MARC REPORT NUMBER 41

An EIA Guidance Document

ENVIRONMENTAL IMPACT ASSESSMENT

AN ANALYSIS OF THE METHODOLOGICAL AND SUBSTANTIVE ISSUES AFFECTING HUMAN HEALTH CONSIDERATIONS

MONITORING AND ASSESSMENT RESEARCH CENTRE

WORLD HEALTH ORGANIZATION

The Monitoring and Assessment Research Centre (MARC) is an independent international institute undertaking research on major environmental pollution problems. It is located in King's College London in the University of London and has been in operation since July 1975.

The objective of the MARC core research programme is to develop and apply techniques for the assessment of pollution problems of global, regional or local significance. The programme is mainly carried out by means of reviews which synthesize existing relevant knowledge from a wide range of disciplines.

MARC currently receives financial support from the United Nations Environment Programme (UNEP) and the World Health Organization (WHO).

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Introduction

A principal mission of the World Health Organization (WHO) is the promotion of procedures and approaches to planning by governments that can contribute to the improvement of the standard of human health. One of the major developments in recent years has been the use of the environmental impact assessment (EIA) methodology as a means of incorporating environmental considerations into the planning process. This interest was first fanned by the enactment in 1969 of the United States National Environmental Policy Act (NEPA) which contained a provision requiring U.S.A. agencies to carry out environmental impact assessment as part of federal project planning. Subsequently, various expert groups and meetings convened by WHO and other multilateral agencies have concluded that the EIA process can be an effective mechanism to foster human health and welfare considerations in development planning along with economic and technical objectives. The need for analysing possible health hazards and environmental implications in connexion with large-scale socio-economic development projects was further reiterated by the Thirty-fifth World Health Assembly in its Resolution WHA 35.17 (Annex 1).

EIA is invariably associated with broader institutional planning and decision-making processes (Annex 2) which require that the assessment of human health and welfare impacts be made integral to ecological and economic considerations. When environmental impacts impinge on established sanitary standards, health agencies have review and regulatory responsibilities. However, a principal aim of the concept is to force development agencies to give overt consideration to health and environmental effects which are more commonly not captured by regulations or are unquantifiable.

The methodology is best considered as part of the overall planning process and not as a separate discrete assessment exercise. On balance, the primary objective for adopting EIA is to aid decision-making. It is this broader viewpoint that differentiates the process from being a purely scientific study and gives it an operational cast. Assessment of impacts is undertaken to provide information to facilitate the design and project selection process.

In order to play a credible and influential role in articulating human health and welfare concerns and to ensure that the process is effective and sensitive to these interests, health authorities need to understand the overall planning paradigm and the dilemmas facing project proponents and be involved in the whole process. On the other hand, development authorities are not always familiar with how health impacts are to be addressed and evaluated and the practical limits of this inquiry. These operational issues are analysed in this report.

Further, it should be made clear at the outset that the EIA process is only a tactical level technique to avoid causing undesirable impact on the human environment. It is not a substitute for the development of environment control plans.

Conceptual principles and methodological approaches to EIA developed under NEPA are discussed insofar as they are useful in clarifying issues and provide a historical and developmental perspective.

I An Overview

1 History

The need to systematically identify and evaluate the environmental impacts of major projects was first articulated by the United States Congress in 1969 when it enacted the ground-breaking National Environmental Policy Act (NEPA). The legislation directs all U.S. agencies to "give appropriate consideration to environmental amenities and values in the agency's decision-making along with economic and technical considerations". A requirement was imposed on the agencies to prepare a detailed statement on:

- the environmental impact of the proposed action;
- any adverse environmental effects which cannot be avoided should the proposal be implemented;
- alternatives to the proposed action;
- the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and
- any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

This congressional mandated statement has come to be known as the Environmental Impact Statement (EIS), and led to the adoption of EIA as a formal planning concept.

Two aspects of the EIA process were emphasized:

- the need for rigorous exploration and objective evaluation of alternative actions;
- the need for cumulative impacts of many small projects to be considered.

