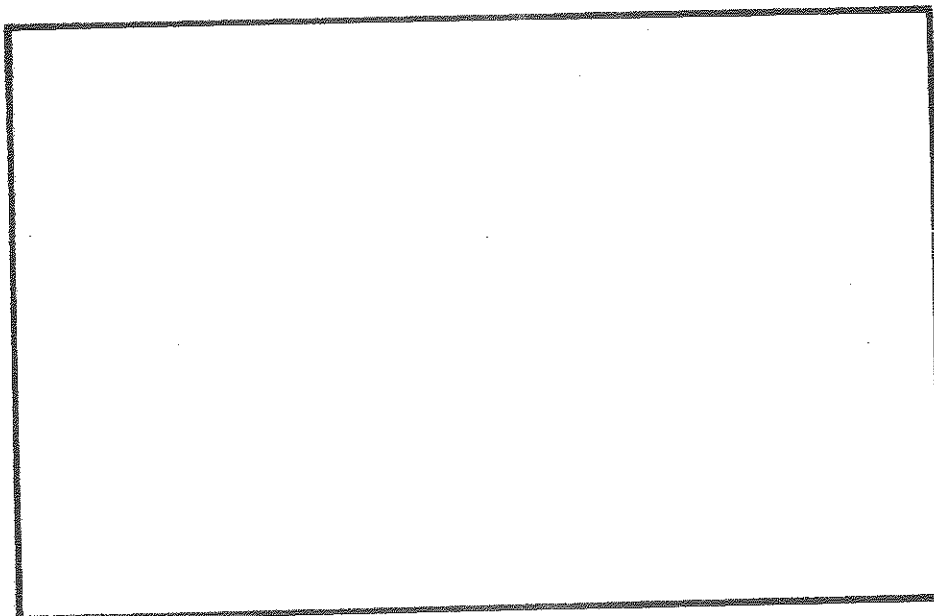


CORNELL
AGRICULTURAL ECONOMICS
STAFF PAPER



Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York, 14853

It is the policy of Cornell University actively to support equality of educational and employment opportunity. No person shall be denied admission to any educational program or activity or be denied employment on the basis of any legally prohibited discrimination involving, but not limited to, such factors as race, color, creed, religion, national or ethnic origin, sex, age or handicap. The University is committed to the maintenance of affirmative action programs which will assure the continuation of such equality of opportunity.

**Economics and the Risk from
Low Level Radioactive Waste**

by

Jon M. Conrad

Professor of Resource Economics

Cornell University

Ithaca, New York

14853

*This paper was prepared for the symposium *Low Level Radioactive Waste: Controversy and Resolution* sponsored by the New York Academy of Medicine and the New York State Department of Health, held Friday, September 23, 1988 at the New York Academy of Medicine, 2 East 103 Street, New York City.

Economics and the Risk from Low Level Radioactive Waste

I. Introduction

The title of this afternoon's session is "Low Level Radioactive Waste: How Does Society Respond". The title is interesting to an economist, in particular the selection of the word "does", as opposed to the word "should". A subtle difference to most, but to an economist there is an important distinction. A theory on "how" society allocates resources is said to be a "positive" theory (Friedman 1962, p. 8). Positive economic theories can often be tested to see if they can predict economic behavior or are consistent with empirical evidence. The question "How *should* society allocate its resources?" is said to be a "normative" question because to answer it requires some criterion or way of evaluating alternative feasible allocations. The choice of a criterion is subjective, and thus open to debate.

We have heard papers in this morning's session which have been positive, in the sense that they describe how we are currently handling low level radioactive waste (LLRW), and normative, in the

An economic analysis of LLRW might examine several factors including (1) the way such wastes are generated and the substitution and technical possibilities for reducing the amount of waste or level of radioactivity, (2) the public health and environmental costs which these wastes might impose if released into the biosphere, (3) the way individuals perceive these risks and their willingness-to-pay to have such risk reduced, (4) the costs of private and public actions to reduce environmental health risks, and (5) the cost of remedial action if LLRW escape into the biosphere.

All of the above factors are relevant when evaluating public policies for LLRW. In the limited time available I will focus my discussion on risk perception and the notion of willingness-to-pay for risk reduction.

II. Risk Perceptions, Risk Preferences and the Value of Public Programs to Reduce Environmental Risk

There is a vast literature on the economics of choice under uncertainty. (For a recent, relatively nontechnical article see Machina 1987.) Economists have had a long standing interest in how people make decisions when the outcomes of those decisions are not known

relating these concepts to public policy for LLRW.

