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# RANN UTILIZATION EXPERIENCE

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CASE STUDY NO. 11

**NATURAL HAZARDS**

UNIVERSITY OF COLORADO

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## NATURAL HAZARDS

### Introduction and Summary

A number of Federal agencies and offices are concerned with preventing or mitigating the impact of disasters. However, valid and reliable data on the economic and social costs of disasters are not generally available. It is, therefore, difficult for policymakers to develop satisfactory programs for minimizing the consequences of recurring disastrous events or for assigning priorities for hazard and disaster research. There is a clear and urgent national need to establish satisfactory cost estimates, to systematically assess alternative social and economic responses to natural disasters, and to set priorities for research and for resource allocations.

The "Natural Hazards" study is directed to this need; it focuses on the national status of research efforts and research needs with regard to natural hazards such as floods, earthquakes, or hurricanes. Its aim is to provide both information on the immediate policy alternatives and evaluations of existing research concerning such hazards.

This project is being carried out at the University of Colorado in Boulder with Dr. Gilbert F. White as principal investigator. Dr. White, a geographer, is Director of the Institute of Behavioral Sciences. Through his long experience in studying the social, economic, and physical effects of natural disasters, Dr. White has become an acknowledged expert in that field. Dr. J. Eugene Haas, the principle associate of Dr. White, has extensive experience on many aspects of natural hazards

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and disasters, particularly earthquakes. A core 15-person research team that includes economists, engineers, geographers, geophysicists, meteorologists, psychologists, social scientists, and a lawyer also participated in the project studies. In addition, various specialists associated with the National Center for Atmospheric Research, Travelers Insurance Company, and Colorado State University have made valuable contributions to the research.

The project, formally entitled "Assessment of Research on Natural Hazards," was initiated in April 1972, with NSF-RANN funding of \$723,900 for a period of 26 months. Supplemental grants of \$49,000 in the fall of 1973 for additional research and \$26,000 in 1974 to assist in the publication and distribution of the research results were awarded.

The research focused on analysis of (1) existing data, (2) the quality of the data, (3) the effectiveness of methods for coping with hazards, (4) the probable effectiveness of alternative methods, and (5) the costs and benefits of the various methods. Some 15 natural hazards were considered. After coalescing present data on each, areas that should be further researched were identified. In order to provide a basis for evaluating public policy alternatives and assigning priorities to new research relating to geophysical hazards, an assessment of the costs and benefits of various methods of coping with hazards has been given.

This research was mainly directed toward the Federal, State, local, and private agencies concerned with natural hazards and disasters. A strong involvement of officials from these agencies and from the private sector (e.g., the insurance industry, the American Red Cross, and

academic institutions) has provided these officials with an understanding of the principal findings before the research was completed, and such involvement supplies a solid foundation on which to base future utilization.

Understandably, full utilization of this project has not yet been realized. While the actual research ended in July 1974, publication and distribution of the final report did not occur until June 1975. Prior to the availability of that report, dissemination of the research had been mainly to and through the officials on the Advisory Committee, a special invitational conference on the project, and selected briefings of key officials by the Principal Investigator. Participation of officials on the Advisory Committee has provided them with general assistance in exercising their responsibilities concerning natural hazards, although to date, most of them are unable to identify specific policy impacts of the Colorado study. Others with professional interests in natural hazards know of the study and recognize its importance. They are eagerly awaiting the report and expect it to exercise a pivotal effect on future decisions.

This utilization study is based on information supplied by Dr. Baker, the program manager at NSF, by Dr. White, and by participants and users identified in the following discussion. Most of the information was obtained through extended telephone conversations with those parties. Other materials about the research were found in the Spring 1973 issue of MOSAIC, a quarterly publication of the National Science Foundation, and in Energy Environment Productivity-Proceedings of the First Symposium on RANN, Research Applied to National Needs.

## Research History

The specific objectives of the Colorado research on natural hazards were the following:

- " To develop standard criteria for the production of social and economic costs data on major natural hazards and to determine the population at risk;
- " To assess for the Nation, its regions, and the States the present and prospective economic and social costs for major natural hazards and to determine alternative feasible ways of reducing those costs;
- " To prepare a program statement of needed research and the expected payoffs;

The evaluation of each of the 15 natural hazards (listed in table 11-1) followed a general outline, with some variances within the topic subcategories. A literature review of opinions of research needs and of actual research activities initiated each hazard assessment. Analyses of current losses, benefits, and research activities showed the state-of-the-art and the magnitude of each hazard. When possible, the cost-effectiveness of alternative responses to each hazard was estimated. The estimates included the direct benefits and social costs; which are difficult to make even to the nearest order of magnitude. Simulation modeling of various proposed responses was conducted to help estimate the impact of a proposed action.

