

## Weather Modification and Public Opinion in South Dakota, 1972 and 1973

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### ABSTRACT

Public response to South Dakota's operational cloud seeding program (SDWMP) has been traced since before its implementation. Data are presented from interviews conducted at the end of each of the program's first two operational seasons. Variables included are respondent 1) attitudes toward weather modification, 2) beliefs that it is effective in increasing precipitation and suppressing hail, 3) sources of information about the SDWMP, 4) knowledge about the weather modification program, 5) evaluation of cloud seeding programs, and 6) preferred decision making and funding for the program. The dependent variable is evaluation of programs; relationships among the variables are described. The impact of the Rapid City flood on opinion about weather modification in South Dakota is summarized.

### 1. Introduction

The South Dakota Weather Modification Program (SDWMP) has become institutionalized in the State of South Dakota. The Program, begun in 1972, has since expanded to include about 60% of the land area of the state at a cost of approximately \$1 million a season. The SDWMP has become a standard item in the Governor's budget for presentation to the South Dakota legislature each year.<sup>1</sup>

Public acceptance of cloud seeding in South Dakota has been carefully monitored since before the Program's inception. Social surveys have been conducted in 20 South Dakota counties, with interviews conducted in early 1972 (T<sub>1</sub>), fall 1972 (T<sub>2</sub>), fall 1973 (T<sub>3</sub>), and fall 1974 (T<sub>4</sub>). Data reported in this paper are from T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>.<sup>2</sup>

Considerable experimentation in weather modification had been carried out in South Dakota prior to the development of an operational program. About a decade of research was conducted at South Dakota Institute of Mines and Technology under Federal sponsorship. Therefore, first interviews in this study reflect public attitudes *after* a considerable period of experimentation but *prior* to program operationalization. Baseline results of this survey may well differ from those in an area where implementation of contemporary cloud seeding technology has *never* occurred.<sup>3</sup>

<sup>1</sup> For a description of the SDWMP, cf. Williams (1973).

<sup>2</sup> Two reports on this study have been issued to date (Farhar and Krane, 1973; Farhar and Mewes, 1974).

<sup>3</sup> For example, favorability of an Oklahoma sample from an area with no prior weather modification efforts was lower than for the South Dakota sample (Bohland, 1974).

Variables for which data are reported in this paper include respondent 1) attitudes toward weather modification, 2) beliefs that it is effective in enhancing precipitation and suppressing hail, 3) sources of information about the SDWMP, 4) knowledge about weather modification programs, 5) evaluation of cloud seeding programs, and 6) preferred decision making and funding for the program. The key dependent variable is evaluation of programs. Relationships among the study's variables and their predictive power with regard to the dependent variable are discussed. Finally, a summary of the impact of the Rapid City flood on public opinion about weather modification is presented.<sup>4</sup>

### 2. Attitudes toward weather modification

Ten items designed to measure attitudes toward science, weather, and weather modification were included in the South Dakota interviews. These items did not relate specifically to the SDWMP, but more generally to weather modification technology as a whole.

#### *a. Favorability to the technology*

Two items allowed respondents to express opinion about operational weather modification. At all time periods, over two-thirds of respondents agreed that attempts to control extreme weather conditions are appropriate (Table 1) and that "State and county officials should feel free to use such things as cloud seeding if it might help farmers avoid crop losses" (Table 2). There was no significant difference across time periods on these items.

<sup>4</sup> After initial interviews had been conducted, the Rapid City flood occurred in the presence of cloud seeding (9 June 1972).

TABLE 1. If weather is a problem to farmers, it is appropriate to try to directly control extreme weather conditions by using the most effective techniques known.

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Strongly agree	9	17	16
Agree	60	49	56
Unsure	11	8	8
Disagree	19	18	14
Strongly disagree	1	8	6
	100%	100%	100%
Total N*	436	368	326

\* N, number of respondents.

A third item linked scientific endeavor in general with cloud seeding experimentation. At T<sub>3</sub>, 82% agreed that, "It is a good idea for scientists to experiment with cloud seeding . . ." (Table 3). The proportion of the sample approving of operational weather modification by T<sub>3</sub> (about 75%) was nearly as high as the proportion favoring experimentation. These results suggest an increasing approval of utilizing the technology primarily for operational purposes in South Dakota, although respondents still favor continuing experimentation.

