can be compared across time and space.

1. The studies indicate that the public has little knowledge of weather modification. This was an interesting fact. A great deal of information about cloud seeding has been shared in local and regional newspapers in areas where studies were conducted, as well as other media. One study indicated the level of knowledge may support the cognitive dissonance theory
of Festiner (1957) who suggested that messages in the communication system that require a person to change his behavior are "tuned" out. Or, people may use the mass media selectively for different purposes (Katz, et al., 1973). For example, the local weekly newspaper may be used more for social information than for general information about programs such as weather modification. By implication more research is needed to determine the level of knowledge before a cloud seeding begins in an area, how this knowledge changes with increased public information programs, and what sources are used by the public to secure information and formulate opinions.

2. The studies show favorable attitudes and support for cloud seeding programs. Support appears to be greater for experimental than for commercial programs. Residence is a significant factor, with urban residents reported in one study the least willing to support cloud seeding programs through taxes or voluntary contribution. Although local residents want to share control over the programs, little is known about the public awareness or use of these local committees. Additional research is needed to determine possible shifts in attitudes and reasons for such shifts. For example, are expectations greater for cloud seeding programs in a dry year?

3. The research findings are not conclusive when attempting to determine perception of environmental damage from cloud seeding. This is due, in part, to the low level of knowledge about cloud seeding. An uninformed public may perceive environmental damage when in fact clouds have not been seeded. Additional research is needed to determine which seeding agents are perceived most harmful to the environment, to identify the emergence of environmental action groups, and to identify perceived harmful effects of cloud seeding.
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