Table 11-1. Natural hazards, associated losses, and catastrophe potential in the United States

Hazard	Average Annual		Catastrophe Level
	Losses	Deaths	
	(millions, 10-yr base)		
Flood	\$2,000	129	High
Frost	1,000	0	Low
Hail	550	0	Low
Drought	500	?	Medium
Hurricane	400	50	High
Coastal erosion	300	0	Low
Tornado	215	101	High
Landslide	200	?	Low
Earthquake	100	9	High
Wind	100	50	Medium
Lightning	50	115	Low
Urban snow	20	?	Low
Tsunami	10	12	High
Avalanche	1	7	Low
Volcano	?	?	High

The simulation approach worked when models were available or were geared for expansion. Alternative approaches or responses to hazards, particularly those to interconnected hazards, were developed through a scenario analysis, where past and/or future actions in particular situations were analyzed with different inputs.

The research staff investigated the hazards in nearly parallel tasks, rather than serially, to expedite the time required for completion. Workshops and reviews were held with expert consultants who are also potential

users. They examined preliminary findings, made recommendations, and participated in the scenario and simulation approaches. Such workshops normally included staff members associated with more than one hazard.

Finally, a preliminary list of research findings, evaluated according to a set of criteria and reflecting more than a year's effort, was developed. A national conference of invited experts from all hazard areas and various levels of government was held in October 1973 to critically appraise and recommend changes to the draft.

The research ended in July 1974, the team having accomplished its goal. The report, consisting of a 400-page basic summary of findings and recommendations, was published in June 1975 by the MIT Press. Nineteen individual supplemental reports will be published simultaneously at the University of Colorado. Interested parties from many responsible academic, governmental, and industrial positions, identified by the dissemination process, are looking forward to distribution of the results.

### **Planned Utilization**

As planned, governmental policymakers, administrators, technologists, and officials of private agencies concerned with disaster relief were to be the prime users of the results of this project. Half of the advisory committee members were associated with government, thus insuring that the research addressed that audience. Continued working contacts were anticipated with Federal agencies (e.g., Departments of Agriculture, Interior, Commerce, Defense, and Housing and Urban Development; and the Office of

Emergency Planning) so that the findings of the research would be known to the relevant agencies by the time the project was completed. The most immediate use expected at the Federal level was in planning for internal and external funding for research. Already policy is being influenced and agencies are planning actions based on the research results. Academic and industrial utilization should follow.

### **Actual Utilization**

The advisory committee was organized as planned. Its membership is shown in table 11-2. This group, according to Mr. White, provided active guidance to the research, reviewed accomplishments, and has facilitated dissemination of the results.

The planned national conference was held at Estes Park, Colorado, in October 1973. The invited participants represented a cross section of both contributors to and users of the research. Of the approximately 150 attendees, 50 were associated with the Federal Government, 13 with local or State government, 43 with academic organizations, 6 with insurance companies, 13 with industry, and the remainder with public interest groups, disaster relief organizations, and the communications media. The conference was organized such that a project staff member presented information and analysis relative to each of the identified hazards. That presentation was critically reviewed by a participant. Separate discussion groups were then organized to review and critique the findings and provide for constructive interactions between the various participants. The composition of these discussion groups was deliberately changed frequently to

Table 11-2. Natural Hazards Advisory Committee\*

George W. Baker Division of Social Systems and Human Resources RANN National Science Foundation Washington, D. C. 20550 (NSF Program Manager)	E. L. Quarantelli Disaster Research Center Ohio State University 127-129 West 10th Avenue Columbus, Ohio 43210
Kenneth E. Boulding Institute of Behavioral Science IBS #3, 102A University of Colorado Boulder, Colorado 80302	Will Reedy Division of Planning Coordination Bureau of Reclamation Building 67 Denver Federal Center Denver, Colorado 80225
Earl Cook Texas A & M University College of Geosciences College Station, Texas 77843	Robert Schnabel Federal Disaster Assistance Administration Executive Building Annex 17th and F Street Washington, D. C. 20504
Charles H. W. Foster Secretary of Environmental Affairs Commonwealth of Massachusetts 18 Tremont Street Boston, Massachusetts 02133	Herbert Temple, Jr. Office of Emergency Services State of California Meadow View Road Sacramento, California 95823
George Housner Earthquake Engineering California Institute of Technology Pasadena, California 91109	Joseph Tofani Policy and Analysis Division Civil Works Directorate Room 46046 Forrestal Building Washington, D. C. 20314
Thad McLaughlin U.S. Department of the Interior U.S. Geological Survey Building 25 Denver Federal Center Denver, Colorado 80225	John Townsend National Oceanic and Atmospheric Administration Rockville, Maryland 20850
Daniel Price Department of Sociology University of Texas Austin, Texas 78710	Neil P. Woodruff Agronomy Department Kansas State University Manhattan, Kansas 66504

\* Positions are given as of the date the committee was organized.

enhance fluidity of idea exchange.