*b. Religio-natural orientation*

The assertion that "cloud seeding probably violates God's plans for man and the weather" received less support at T<sub>3</sub> than at earlier time periods (38% agreed, 47% disagreed at T<sub>3</sub>), although the differences were not great enough to achieve statistical significance (Table 4).

At T<sub>3</sub>, 40% of the sample agreed that "Even when carefully controlled, cloud seeding programs are very likely to upset the balance of nature" (Table 5). Through this item, respondents appeared to express reservation about whether man can adequately control the technology, suggesting a cautionary note in their otherwise favorable set toward it.

TABLE 2. South Dakota State and county officials should feel free to use such things as cloud seeding if it might help farmers avoid crop losses.

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Strongly agree	9	14	17
Agree	65	52	58
Unsure	8	9	7
Disagree	17	17	13
Strongly disagree	1	8	5
	100%	100%	100%
N	436	367	326
Missing data	0	1	0
Total N	436	368	326

TABLE 3. It is a good idea for scientists to experiment with cloud seeding so that we can find out if it really does work.

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Strongly agree	11	17	16
Agree	75	60	66
Unsure	5	8	7
Disagree	8	10	7
Strongly disagree	1	5	4
	100%	100%	100%
N	436	366	325
Missing data	0	2	1
Total N	436	368	326

A clear minority of the sample felt that man should not interfere with the weather. Although 33% of respondents did not object to such intervention at T<sub>1</sub>, this proportion had increased to 59% by T<sub>3</sub> (Table 6).

Prior to the first operational season, the majority of respondents expressed reservations about active intervention in weather processes either because such activity would upset nature's balance or impinge upon the domain of the Supreme Being. At the end of the second year of operations, however, majority opinion rejected this "religio-natural orientation." These findings suggest that as they gain experience with operational weather modification, the public slowly becomes more confident that the technology can be applied without dire consequences.

*c. Importance of weather modification*

At T<sub>3</sub>, we attempted to discover how important respondents thought weather modification was relative to other social problems and solutions. One item suggested that man should find other ways of dealing with the weather, such as improved forecasting or cheaper crop insurance. While a third of the sample agreed with this item, nearly 50% disagreed (Table 7). A second item suggested that other problems be solved "before spending any more tax money on weather modification programs." Exactly 39% agreed and 39%

TABLE 4. Cloud seeding probably violates God's plans for man and the weather.

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Strongly agree	10	15	10
Agree	33	28	28
Unsure	14	12	15
Disagree	38	37	38
Strongly disagree	5	8	9
	100%	100%	100%
N	436	365	326
Missing data	0	3	0
Total N	436	368	326

TABLE 5. Even when carefully controlled, cloud seeding programs are very likely to upset the balance of nature.

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Strongly agree	4	12	7
Agree	38	36	33
Unsure	21	20	23
Disagree	35	27	32
Strongly disagree	2	5	5
	100%	100%	100%
N	435	367	326
Missing data	1	1	0
Total N	436	368	326

disagreed with this statement (Table 8). The overall favorability toward weather modification consistently demonstrated by the sample across time was somewhat moderated when the technology was placed in the context of other potential commitments for tax monies.

In general, there was little significant change in attitudes between T<sub>1</sub> and T<sub>3</sub>. Overall favorability toward science and toward both operational and experimental weather modification remained constant throughout, although there was "wavering" at T<sub>2</sub>. (The T<sub>2</sub> results can be seen as a consequence of the June 1972 flood at Rapid City.) Attitude scale scores showed a change in the direction of favorability to weather modification across time. At T<sub>3</sub>, respondents still indicated some caution about possible side effects of cloud seeding. On the whole, however, it is clear that after *two full seasons of operations and the experiences of flood and near-drought, favorable attitudes toward the technology remained the majority perspective.*

### 3. Belief in the effectiveness of weather modification

It has been hypothesized (Farhar and Mewes, 1974) that if respondents believe cloud seeding can actually produce more rain and suppress damaging hail, they will be more favorably inclined toward it. At all interviews, respondents were asked: "Do you think cloud seeding can actually increase moisture?" and "Do you

TABLE 6. Man should take the weather as it comes and not try to alter it to suit his needs or wishes.

