A SOCIOLOGICAL PERSPECTIVE ON THE SITING OF HAZARDOUS WASTE FACILITIES

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ABSTRACT

The siting of hazardous waste facilities has been, and will likely continue to be, both an important societal need and a publically controversial topic. Sites have been denounced, shamed, banned, and moved at the same time that the national need for their installation and use has grown. Based on available technologies, the effective siting of facilities is more of a major contemporary social issue than it is a technological problem. Traditional social impact assessment approaches to the siting process have generally failed to meaningfully contribute to successful project implementation; these efforts have largely ignored the public perception aspects of risk and hazard on the success or failure of facility siting. It is proposed in this paper that more readily acceptable solutions to siting hazardous waste facilities might result from the integration of two social science approaches: (1) social impact assessment, which seeks to define and mitigate problems, and (2) hazards policy studies, which has sought to understand and incorporate public risk perceptions into effective public decision-making. This paper illustrates how this integration of approaches could be implemented.

INTRODUCTION

The National Environmental Policy Act of 1969 (NEPA) and related environmental legislation represents the institutional beginnings of social impact assessment (SIA) as it is currently practiced. The mandate has been to analyze and anticipate social effects on the human environment that would likely occur from proposed federal actions. In attempting to carry out this mandate, the field of SIA has expanded and developed over the last 15 years and has been the main process by which social issues have been addressed. One of the most recent publications in the field addresses the assessment of social and economic issues related to nuclear waste exclusively.[1]

The SIA approach is now being used in the assessment of potential impacts of hazardous waste facilities at specific locations. Such an assessment usually addresses risk objectively in the sense that an accident is assumed to occur and the consequences of such an accident are estimated. This represents an artificial constraint on the factors that need to be explored to more fully understand the social impact of hazardous waste management. A missing ingredient is the concept of risk management in a perceptual sense because radioactive and other waste facilities are more than just "proposed actions" in the SIA tradition. From the public's viewpoint, these facilities equate to hazards. Social scientists, for more than 50 years, have been assessing how and why publics perceive and respond to the risk of natural and technological hazards. Currently, knowledge from hazards research, in combination with traditional SIA approaches, promises much for the siting of hazardous waste facilities.

Hazards research summaries,[2] as well as specific hazards studies,[3] agree that the most important factor in shaping human response to hazards is how that public perceives the risk.[4] Risk perceptions, whether defined as cognition or belief in the seriousness of the risk imposed by a hazard or as the subjective probability of the risk imposing negative effects, are typically formed on the basis of imperfect information. Additionally, that information is most often interpreted with difficulty and heard in a biased way by those who receive it. At the same time, the means to help people form perceptions of risk more closely in line with objective risk (technically calculated risk) is beginning to be documented in the hazards research field. The following discussion focuses on three basic ideas from hazards research: (1) the basic process whereby community perceptions of risk are formed; (2) the factors that indicate why perceived risk is so often not reflective of objective risk; and, (3) suggested ways to help publics more accurately perceive the risks of natural and technological hazards. A brief review of the most promising aspects of both SIA and hazards research will introduce the important variables that should be included when making decisions about siting hazardous waste facilities.

SOCIAL IMPACT ASSESSMENT

Most SIA work has focused on social disruption and stress to public facilities and services caused by the in-migration of labor for large construction projects. This perturbation in the social system has generally been interpreted as contributing to the loss of community cohesion/integration. These "costs" have generally been weighed against the "benefits" of increased jobs, increased income in the community, increased tax base from the new facility, and secondary economic benefits related to the new facility. This social disruption approach has been recently challenged.[5] The ensuing debate has evoked a general consensus among practitioners that the time is suitable to advance the field. It appears that past approaches, centered on population increases, are an inappropriate focus of SIA in relation to waste management.

Recent methodological work in SIA[6] has demonstrated the importance of examining several key sociological variables in the process of community

adaptation. These process-oriented variables are: social differentiation--the process by which systems become more complex; social integration--the process by which individuals and groups become connected to the social system; extra-local linkage--the process in which the community interacts with the larger society; and social stratification--the process that determines differential access to resources. Under the model of community adaptation suggested by Thompson et al.,[6] community resources (such as history, diversity, ideology, population size, population density, and economic base) are operating through sociological processes (differentiation, integration, extra-local linkage, and stratification) to interact with exogenous factors (such as a radioactive waste management project) to adapt to the changing environment. The importance of the key sociological variables lies in their determination of the community's ability to adapt to the changes imposed by a project. The relationships between these key sociological variables and overall quality of life is indicated in the model presented in Fig. 1.