In most cases, each hazard is individually covered in one of the 19 monographs to be published at the University of Colorado. Two exceptions are the booklet entitled "Severe Storms," which includes tornadoes, lightning, and hail, and the booklet "Earthquake and Tsunami," which combines those two hazards. Supplements covering simulation modeling, distribution aspects, land use management, relief and rehabilitation, warning systems, and the scenario method will also be published.

To expedite and guide the distribution of the report and monographs, Federal and State agencies have been canvassed for potential users. Those users were requested to provide lists of others who could complement the research results. From these sources a list of approximately 1,000 potential users was compiled, and without charge they will receive the summary report and specific monograph related to their specialized interests.

A newsletter--not a planned part of the research publications--has developed as an outgrowth of inquiries into the research program. It was intended to keep as many people as possible informed of the progress in all the various areas of the research. The newsletter was not published according to a schedule but rather to highlight significant events or to offer updated news of the most recent research efforts.

Professor Martin Duke, past President of the Earthquake Engineering Research Institute, said that the newsletter alerted him to the scope of the research, quickened his interest, and kept him abreast of the results.

The experience and professional stature of Dr. White and Dr. Haas, as well as the recognized importance of the topic, have also led to potential utilization of the findings of the study. Dr. White, for example, points

to recent meetings with congressional staff members and public interest groups concerned with conservation and wildlife. In these meetings legislative implementation of some recommendations contained in the draft report was discussed. It appears that such legislation will be introduced after the report is published. Dr. White has also testified before a subcommittee of the Senate Banking Committee concerned with flood insurance and has been contacted by another congressional subcommittee for testimony.

Two months after this research began, a flood devastated parts of Rapid City, South Dakota, causing over \$100 million in damage and resulting in the loss of 231 lives. Members of the research team collected information on the response to the catastrophe. According to Mr. William Duhamal, a Rapid City broadcasting executive, the Colorado research team demonstrated to community officials how changes of policies and procedures for community preparedness--and specifically the flood warning system--could have reduced the impact of the flood. Most of the suggested changes reflect a common-sense approach to the problem.

Both Dr. Haas and Mr. Duhamal spoke to a convention of radio and television news directors in October 1973 on the role of the broadcasting industry in planning for disasters. These presentations led to the preparation of the 19-page booklet "A Broadcaster's Guide to Planning for a Natural Disaster," published and distributed by the National Association of Broadcasters. At this time, Mr. Duhamal is unsure of the reaction of the broadcast industry to the measures suggested, but he believes that only a few stations have been sufficiently motivated to take positive action.

The Federal Insurance Administration (FIA) of HUD is responsible for flood insurance programs, a very important aspect of flood plain development. Communities that do not initiate flood plain studies are not eligible for flood insurance programs. Director of Program Development Staff, Dr. Theodore Levin, of FIA, feels that measures and concepts presented in the draft report will be very helpful in giving direction to the allocation of FIA's resources.

The U.S. Army Corps of Engineers, according to Mr. George Phippen, engineer in the Office of the Chief Engineers, has underway a new national assessment of flood losses to update a 1968 assessment. The "Natural Hazards" research used a simulation model to assess present and future flood losses. The Corps plans to compare this with other methods for estimation of losses and, based on its experience, to assess the future effects of proposed regulations.

Mr. Ugo Morelli, Research Analyst, Preparedness Division of the Federal Disaster Assistance Administration (FDAA) of HUD, has been actively involved in the entire research project, helping evaluate the proposal for NSF, participating in review sessions and the Estes Park Conference, and finally, reviewing the final draft report. He was awaiting the publication and distribution of the summary report and the specialized supporting monographs before attempting implementation of the research findings applicable to FDAA. In anticipation of the report, the Preparedness Division has asked the Policy Development and Research Division of FDAA to set aside funds for the upcoming year so that it can determine policy or generate research programs based on the findings of the "Natural Hazards" report.

FDAA is also publishing this spring a "Directory of Disaster Related Technology," which will include the bibliography from the "Natural Hazards" basic report.