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Strongly agree	6	11	8
Agree	49	28	23
Unsure	12	7	10
Disagree	30	47	48
Strongly disagree	3	7	11
	100%	100%	100%
N	436	367	326
Missing data	0	1	0
Total N	436	368	326

TABLE 7. Instead of trying to change the weather, man should find other ways of dealing with it—for example, improved weather forecasting, cheaper crop insurance.

Response at T <sub>3</sub>	%	N
Strongly agree	3	11
Agree	28	91
Unsure	20	64
Disagree	44	143
Strongly disagree	5	16
	100	325
Missing data		1
Total N		326

think cloud seeding can actually suppress hail?" Results are presented in Tables 9 and 10.

The increase in proportion of respondents who believed cloud seeding effective in enhancing rainfall between T<sub>1</sub> and T<sub>3</sub> was significant at  $\alpha=0.001$ . (The slight decrease in those responding positively at T<sub>3</sub> was probably due to the unusually dry summer experienced in South Dakota during 1973.)

An even more notable increase in belief was discovered in relation to hail suppression activity. Greater proportions of the sample at each interview reported that they believed cloud seeding to be effective in reducing hail. These changes were also significant at  $\alpha=0.001$ .

Clearly, respondents believed that the technology is effective for precipitation augmentation and hail suppression after experiencing two operational seasons. Correlational analysis provided support for the hypothesis that belief in the effectiveness of cloud seeding is related to favorable program evaluation: the two variables correlated at  $r=0.58$  at T<sub>3</sub>.

### 4. Sources of information about weather modification

We inquired at each interview whether respondents had gained information about the SDWMP from the following sources: meetings, public lectures or discussions, newspaper and magazine articles, radio and television programs, and informal discussions around town. The data showed that 96% of the sample subscribed to at least one daily or weekly newspaper, and

TABLE 8. We should try to solve other problems before spending any more tax money on weather modification programs.

Response at T <sub>3</sub>	%	N
Strongly agree	11	37
Agree	28	92
Unsure	22	70
Disagree	33	108
Strongly disagree	6	19
	100	326

TABLE 9. Do you think cloud seeding can actually increase moisture?

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
No	13	11	14
Don't know	39	15	17
Yes	48	74	69
	100%	100%	100%
N	435	368	326
Missing data	1	0	0
Total N	436	368	326

84% subscribed to at least one journal or periodical. Therefore, for South Dakota respondents, the written media are an important information source.

The proportion of respondents reporting that they had read one or more articles about the SDWMP increased significantly between T<sub>1</sub> and T<sub>3</sub> ( $\alpha=0.001$ , Table 11). Likewise, those reporting that they had heard about the SDWMP on radio and television programs increased significantly ( $\alpha=0.001$ , Table 12). Of course, formal information sources comprise only a part of the total flow of information in the community.

Most information about local cloud seeding was received through the informal communication network existing in each community and from written media. The greatest proportion of respondents, 55%, had derived information about weather modification from informal discussion, followed closely by 49% indicating information had been gained from written media. About a third had received information from programs, while virtually no one received relevant information through meetings, lectures or discussions.

These results underscore the fact that much information about the technology flows through informal communications links in communities. Facts and distortions of facts, and rumors, both favorable and unfavorable to the technology, circulate, particularly in a small-town society. Empirical evidence suggests that such information goes through a "two-step" flow.<sup>5</sup> That

TABLE 10. Do you think cloud seeding can actually suppress hail?

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
No	14	18	19
Don't know	67	43	29
Yes	19	39	52
	100%	100%	100%
N	435	367	326
Missing data	1	1	0
Total N	436	368	326

<sup>5</sup> Cf. Katz and Lazarsfeld (1955) and Lazarsfeld and Menzel (1963).

TABLE 11. Number of articles read about the SDWMP.

Number of articles (newspaper and magazine)	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
None	68	57	51
One	12	18	12
Two-three	13	17	20
Four-five	3	3	8
Six-ten	2	4	4
More than ten	2	1	5
	100%	100%	100%
N	434	367	324
Missing data	2	1	2
Total N	436	368	326

is, influentials and other key community leaders make information they receive and their interpretation of it available to their respective groups in the community. In the case of the SDWMP, county commissioners and others are probably relevant influentials who make information available at the community level.