Community culture, demographic characteristics, economic base, and the ecological setting are important factors in shaping social structure. The basic premise of the model is that the particular form of social organization and interaction in the community determines how exogenous factors are handled by the social system. Communities that are differentiated, integrated, connected to the larger society, and have access to resources represent an ideal-type "developed" community. As such, these communities are more responsive to needs for change. Also, these communities are more likely to be urban with a more educated, higher-income population and to have people endorsing environmental values against pollution and nuclear technology. On the other hand, communities at the opposite end of the continuum may lack the professional expertise, connections to agencies or groups that could be of assistance, a common interest in progress, and the necessary resources to facilitate change. Communities of the latter type need assistance in adapting community facilities and services. In the case of waste management, such services as

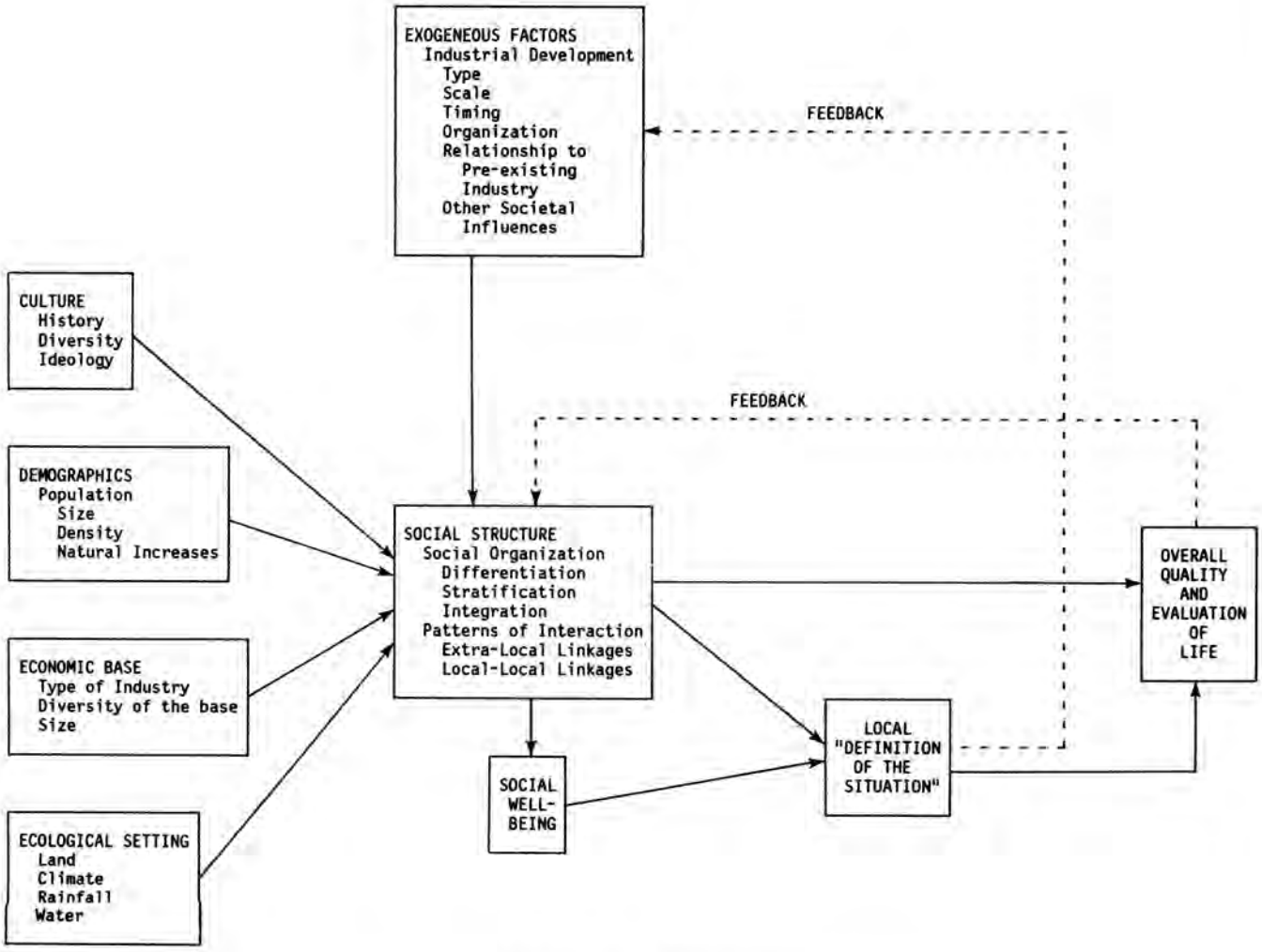

Fig. 1. Model of Community Organization and Change.