Risk Perceptions

As noted this morning it is generally not possible for epidemiologists to reliably estimate the probability that an individual will develop a disease or condition based on some level of exposure to a particular chemical. Individuals must therefore "filter" various pieces of information (from newspapers, magazines or government brochures) to form a risk assessment. Bayesian statisticians would refer to these as "subjective" priors. The way in which people form and update these prior probabilities is not well understood but it appears that they use certain "heuristics" that do *not* follow fundamental rules of logic or probability (for a collection of papers on this subject see Kahneman, Slovic and Tversky 1982). In a recent study of risks from radon, Johnson et. al. (1988) examine the effectiveness of six different "information treatments" in communicating the risks of radon to residents of New York. Learning was measured in terms of their improvement in answering basic questions about radon and how accurate they were in advising neighbors about their health risks. As part of the same study Smith and Desvousges (1988) obtain empirical evidence that households did

successful in "educating the public" and there is a "convergence" in the risk assessment of alternative disposal techniques for LLRW, different risk preferences may cause people to disagree over the design and level of safety that should be mandated at disposal sites.

Because public policy is formulated and implemented by politicians and bureaucrats *their* risk preferences become especially important. While politicians and bureaucrats may face the same health risks as the public at large, they may face an acute "risk of responsibility" if LLRW contaminates the environment. The people responsible for the design and operation of radioactive or toxic waste facilities may desire levels of safety beyond the level deemed appropriate by scientists or even the public at large if they will be held responsible for any accidents. Given that their share of the cost of increased safety is relatively small we can see how *publicly* operated facilities may be "excessively" safe when analyzed on an "expected-cost-per-death-avoided" basis.

Private Actions and the Value of Public Projects

The third factor that may generate disagreement over the appropriate standards for LLRW disposal is the fact that individuals can

issue, but for an interesting economic solution to this problem see Kunreuther et. al. (1987).

III. Conclusions

Determination of appropriate policy for public or collective risks is made difficult by the fact that (1) different people will have different subjective assessments on the likelihood of various health outcomes. Epidemiological data is frequently inadequate to statistically infer risks for different levels of exposure. (2) Even if a convergence of risk assessment is possible, people may differ in their risk preferences (ie, their willingness to accept certain financial or health risks). (3) Even public or collective risks might be reduced by private actions. People who are aware of self-protective actions and who can afford to take them may be less willing to support public policies that reduce risks for others.

It would appear, based on the papers presented this morning, that many individuals, politicians and administrators have subjectively overestimated the health risks from LLRW. An education campaign, using some of the methods of risk communication employed in the

References

- Conrad, J. M. 1986. "On the Evaluation of Government Programs to Reduce Environmental Risk". *American Journal of Agricultural Economics* 68(5):1272-75.
- Eisenbud, M. 1988. "Management Strategies for Low Level Waste Disposal". A paper prepared for the symposium "Low Level Radioactive Waste: Controversy and Resolution", held at the New York Academy of Medicine, New York City.
- Hall, E. J. 1988. "Radiation and Life". A paper prepared for the symposium "Low Level Radioactive Waste: Controversy and Resolution", held at the New York Academy of Medicine, New York City.
- Friedman, M. 1962. *Price Theory*. Aldine, Chicago.
- Houk, V. N. 1988. "Epidemiology in Risk Evaluation". A paper prepared for the symposium "Low Level Radioactive Waste: Controversy and Resolution", held at the New York Academy of Medicine, New York City.
- Johnson, F. R., A. Fisher, V. K. Smith, and W. H. Desvousges. 1988. "Informed Choice or Regulated Risk: Lessons from a Study in Radon Risk Communication". *Environment* 30(4):12-15+.
- Kahneman, D., P. Slovic and A. Tversky. 1982. *Judgement Under Uncertainty: Heuristics and Biases*. Cambridge University Press, Cambridge.
- Kunreuther, H., P. Kleindorfer, P. J. Knez and R. Yaksick. 1987. "A Compensation Mechanism for Siting Noxious Facilities: Theory and Experimental Design". *Journal of Environmental Economics and Management* 14(4):371-383.
- Machina, M. J. 1987. "Choice Under Uncertainty: Problems Solved and Unsolved". *Economic Perspectives* 1(1):121-154.