## 5. Knowledge about the SDWMP

By September 1973, respondents had experienced two operational seasons, the Rapid City flood, and considerable media exposure about weather modification and the State Program. We have hypothesized that as experience with and information about cloud seeding accumulated, respondents would become more knowledgeable on these topics and thus more favorable to the technology.

Data from T<sub>2</sub> (Farhar and Krane, 1973) showed that respondents viewed media coverage of the SDWMP as favorable and accurate. We also found that respondents who had greater exposure to information sources about the SDWMP had higher knowledgeability scores.

The overall trend has been toward slightly increased knowledge about the SDWMP over time. For example, data presented in Table 13 show a significant decrease between T<sub>1</sub> and T<sub>3</sub> ( $\alpha=0.001$ ) in the proportion of respondents who had not heard about the SDWMP.

TABLE 12. Number of programs heard about the SDWMP.

Number of programs (radio and television)	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
None	88	69	64
One	7	11	7
Two-three	4	15	20
Four-five	0	4	4
Six-ten	0	1	3
More than ten	1	0	2
	100%	100%	100%
N	434	367	326
Missing data	2	1	0
Total N	436	368	326

TABLE 13. Subjective assessment of knowledgeability about the SDWMP.

Level of knowledgeability	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Not at all informed/ haven't heard of program	56	27	20
Slightly informed	40	68	71
Fairly well informed	3	5	8
Very well informed	1	0	1
	100%	100%	100%
N	435	368	326
Missing data	1	0	0
Total N	436	368	326

At T<sub>3</sub>, nearly half of the sample correctly identified the purposes of the SDWMP as increasing rainfall and suppressing hail. The proportion of respondents able to correctly identify the organizations involved, dates and places of operations did *not* increase significantly over time. While 74% of the sample were aware that aircraft were used in the Program, 79% did not know what seeding agent was used.

In spite of public education efforts by the Division of Weather Modification in South Dakota involving media presentations and local meetings, we find very modest increases in awareness about weather modification among respondents between early 1972 and late 1973. Findings on the relationship between knowledge and favorability remain inconclusive.

## 6. Evaluation of cloud seeding

The major dependent variable of the study has been whether respondents favor or oppose cloud seeding as implemented in South Dakota. Inquiry was made into respondent assessment of programs, expectations of benefit or harm, concerns about side effects, and anticipated action toward programs.

A major reason for launching a cloud seeding program in an agricultural area is the economic benefit that can derive from it. Studies have been conducted on the potential economic benefit to the state of an additional inch of rainfall per season<sup>6</sup> and the amount of damage from hail that could be prevented.

<sup>6</sup> See, for example, Rudel (1973) and Special Study Team, (1972).

TABLE 14. Anticipated economic benefit/harm from cloud seeding.

Response	T <sub>1</sub>		T <sub>2</sub>	T <sub>3</sub>
	Hail suppression	Rain augmentation		
Benefit	76	72	76	73
No difference or don't know	23	26	22	24
Harmful	1	2	2	3
	100%	100%	100%	100%
Total N	436	436	368	326

TABLE 15. Do you have any particular thoughts about possible side effects from cloud seeding?

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Yes	31	39	34
Don't know	18	7	8
No	51	54	58
	100%	100%	100%
N	436	365	326
Missing data	0	3	0
Total N	436	368	326

We examined respondents' perception of economic benefit or harm as a result of cloud seeding. Findings presented in Table 14 show that about 3 out of 4 respondents anticipated economic benefit rather than harm from cloud seeding. The proportion anticipating benefit changed very little across time.

In keeping with the general pattern of overall favorability, 93% of knowledgeable respondents (those aware of their local program) reported at T<sub>3</sub> that the program had either benefited them or made no difference to them. Those who reported benefit from the local effort (N=60 at T<sub>3</sub>) cited good crops, moisture received, and lack of hail damage. Several local merchants reported direct and indirect benefit, as well. For example, a car dealer reported that fewer cars had been hail damaged during the 1973 season and expressed appreciation for the benefit he had derived from the program. A farm implements dealer said that his business was better if farmers had good crop years, and he felt that the local program had helped ensure that outcome.

