

INTEGRATING THE SOCIETAL COMPONENT
IN THE PROPOSED NORTHERN COLORADO
TOTAL AREA MOUNTAIN SEEDING EXPERIMENT

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INTRODUCTION

"Robbing Peter to Pay Paul" -- explain as we will, that is often what the layman believes is the essence of successful precipitation enhancement. There is a certain seat-of-the-pants logic to the stream analogy -- you take a bucket of water out upstream and it is not available downstream. That sort of reasoning cannot always be shaken by pointing out physical differences between water on the ground and in the atmosphere. Perhaps it is one of those situations when "the more you explain it, the less they understand it". In any event the acquisition and analysis of data from an experiment designed to study the total area of effect from seeding ought to clarify what is actually taking place. Information on precipitation changes -- upwind and downwind, increase and decrease, or any combination thereof -- would illuminate the real impact of seeding on Peter as well as on Paul.

The Department of Atmospheric Science at Colorado State University has proposed carrying out in northern Colorado a cold weather orographic seeding experiment in which data will be sought concerning the total area of effect of winter snowpack augmentation seeding (Grant, Mielke and Chappell, 1977). Earlier experiments have focused upon getting information from target areas located relatively close to areas in which seeding has been done (Grant and Kahan, 1974). The northern Colorado proposed experiment has been formulated to obtain data from an extended area downwind from such near target areas.

Like most large-scale seeding studies and field experiments, the proposed total area mountain seeding project will require federal funding. States or other governmental or private sponsors of seeding projects are interested in getting information about their seeding results. They need it for evaluation. But they lack funds to set up necessary instrumentation and evaluate data -- particularly to find out what has happened downwind from areas intended to be affected. Federal funding will be essential.

When federally-funded undertakings have a significant effect on the quality of the human environment they must comply with the National Environmental Policy Act (NEPA). NEPA was designed to assure a concerned public that societal values will be considered in connection with such federal activities (Anderson, 1973). Societal considerations are also now part of the permit issuance process for seeding projects in some states (Davis, 1975). Moreover both the final report of the Weather Modification Advisory Board (1978) and the report of the Secretary of Commerce required by Public Law 95-490 (1979) call for increased societal awareness by weather modifiers.

As part of its program planning for the total area mountain experiment, the Colorado State University Department of Atmospheric Science consulted with a task group of persons knowledgeable in the interaction of seeding clouds with environmental concerns, sociological matters, economic considerations, and legal, political and institutional ramifications. This task group of societal experts worked on planning the societal component of the northern Colorado downwind experiment, and produced a document which can be used in any replication of a societal component in a weather modification program (Jones, Klein, Davis and Piernot, 1978).

PLANNING EXPERIMENT

NEPA section 102 (a) requires federal planners for environmentally-sensitive activities to use an interdisciplinary planning approach. Before plans are set, there must be input from societal experts. Planning no longer can be the exclusive preserve of the technicians (Meyers and Tarlock, 1979).

To enforce section 102 (a) Congress added section 102 (c) which calls for preparation of detailed environmental impact statements by agencies proposing any "major Federal actions significantly affecting the quality of the human environment". Such EIS's should be the products of careful and comprehensive interdisciplinary studies, including societal studies like that proposed as a part of the total area mountain experiment.

NEPA has not been completely effective in reaching the goal of truly integrated multidisciplinary project planning. Some EIS's are prepared by merely "filling-in-the-blanks" of standard form statements. And societal studies are not often enough really integrated into the planning process. Instead they are tacked on as afterthoughts to meet statutory and administrative "letter-of-the-law" requirements.

The intent of NEPA, as described above, appears to be captured in the northern Colorado winter seeding proposed experiment. Societal considerations have been at the center of conception and design of the project. And the societal experimental design calls for continued integration of that component with the physical project during its operation and evaluation. This will require a close linkage between the physical and societal portions of the project, with data from the physical experiment being used by the societal group as it becomes available. Also the researchers into societal issues will need to keep each other regularly informed of their activities and findings. In such a fashion information obtained will be maximized.

Much prior work on societal issues relating to weather modification has come after the fact. Part of the importance of the approach of the northern Colorado experiment is that there will be concurrent efforts. Meteorological and societal work will take place in the same time frame. Societal studies will not be tacked on as afterthoughts.

OPERATION OF EXPERIMENT

The northern Colorado project is planned as a five-year experiment. At

least during the first year of the project no data from the physical portion of the experiment will be available for use by the societal team. However, by using techniques used in technology assessments of cloud seeding (Changnon et al, 1977; Weisbecker, 1974), estimates of impacts can be made and used by societal researchers. Also, societal effects will be taking place quite independently of any physical effects. The mere mounting of a seeding project may alter human expectations and people may perceive changes.

Data from the physical experiment, as it becomes available, will be fed into the societal component. It is recognized that each of the societal disciplines can have different critical time scales. Information will need to be accumulated and communicated on a series of levels -- per event, per series of events, per season, and per series of seasons.

The major areas of effect which will be studied as part of the societal component will be in the north central Colorado Rocky Mountain foothill area. The drainages included are the North Platte and the north Park area into Wyoming and Nebraska, the Yampa River which flows into the Colorado River system, and the Poudre River, a tributary of the South Platte.