planning and water and air quality monitoring may need to be provided. With the more developed type of communities, the basic expertise, planning capability, and monitoring capability may be in place, but opposition based on environmental values may also be higher. Thus, community variation in social structure may make a difference in how project sponsors should work with communities on a given project.

The inclusion of the concept "social definition of the situation" is important in the model because it allows for the local interpretation of existing conditions in relation to a proposed action. The concept's inclusion allows for risk perception from hazards research (previously not included in SIA work) to be brought into the overall model of SIA for the siting of hazardous waste facilities.

PUBLIC RISK PERCEPTION IN HAZARDS RESEARCH

The field of hazards research has explored the formation of risk perceptions in understanding community adaptation and response to risk.[7] It remains as a central factor in reference to human adjustment to hazards.

The Process of Risk Perception Formation

Risk perceptions, and how they are formed, are best viewed in terms of a perception-formation process comprised of the following five steps: (1) hear, (2) understand, (3) believe, (4) personalize, and (5) decide. Although this model over-simplifies the process whereby perceptions are shaped, and the steps suggested need not be followed in logical sequence, the model does provide a means to catalogue what must be addressed to understand the complete range of potential factors in risk perception formation.

The first stage in risk perception formation is hearing or learning about the hazard. Community residents will hear official announcements differently from one another. The second stage is that once heard, hazard information must be understood. This does not mean an understanding of what is said, but rather attachment of meaning to the information received. For example, flood risk information may be understood as a wall of water to one person, but ankle-high runoff to another. Volcanic ashfall may be construed as a suffocating blanket of coverage or a light dusting of powder. A "fifty-percent probability" may be understood as a certainty by some or as unlikely by others. A singular risk information message could be understood as involving no risk by some, but a threat to human life by others. In each of these examples, people attach different meanings to the same message. Depending upon individual perception of risk, however, each person understands the message to mean something different. In addition, understanding is connected to people's knowledge and overall frames of reference. For example, it may be difficult for someone to understand a message about the risk of a hazardous waste site when they do not understand much about the hazard. Public risk information must be able to provide the public with accurate and common understandings of the hazard. The differing understandings that naturally emerge among people can be minimized with proper attention to information management. During the siting and regulatory processes, interaction at public meetings or regularly scheduled press conferences can guarantee the continued flow of information about the project and its risk and provide local residents with the opportunity to understand the meaning of the risk.

Once risk information has been repeatedly provided to facilitate public understanding, it is necessary for people to form a level of belief regarding the contents of the risk information. Believability is influenced by the method and content of public risk information, the consistency of the information, and the situation in which the information is made public. Press releases, public meetings, interactions with elected officials, and interest groups all allow for project sponsors and project scientists to communicate what is known and what needs to be known about the proposed project and its risk.

Once people have formed a level of belief in public risk information, they consider its implications for themselves and their social group (usually their family). If people do not think that risk information was meant for them, (the "it-can't-happen-to-me" syndrome), they will likely ignore it. If people think they are the intended targets of the information (the "it-must-be-me" syndrome), they may act accordingly. Personalization can lead to both underreactions and overreactions to risk information. When information is not clear in describing the location of the risk, for example, people misunderstand the implications of the information and consequently may overrespond or underrespond. The area of site influence needs to be determined as scientifically as possible, with all assumptions stated clearly and openly. This can be done only generally during early siting process stages and much more precisely at later stages of regulatory and environmental review. Accordingly, the dissemination of risk information at its various stages of development is necessary for an effective public education program.