Concern about possible side effects of the technology has been widely expressed among scientists and the general public. We asked South Dakota respondents whether they had any thoughts about possible side effects of cloud seeding, and what these were. Results, presented in Table 15, show that about two-thirds of the sample indicated they had no particular worry about such effects. Those expressing concern (N=111 at T<sub>3</sub>) were primarily sensitive to the danger of flooding or excessive moisture.

Respondents were asked to indicate what action they would take (if any) if a cloud seeding program were proposed for their area (Table 16). The proportion proposing supportive action increased from 24% at T<sub>1</sub> to 37% at T<sub>3</sub>, a change significant at  $\alpha=0.005$ . The most commonly mentioned supportive action was voting in favor of the program. This finding suggests that public response to cloud seeding proposed for the subsequent season would be, at least, benign. Actual behavior has been consistent with these findings to the extent that all counties in the sample opted to continue participation in the 1973 and 1974 operational seasons.

Favorability toward the SDWMP is summarized in Table 17. The pattern of reasons for favoring and op-

TABLE 16. If there is a cloud seeding program proposed for your area this summer (next summer), do you think you will do anything to support or oppose it?

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Yes, support	24	37	37
No	60	46	49
Don't know	14	11	9
Yes, oppose	2	6	5
	100%	100%	100%
N	419	366	324
Missing data	17	2	2
Total N	436	368	326

posing the SDWMP have remained relatively constant. Reasons mentioned include perceived need for moisture and hail control, help to farmers, belief in science, and help to the state as a whole. Those opposed mentioned reasons we term "religio-natural," e.g., belief that the weather should remain inviolably in God's or nature's domain. Over half of all respondents favored the Program, 20% had not reached a decision, and 14% opposed it.

### 7. Decision making and funding

The SDWMP is administered by the State's Division of Weather Modification. Participation is optional by county; the local decision is made by county commissioners whose choice may be based on such local input as popular vote, polls and the like. County funds (property tax mill levy) provide one-fourth of the Program's cost. State general fund appropriations furnish the remaining 75% of operating costs. For 1973, costs totaled 3.2¢ per acre, with \$643,818 provided by state funds and \$190,000 from counties, with a total Program cost of \$833,818.

TABLE 17. Based on your understanding of the SDWMP, how do you feel about the Program?

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Strongly oppose	2	5	5
Oppose	7	8	9
Neutral	14	11	13
Favor	40	46	39
Strongly favor	6	10	14
Insufficient knowledge to judge	31	20	20
	100%	100%	100%
N	436	365	326
Missing data	0	3	0
Total N	436	368	326

  

Summary	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Oppose	9	13	14
Favor	46	56	53

TABLE 18. Preferred decision making regarding cloud seeding programs.\*

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Local residents; local (county) government; farmers and ranchers	47	44	43
Local and state government	11	7	7
Local, state and federal government	1	2	3
State government	7	13	13
State and federal government	4	1	2
Federal government	2	0	1
Scientists conducting program	6	5	1
Other**	16	21	18
Don't know	6	7	12
	100%	100%	100%
Total N	436	368	326

\* At T<sub>1</sub>, the question was phrased: "Who do you think *should* make the decision whether or not a cloud seeding program should be allowed in your area?" At the two post-operational interviews, we asked: "Who do you think *should* make the decision whether or not to continue the program in your area next summer?"

\*\* Other includes "politicians," "county agents," "governor," "president."

Counties are organized into six unofficial multi-county weather modification districts, whose boards convene annually to decide program emphases (e.g., hail suppression vs rain enhancement) and overall policy on such questions as whether or not to continue seeding during tornado watches. The boards are responsible for providing the Division with information on local soil moisture and crop conditions; they have the authority to suspend operations at any time.

Little is known among respondents about the intricacies of the weather modification decision process. Those most intimately involved (county commissioners and the division staff) appear to be satisfied that the process is viable. The key element, that of local control, is the decision-making method preferred by South Dakota respondents (see Table 18).

Conclusions regarding preferred decision-making processes from the study's findings are:

- 1) The application of weather modification is definitely perceived as a political decision.
- 2) A very sizable minority (over 40%) prefer that such decisions be kept at the local level.
- 3) Very few believe that decisions should be made by anyone outside the state.

