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. Despite available technologies and physical science capabilities, the effective siting of facilities stands more as a major contemporary social issue than it is a technological problem. Traditional social impact assessment approaches to the siting process have largely 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. This paper proposes that the siting of hazardous waste facilities could well take advantage of two rich but somewhat disparate research histories in the social sciences. A convergent and integrated approach would result from the successful blending of social impact assessment, which seeks to define and

mitigate problems, with an approach used in hazards policy studies, which has sought to understand and incorporate public risk perceptions into effective public decision-making. It is proposed in this paper that the integration of these two approaches is necessary for arriving at more readily acceptable solutions to siting hazardous waste facilities. 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 currentiy 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, sometimes successfully and sometimes not, the field of SIA has expanded and developed over the last 15 years. In the past, the SIA process has been the main process by which social issues have been addressed; and a number of publications on SIA methods have been produced.[1]

This approach has been carried over to the assessment of potential impacts of hazardous waste facilities at specific locations. Assessments usually address risk in an objective sense, but only in that studies assume an accident will occur. Consequences of such an event are then 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, since 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. Exploration by social scientists into how and why publics perceive and respond to the risk of natural and technological hazards began over half a dozen decades ago and still continues. Knowledge from hazards research, in combination with traditional SIA approaches, promises much for a less combersome implementation of siting of hazardous waste facilities.

Hazards research summaries,[2] as well as specific hazards studies,[3] agree that the single-most important factor in shaping human responses 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 a 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 risks)[5] is beginning to be documented in the hazards research field. The following discussion focuses on three basic ideas from social science hazards research. First, the basic process whereby community perceptions of risk are formed; second, the factors which indicate why perceived risk is so often not reflective of the objective risk; and, third, what research suggests as the way 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 which will introduce the important variables that should be included in a model of human factors which should be used in the process for siting hazardous waste facilities.

SOCIAL IMPACT ASSESSMENT

The bulk of the SIA work has focussed on social disruption and stress to public facilities and services caused by the inmigration 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 into 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 ripe to advance the field. It is also agreed 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 process of community adaptation. These process-oriented variables are: social differentiation, or the process by which systems become more complex; social integration, or the process by which individuals and groups become connected to the system; extra-local linkage, or the process in which the community interacts with the larger society; and social stratification, or 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 adjust and 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 Figure 1.

The model depicts the importance of community culture, demographic characteristics, economic base, and the ecological setting in shaping social structure. The particular form of social organization and interaction in the community determines how exogenous factors are handled by the social system. This is the basic premise of the model. 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. Such communities are more likely 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 planning and water and air quality monitoring may need to be provided. With the more developed type of communities, the basic expertise, planning capability, monitoring capability may be in place, but opposition based on environmental values may also be higher. Thus, community variation in social structure makes a difference in how a community responds to growth.