Mr. Morelli suggested that another conference on the final results of the research, along the same lines as the Estes Park Conference, would be very useful. Whereas the first conference was more beneficial to the research team and gave users some ideas on the direction of the research, the followup conference would have the research team show its comprehensiveness findings and recommendations. Similar regular meetings to review and update the findings could be most effective. Otherwise, the research effort initiated on this project will slowly become obsolete, requiring another effort of similar magnitude 7 to 10 years hence.

Dr. John Townsend, Associate Administrator of the National Oceanic and Atmospheric Administration (NOAA), served on the Advisory Committee for the research and Dr. Robert M. White, NOAA Administrator, led a discussion at the Estes Park Conference. Dr. Townsend said that the setting of priorities for research has had a strong influence on the 1975 and 1976 budget in NOAA.

Professor Martin Duke, Earthquake Engineering Research Institute, said that the preliminary results of this research will influence the directions that he and his associates will emphasize in their earthquake research. He feels that the study has increased the awareness of the relevant socioeconomic factors by earthquake researchers.

Although most of the potential governmental agency users of the research were awaiting formal publication of results before trying to put

research recommendations into effect, the American Red Cross began to utilize the research findings on a broad front before such formal publication. Mr. Roy Popkin, Assistant National Director of Disaster Service with the Red Cross, was intimately involved in the "Natural Hazards" study as a consultant and reviewer. Through this participation, information germane to the Red Cross mission related to frequently occurring natural disasters came to his attention. This information was distributed internally to increase staff awareness of the concepts discussed by the research team.

A recurring theme of the research program has been the need for coordination of emergency services. Although Mr. Popkin was skeptical of the need at first, the Red Cross joined with other volunteer agencies in conducting four regional conferences on coordination of services. Later on, subregional conferences dealing with the planning and implementation of coordinated emergency services will involve responsible agencies, both private and public, at the grass roots level.

Only recently the Red Cross has begun advocating changes in policy and service delivery that would help minimize the impact of disasters, rather than merely concentrating on improving traditional after-the-fact response. Recommendations of the research team on building codes, land use planning, insurance, and other related areas have been transmitted to local and regional Red Cross chapters for use in decisionmaking and activity planning.

The research highlighted the need for effective dissemination of warning information, rather than new technologies in communications. As a result of the finding, the Red Cross initiated a program of cooperation

with the Community Preparedness Section of the National Weather Service. The Red Cross Youth Program has, with the Weather Service's help, begun tornado drills in the schools located in tornado-prone areas. These drills, similar to fire drills, prepare students and teachers for actions before the emergency arises.

### **Factors Affecting Utilization**

At this point in time, it is too soon to assess the full range of utilization that may result from this project. However, this is understandable, because the final summary report--the study's primary tangible product--has just been distributed. Some utilization already has arisen from the users' continuous interaction with researchers throughout the project. Yet even those users who have already benefited from the research expect the most significant impacts to follow issuance of the report. Dr. White expressed the opinion at the beginning of the study that the summer of 1975 was the earliest that any major utilization could be expected. Thus, this utilization study is in some ways premature, and the utilization reported herein is not representative of the full range that will result from the research.

Each of the users contacted gave some signs of what Mr. Morelli of FDAA called "conceptual conditioning." The users had begun to view subject areas with a different, wider perspective as a result of their contacts with the research program. Such conceptual changes are not always directly translated into policy or specific programs, but they temper actions taken at all levels of responsibility. Methods for describing and quantifying the "conditions," such as an appropriately

designed survey, should be considered. This "conditioning" would appear to be a significant outgrowth of the study, yet it is difficult to describe or precisely quantify.

All the ingredients for a high level of utilization have been present in this project. Its subject is of major continuing importance; a competent advisory committee has provided guidance; the investigators related well to the user community and that community was directly involved throughout the project; Dr. White and Dr. Haas are experienced and have high professional stature; and finally, dissemination has been thoughtfully planned. All indications, therefore, point to widespread use of the research results after their publication and distribution.

## **Conclusion**

In this project, there was high level of participation in workshops and in the national conference by persons who were associated with government at the Federal, State, and local level. This appears to have had a beneficial effect on the course of the research and should eventually promote a high level of utilization.

One cannot escape the conclusion that in order to be productive, efforts to solve problems of the scope and importance of "Natural Hazards" require generous funding, as was provided for this project. Full justification of this large investment is to be expected in the future utilization of the research results. Projects dealing with topics as vital to the public as was this should continually be sought by RANN.

A continued follow-on activity to enhance utilization and update results warrants consideration. Mr. Morelli of FDAA, Mr. Popkin of the Red Cross, and others endorsed a biannual reconvening of the Estes Park workshop in a comparable nonoffice atmosphere. Support for planning and execution of such a gathering should come from RANN and other primary agencies supporting the Interagency Disaster Committee.

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