Knowledge among respondents about actual decision-making and funding processes remained at a low level after two operational seasons.

With regard to Program funding, most respondents believed cloud seeding to be expensive enough to

TABLE 19. Preferred funding of cloud seeding.

Response	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Local residents	6	12	11
Local agriculturists	9	13	14
Local (county) government	2	5	7
Local and state government	3	4	6
Local, state and federal government*	—	—	13
State government	20	27	19
State and federal government	10	13	9
Federal government	12	9	6
Other**	21	8	3
Don't know	17	9	12
	100%	100%	100%
N	253	366	326
Missing data	1	2	0
Total N	254***	368	326

\* Not a code category at T<sub>1</sub> and T<sub>2</sub>.

\*\* Other: mostly unidentified taxpayers.

\*\*\* Asked only of April 1972 respondents.

warrant tax-based support. The majority, however, felt that programs should be financed at the state and/or local levels (see Table 19).

Weather modification projects are unique in that they potentially cost more than a local tax base can provide, yet residents desire to retain control over what is to be done with their weather. South Dakota findings corroborate those from other states on this point (Haas, 1973). Indeed, it may be that much of the general acceptance of and lack of opposition to the South Dakota Weather Modification Program is due to the intimate involvement of local governmental representatives in the decision process. Social scientific evidence is accumulating that local control may be a key factor in public acceptance of the technology.

### 8. Multivariate analysis<sup>7</sup>

As noted earlier, the study's major dependent variable has been evaluation of operational weather modification in South Dakota. It has been hypothesized that evaluation of programs would be affected by:

- (i) belief or not in the efficacy of the technology
- (ii) acceptance or rejection of the religio-natural orientation
- (iii) knowledge gained about operational programs
- (iv) attitudes toward weather modification in general
- (v) perceived benefit or harm as a result of programs
- (vi) attribution or not of unusual weather to cloud seeding operations
- (vii) the perceived relative importance of cloud seeding to other problems and solutions.

<sup>7</sup>The multivariate analysis is fully reported in Farhar and Mewes (1974, pp. 156-169).

The direction of hypothesized relationships is generally that greater belief, knowledge, favorable attitudes toward technology, etc., are associated with more favorable program evaluation, while less belief, knowledge, etc., are associated with less favorable program evaluation.

Scale analysis has provided support for the direction of hypothesized relationships and data on the strength of these relationships. For 1973 data, high positive correlations (significant at  $\alpha=0.01$ ) were found between favorable program evaluation and high belief in efficacy, favorable attitudes toward the technology, judgment that weather modification is important, and rejection of the religio-natural orientation. The correlation of knowledgeability and favorable evaluation was positive but not high ( $r=0.46$ ).

Using factor analysis and stepwise regression analysis, we have addressed the question of the degree of predictive power of these variables for evaluation of programs. The four factors utilized in the analysis were ranked in their order of predictive power at T<sub>3</sub>: 1) attitudes toward weather modification, 2) belief in efficacy, 3) knowledgeability, and 4) religio-natural orientation.

At T<sub>3</sub>, 54% of the variance in program evaluation was accounted for by these four factors. Belief in efficacy emerged over time as a more powerful predictor variable in accounting for how programs are evaluated, while attitudes about man's interfering with God's domain or the balance of nature became somewhat less powerful predictors.

Addition of other explanatory variables, such as perceived benefit/harm as a result of the technology, awaits further data collection and analysis.

### 9. Impact of the Rapid City flood on public opinion about the technology

We had interviewed in South Dakota both before and after the disastrous Rapid City flood of 9 June 1972, which occurred in the presence of cloud seeding. We were interested in comparing pre-flood to post-flood responses stratified by respondent assessment of the causal relationship between cloud seeding and the flood [see Farhar (1974) for a complete analysis].

Findings showed that most respondents were aware that cloud seeding had occurred prior to the flood and that the majority did not attribute the flood to cloud seeding. Rapid City area residents were no more likely than other respondents in the state to attribute a causal link between cloud seeding and the flood. The perception of the disaster as man-made was associated with increased knowledge about programs, increased belief that the technology is effective, and decreased favorability toward the technology and toward programs.