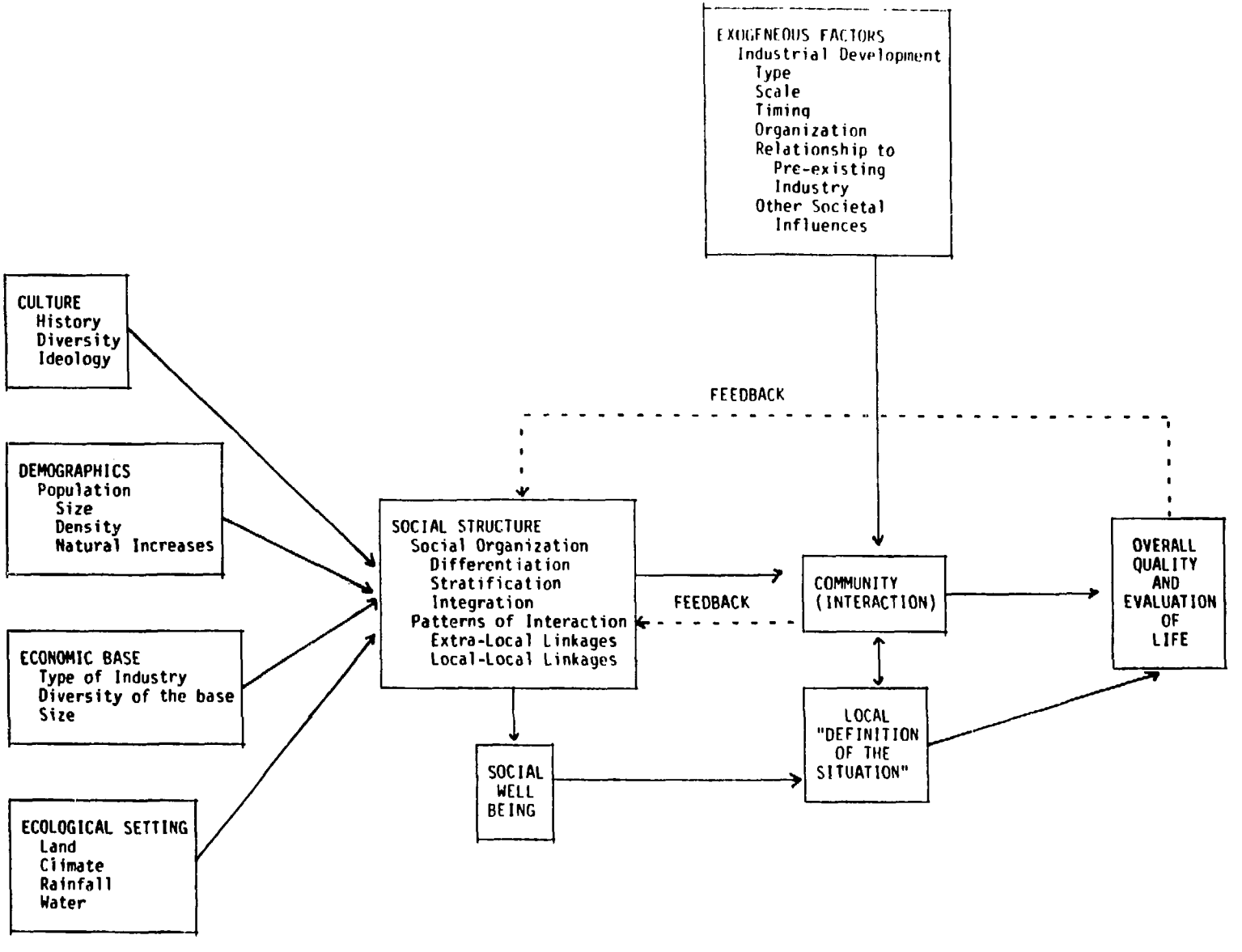

Figure 1. Model of Community Organization and Change.

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 risk perception formation factors.

The first stage in the public risk perception formation process is hearing or learning of 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 contents of public risk information, the consistency of the information, and the situation in which it is made. 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 likely will ignore it. If people think they are the intended targets of the information (the "it-must-be-me" syndrome), they may act appropriately. Personalization can lead to both under and over reactions 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 over-respond or underrespond. The area of site influence needs to be determined as scientifically as possible, with all assumptions stated clearly and upfront. This can be done only generally during early siting process stages and much more precisely at later stages of regulatory and environmental review. Accordingly, by 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 has 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 about what to do or not do has a major effect on the decision, as do other factors. If people decide to respond by affecting 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

Research and practical experience have catalogued a host of reasons why the perceptions of risk which publics form about hazards (and what they decide to do or not do about it) 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. Image of loss is what people think will happen to themselves, their possessions, and their community if a pollution hazard or accident resulted from facility operation. The more the potential damage imagined, the more likely people will be motivated to act against the risk.

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 and what to do about it. 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 its 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 of experience they have previously had. 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 get, 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 which are fortunate enough to have access to good information gain more accurate perceptions of risk than others which lack that information.

Hence, providing the public and organizations accurate information about the potential risk of a proposed facility can bring about a more reasonable public dialogue throughout the siting process. 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 requests for information.

Evidence to date concerning the factors which 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 which would allow 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 of the facility's effect on the overall quality of life in a given area can be made.

Enhancing Accurate Public Perceptions of Risk

Because the public will be involved in the decision-making process, it is important that the public perception of possible risk is as accurate as possible. Biased and distorted public perceptions can lead to poor, costly alternative project designs that may not represent the best technical solution to the problem. Mounting evidence suggests that there are ten factors that profile public risk information which can help the formation of accurate public perceptions of risk.[3] First is the source of the information. 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 also should 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 say 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 is the accuracy of what is said in public information. Such 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 respond to the information in ways consistent with their suspicions. Accuracy also effects understanding and belief of official risk information. The siting and regulatory processes dictate that an accurate technical assessment be conducted on the potnetial effects of hazardous waste management. Fourth is the clarity of public risk information. 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. A lack of clarity in a message can lead to people misunderstanding the message

and misperceiving risk. This is a particularly difficult task when trying to convey such risk 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 dessemination.

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 feeling that one has insufficient information, creates confusion, uncertainty, and anxiety. While 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. Several ways of providing information to the public were discussed above and could be incorporated into a public participation process. 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 referenced 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. As well, 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 is the specification of location in the message. Risk information should clearly state 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 personalizing of 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. The public meetings, reading files, documentation in the local library represent several channels of communication that could be used to inform the public. Panel presentations, workshops, and monitoring groups could also be used as ways to convey information.

CONCLUSION

Much is said about the public misperception of risks imposed by hazards; little is done about it based on good knowledge about how to manage it. It appears that an in-depth understanding of community processes would allow

researchers to estimate the potential problems a community may 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 the "local definition of the situation." The inclusion of the "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 the case that two fronts 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, come to 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 suggest 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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