These areas were selected in order to get a limited, but varied, set of response systems. In the North Park there is irrigation from snowmelt but no storage, a hay-type system. In the Poudre there is an extensive storage system and hydrological records. The Yampa flows west and has measuring capacity. These areas of effect have the needed historical records, capability of streamflow and soil moisture measurement, and a locale in which plant growth responses can be studied.

Hydrological studies will form a critical link in connecting the meteorological and societal components (Jones et al, 1979). Snowpack monitoring from the physical experiment will provide input for studying the related hydrological responses. Since there will be delays in observing waterflow changes, the societal group will need estimates of anticipated changes for the first part of the experiment. This information on streamflow timing and amount can be provided to the societal researchers through use of simulation techniques. When actual information is available, that data also will be provided to persons studying the environmental, sociological, economic, and legal-political aspects of the societal component.

1. Environmental

Studies of environmental responses in the project area will be prioritized. Focus will be upon:

- Snowpack and melt dynamics to ascertain effects on transitional alpine communities.
- Dryland farming and any change in the total area of effects.
- Grazing.
- Possible transitional lands-use conversion.
- Effects on plant growth of such impacts as erosion and sediment transport.

-- Indirect effects on game animals.

2. Sociological

Responses of various stakeholder groups will be the focus of the sociological studies. They will examine:

-- Mountain recreation stakeholders.

-- The agriculture, grazing and forest products industries.

-- Costs to governmental entities for such things as snow removal, road upkeep, etc.

-- Potentially impacted downstream and downwind communities.

-- Travel and transport.

-- Energy costs and their impact.

3. Economics

The value of changes in water amounts and timing will be the thrust of economic studies. There are likely to be both positive and negative effects, and they can be primary or can be more remote. Alternative means of water resources management must be considered to place the seeding project in its economic context. The impacts of the efforts to increase water resources will be studied in connection with such local industries as tourism, agriculture, recreation, etc.

4. Legal-political

The legal-political portion of the societal component will emphasize rights to use of water within the drainages, between states, and among nations. It also will consider the legal aspects and political ramifications of the environmental, sociological, and economic impacts. This will view both liability for real negative impacts and political concern for perceived impacts.

During the latter part of the project the societal component will refine its issue analysis, with a thrust toward further prioritizing. Emphasis will be on those issues which are different or not similarly focused from the usual studies of target area effects of seeding. Also policy options will be considered and decision recommendations will be made.

REPLICATION OF SOCIETAL COMPONENT

Once the northern Colorado experiment has been done, there will be a model tested and available for use in doing societal studies in conjunction with other weather modification experiments, demonstration projects, and commercial operations. For example, drought relief plans being prepared by

the Water and Power Resources Service can incorporate a similar component in planning and operations.

There will be differences between the total area experiment and other experimental studies. Research programs will differ from operational ones. Research can be reversed and take place within a relatively short time span. But this study of how to make societal studies part of an experiment has provided a mechanism for longer-term programs. A design for societal studies is now available. During and after conduct of the total area study more data and analysis will be developed. Whatever comes of trying to give some firm numbers to answer the meteorological question of whether Paul robs Peter, more will be learned of societal impacts on orographic seeding -- impacts in an extended area of effect.

REFERENCES

- Anderson, F. R., 1973: NEPA in the Courts: A Legal Analysis of the National Environmental Policy Act. Johns Hopkins University Press, Baltimore, Md.
- Changnon, S. A., R. J. Davis, B. C. Farhar, J. E. Haas, J. L. Ivens, M. V. Jones, D. A. Klein, D. Mann, G. M. Morgan, S. T. Sonka, E. R. Swanson, C. R. Taylor and J. van Blokland, 1977: Hail Suppression: Impacts and Issues. Illinois State Water Survey, Urbana, Illinois.
- Davis, R. J., 1975: Legal Response to Environmental Concerns About Weather Modification. J. Appl. Meteo. 14, 681.
- Grant, L. O. and A. M. Kahan, 1974: Weather Modification for Augmenting Orographic Precipitation. Chapter 7, Weather and Climate Modification, ed. by W. N. Hess, 282-317. John Wiley and Sons, New York.
- Grant, L. O., P. W. Mielke and C. F. Chappell, 1977: Proposal to National Science Foundation for Total Area Mountain Study.
- Jones, E. B., L. O. Grant, D. A. Klein, R. J. Davis and C. Piernot, 1979: A Societal Component Approach for A Colorado River Basin Weather Modification Program. Seventh Conf. on Inadvertent and Planned Weather Modification. 35.
- Jones, E. B., D. A. Klein, R. J. Davis and C. Piernot, 1978: Report on Societal Component of the Total Area Mountain Study.
- Meyers, C. J. and A. D. Tarlock, 1979: Water Resource Management, p. 538, Foundation Press, Mineola, New York.
- Secretary of Commerce, 1979: National Weather Modification Policies and Programs. Report to President and Congress.
- Weather Modification Advisory Board, 1978: The Management of Weather Resources, Vol. 1. Report to Secretary of Commerce.
- Weisbecker, L., 1974: Impacts of Snow Enhancement, Univ. of Okla. Press, Norman, Okla.