### 10. Summary

The South Dakota study has been carried forward with interviews conducted again at the end of the 1974

operational season. Future data analysis will include further development and testing of the multivariate analysis to enhance the predictive capability of the interview instrument.

Major findings for 1972 and 1973 may be summarized as follows:

- 1) After two full seasons of operations, and the experiences of flood and near-drought, favorable attitudes toward the technology remained the majority perspective.
- 2) All attitude scales showed a change in direction of favorability to weather modification across time.
- 3) By the end of 1973, the sample as a whole changed from acceptance to rejection of the "religio-natural" orientation, although a sizable minority of about 38% still held it. This orientation opposes interference with weather processes either because of the belief that it violates the domain of the Supreme Being and/or because it may upset the balance of nature.
- 4) The proportion of the sample believing that cloud seeding can suppress hail rose from 19% at T<sub>1</sub> to 52% at T<sub>3</sub>. Belief that the technology can augment precipitation increased from 48% at T<sub>1</sub> to 69% at T<sub>3</sub>.
- 5) By T<sub>3</sub>, 80% of the sample was aware of the SDWMP. The proportion of the sample aware of their local cloud seeding during 1973 was 41%.
- 6) Most information about local cloud seeding was disseminated through the informal information network existing in each community and through written media.
- 7) By T<sub>3</sub>, there was no increase in awareness that cloud seeding occurred prior to the Rapid City flood. Majority opinion remained the same—that cloud seeding did not cause the flood.
- 8) The majority of respondents continued to favor the SDWMP at T<sub>3</sub>. Those terming their local program successful at T<sub>3</sub> were 54%, while 20% thought it a failure.
- 9) The decision to apply the technology was definitely perceived by respondents as properly political. Two-thirds of the T<sub>3</sub> sample said that local residents/local government, state government, or both, *should* make cloud seeding decisions. The majority felt that programs should be financed at the state and/or local levels. Opinion on both decision making and funding has not changed notably over time.
- 10) Belief in the effectiveness of the technology, favorable attitudes toward it and toward science, and rejection of the religio-natural orientation all correlated to positive assessment of operational programs.

11) Multivariate analysis has shown that up to 54% of the variance in evaluation of programs (support or opposition) can be accounted for by four consistent factors.

12) There has been no organized opposition to the SDWMP in South Dakota since the Program's inception.

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#### REFERENCES

- Bohland, James, 1974: Untitled paper. Dept. of Geography, Universities of Oklahoma, Norman.
- Farhar, Barbara C., 1975: The impact of the Rapid City flood on public opinion about weather modification. *Bull. Amer. Meteor. Society*, 55, 759-764.
- , 1974: The relationship of socio-demographic characteristics and attitudes toward weather modification: The South Dakota study, 1972. *J. Wea. Modification*, 5, 261-276.
- , and Sigmund Krane, 1973: Weather modification and public opinion, South Dakota, 1972—Interim report. Institute of Behavioral Science, University of Colorado.
- , and Julia Mewes, 1974: Weather modification and public opinion, South Dakota, 1973—Interim report. Institute of Behavioral Science, University of Colorado.
- Haas, J. Eugene, 1973: Social aspects of weather modification. *Bull. Amer. Meteor. Society*, 54, 647-657.
- Katz, Elihu, and Paul F. Lazarsfeld, 1955: *Personal Influence*. Glencoe, Ill., Free Press.
- Lazarsfeld, Paul F., and Herbert Menzel, 1963: Mass media and personal influence. *The Science of Human Communication*, Wilbur Schramm Ed., New York, Basic Books.
- Rudel, Richard, 1973: A pilot study to determine direct benefits of increased precipitation of four South Dakota farms. South Dakota Weather Modification Program—Special Studies, Denver, Colo., U. S. Bureau of Reclamation, Division of Atmospheric Water Resources Management, Report SDWMC-R-73-1.
- Special Study Team, 1972: Evaluation of the effects of added rainfall during the growing season in North Dakota. Annual report, Fargo, North Dakota State University.
- Williams, Merlin C., 1973: The South Dakota weather modification program. *J. Wea. Modification*, 5, 7-23.