When a person has heard the risk information, formed an understanding of what is being said, believed or not believed what is being said, and formed an opinion of whether the effect would be personal, that person must then decide what to do. The guidance (or lack of it) provided in public risk information regarding a possible course of action has a major effect on the decision, as do other factors. If people decide to respond by influencing the decision-making process, then every attempt should be made to include the public in a constructive fashion. A public participation program should be designed to enable local influence in the planning and decision-making process.

Factors That Bias Risk Perception

Based on research and practical experience, there are many reasons why the perception of risk that publics form about hazards (and how to act in response) are often biased and incorrect. These include, for example, the ability of different people to estimate risk, perceived causes of hazards, experience with the hazard, propensity of people to initially deny risk, and access to information.

Decisions to adopt and implement an action, influenced by the perceptions and interpretations that people have about risk, typically are made on the basis of imperfect information, biases, and difficulties in understanding risk concepts. People imagine loss to themselves, their possessions, and their community if a pollution hazard or accident results from facility operation. The more the potential damage imagined, the more likely people will be motivated to act against the risk.

The aspects of perceived risk that have been examined are diverse. For example, people are poor probabilistic thinkers, yet are able to estimate the

frequency probability of some risks better than others.[8] People tend to overestimate the probability of occurrence of low-frequency events (a major California earthquake) and underestimate the probability of higher-frequency events (having an auto accident). At the same time, the public in general rarely takes scientific factors into account in estimating risk and defining its perception.[9] The perceived cause of risk or disaster--God, nature, technology, societal choices--affect perceived risk and public choice of whether to act and how to act. For example, those who define the cause of an earthquake as the will of God would rarely elect for a social solution (land use) to reduce earthquake risk. Actual experience with hazards can greatly enhance risk perception, but this effect is reduced as time passes. Having hazard experience can also interfere with accurate risk perception in that people tend to acknowledge risk only to the level they have previously experienced it. Having experienced a small hazard event can interfere with prudent preparation for a larger, objectively defined future event. Thus, in areas that have been contaminated in the past by hazardous waste, residents may incorrectly perceive the objective risk associated with continued or future storage of such waste.

Other determinants of risk perception are propensity to deny risk and access to information. Residents of hazardous areas typically deny the risk imposed by natural disasters by discounting the possibility that anything truly serious will ever happen to themselves or their possessions. However, public controversy can bring about the opposite, that is, a tendency to inflate the risk. Risk perception can be upgraded to more accurate levels as the public access to scientific information about the character of risk increases. In general, certain social units and decision-makers have more access to information about hazards than others. Some organizations, for example, have the resources to employ staff whose job it is to obtain, process, and refine information of interest or concern to the organization. Others lack the perceived need for such employees or the resources to hire them. Social units that are fortunate enough to have access to good information gain more accurate perceptions of risk than others that lack such information. Providing the public and organizations with accurate information about the potential risk of a proposed facility can bring about a more reasonable assessment of such a facility. Information can be made available to the public by putting reading files and documentation on the proposed project in the local library and by being responsive to individual and organizational requests for information.

Evidence to date concerning the factors that shape risk perceptions can be readily summarized. People form risk perceptions on the basis of information to which they have access. Public information is rarely of the sort that allows a diverse public to overcome the bias with which that information is processed (although it could be). Consequently, risk perceptions of hazard by the public are most often distorted. The siting and regulatory review processes, *however*, can be modified to maximize information dissemination and public participation in an effort to enhance an informed "local definition of the situation." In turn, a more enlightened public evaluation can be made of the facility's effect on the overall quality of life in a given area.

Enhancing Accurate Public Perceptions of Risk

Because the public will be involved in the decision-making process, it is important that public perceptions of possible risk are as accurate as possible. Biased and distorted public perceptions can lead to poor, costly alternative project designs that may not represent the best technical solutions to the problem. Mounting evidence suggests that the following 10 factors relative to public risk information can help in the formation of accurate public perceptions of risk.[3]

First, the source of public information must be perceived as credible and reliable by the people receiving it. People have different views about who is credible and who is not. To alleviate the possibility that any one source could be perceived as noncredible, public risk information should contain endorsement by a mix of scientists, organizations, and officials. This can be done in the press, at public meetings, and in printed material. Second, public risk information is best if it contains consistency in the information it gives and the tone used to give it. Inconsistency in the tone or information in a message creates confusion and uncertainty among recipients. The message should also be consistent in the way it conveys information about the level of risk. For example, a message should not say "something bad is happening but there is no cause for concern." Rather, it should indicate how concerned people should be in light of the situation. Message consistency is a determinant of understanding and belief. Consistency among scientists has never been high with reference to nuclear technology, and this has created special problems for radioactive waste management.

Third, the public information must contain timely, accurate, and complete data. If people learn or suspect that they are not receiving the "whole truth," they are likely to ignore what is being said and to respond to the information in ways consistent with their suspicions. Accuracy also affects understanding and belief of official risk information. The siting and regulatory processes dictate that an accurate technical assessment be conducted on the potential effects of hazardous waste management. Fourth, the public risk information must be worded clearly in simple language that can be understood so that people know what is happening and what they should do about it. Lack of clarity in a message can lead to people misunderstanding the message and misperceiving risk. For example, this is a particularly evident when such risk is stated as 3.2×10^{-5} fatalities per year. Simplified, clear statements of risk will have to be tested on the public for clarity and relevance prior to widespread dissemination.

Fifth, a message should convey a high level of certainty about the risk and what people should do or not do. Even if there is a low-probability or ambiguous situation, the message about it should be stated with certainty (even about the ambiguity). Certainty determines the level of belief in risk information and affects decision-making. This is important for scientists as well as waste managers to remember when interacting with the public. Sixth, sufficient information should be given in a risk message so that the public has an idea of exactly what is happening. Not knowing, or believing that one has insufficient information, creates confusion, uncertainty, and anxiety. Although the message must not overwhelm people with too much detail, it should contain enough information so that the public's first response is not to fill the information void with uninformed misperceptions or fears. Seventh, a risk message must contain a clear statement of guidance about what people should do or not do about the event being described and how long a time they have in which to act. Guidance is often necessary to encourage people to take the proper action. Guidance could

easily be included under mitigation plans for a proposed action.

Eighth, the frequency of public messages should be stated so that people will be informed about when they will hear the message, or a new message, again. This information can reduce anxiety created by not knowing when one can confirm what is happening or learn more details. Also, frequent messages can help reduce the effect of misinformation and misperceptions. Frequency affects hearing, understanding, believing, and deciding, and is thus important at all stages of risk perception formation. Numerous studies underscore the importance of repeated hearing of risk information as a condition for accurate perceptions to be formed. Regularly scheduled meetings to discuss monitoring reports on a given waste site could provide a frequent assessment of the integrity of the site. Ninth, the risk information message should clearly specify the location of the areas affected or potentially affected by a mishap. People must be told, and need to know, if they are the intended recipient of the message or not. Identifying a location is important in determining belief and in personalizing risk information. This relates to the clear specification of the area of site influence discussed above. Last, the channel for information dissemination plays an important role in public risk perception formation. Effective information must use a range of possible channels instead of a single channel. Public meetings, reading files, and documentation in the local library represent several channels of communication that can be used to inform the public. Panel presentations, workshops, and monitoring groups are other ways to convey information. The means of providing information to the public as discussed above could be incorporated into a public participation process.

CONCLUSION

Much is said about the public misperception of risks imposed by hazards; little is done about it based on good knowledge regarding how to manage it. It appears that an in-depth understanding of community processes would allow researchers to estimate the potential problems a community might have in adapting to change. The model suggested in this paper includes important determinants of social structure, the processes that make up social structure, and the interpretive aspect of "local definition of the situation." The inclusion of "local definition of the situation" in the model allows the local perception of risk to be taken into account in the decision-making process. Involvement of the public in the decision-making process requires informed participants. Thus, the public must be educated and informed on the issues and facts related to hazardous waste management. The current siting and regulatory processes allow for information dissemination on a proposed project, public discussion of relevant issues, and mitigation to alleviate projected potential impacts. Public concerns can more easily be taken into account in project planning when based on more accurate interpretation of the objective risk involved.

It appears that two approaches are worth pursuing in order to help publics more accurately perceive the risks imposed by natural and technological hazards. First, the professionals who possess technical knowledge about "objective" risk must begin to recognize that heterogeneous publics will hear what is being said in a multitude of different ways and, consequently, will form a varied set of biased risk perceptions. Second, it would be useful to alter how risk information is presented to the public along the lines that past studies have suggested will lead to more accurate risk perceptions. The current state-of-affairs, where public risk perception does not match objective risk of hazards, seems more a consequence of those who give the public risk information than the result of unreasonable citizens.

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