The intent of NEPA's EIS requirement was to give the legislative policy statement an action-forcing, operational aspect and to reform institutional decision-making processes.

Following the advent of NEPA, the concept of requiring an EIA as part of development planning has gained widespread acceptance. Accord-

ing to one source (Ahmad and Sammy 1985), more than three-quarters of the developing countries and most of the industrialized countries have done at least one EIA. Due to differences in institutional systems, however, most countries have modified the review procedure. Many require EIA primarily as a test for ascertaining if environmental impacts resulting from a development proposal conform to established control and land use standards. From an operational standpoint, the decision-making process in this situation is simple and explicit. A proposal either meets a set of established criteria and standards or it fails. Except in terms of scope, this is similar to traditional sanitary regulatory practice. Another significant difference is that most countries have adopted the EIA process through administrative policy rather than legislation. But there is movement in the industrialized countries generally toward a more formal, explicit requirement for EIA (OECD 1986).

At the international level, the United Nations Environment Programme and the World Bank have been prominent advocates for the inclusion of EIA in project planning. The World Bank "... views environmental input as fundamental to the good design of projects" and emphasizes prudence when assessing impacts that are potentially irreversible. Other multilateral and bilateral agencies have also instituted their own requirements in recent years for some form of EIA for projects financed with their assistance.

2 Purpose of EIA

Reasons that have been advanced for introducing EIA are that the increasing scale of resource development schemes and their resulting impacts to the physical environment and communities could no longer be ignored; and that traditional appraisal techniques were inadequate to deal with various environmental and social issues, particularly those having long-term consequences (O'Riordan and Sewell 1981).

Concerns for natural systems conservation provided the original driving force for EIA. Human health and higher order socio-economic effects were usually either ignored or given only superficial attention in early studies. Part of the explanation for this passage is that most projects which were required to undergo the EIA process were civil works that primarily impact on natural systems. Nature conservation issues were also highly visible politically in the developed countries during this period and have active and vocal proponents. However, more recently, human

health and secondary socio-economic effects have received increased attention, particularly in the aftermath of toxic waste incidents and major public health problems resulting from development projects.

The objective of any EIA requirement is to promote and ensure that planning decisions take into account environmental costs and benefits. In practice, its effectiveness in influencing decisions rests on the following assumptions:

- interested public or 'watchdog' agency scrutiny of environmental issues disclosed by the EIA will reinforce accountability of decision-making processes;
- the process can order information on environmental impacts along with economic and technological issues so that more balanced decisions can be made by the project's proponents.

Under the NEPA process, U.S. agencies retain the discretion to make final decisions. From an operational perspective, this is quite understandable since there are no generally accepted objective decision-making matrices for balancing all the different variables and the agencies are not expected to submerge their primary goals to environmental considerations. They are only required by NEPA to take these latter considerations into account in the decision calculus. Balancing economic costs and environmental benefits is in the final analysis judgemental and resides with the agencies. Different countries have different 'political cultures' and actors involved in the decision-making process but all basically subscribe to the viewpoint that the development authorities make these trade-offs, except on the matter of compliance with prescribed standards.

The range of variation in the application of EIA as a planning concept is illustrated by the following sampling:

In France, EIA is required for certain projects planned by public entities which require the approval of the Government. This requirement is embodied in the 1976 Nature Conservation Bill. The specific concerns to be addressed in an EIA are established by the Minister for the Environment and are operationally focused on conformance to nature conservation and land use objectives.

In Canada, the Federal Government has issued guidelines for environmental assessment reviews for certain federal projects. But these are not comprehensive statements, nor are they necessarily made public, as public hearings are discretionary. Full EIAs are only authorized at the recommendation of an internal (Environment Canada) assessment panel on

the basis of a review of preliminary environment 'prediction statements'.

In Germany, a 1975 Cabinet Resolution voiced the same kind of objectives stated in NEPA. But there is no 'forcing' provision such as the requirement for a formal EIS process. Reliance is basically placed on regional environmental goals and land use policy. Projects are tested for compliance against plans and regulations developed by local authorities. Federal influence is exerted through the issuance of guidelines and principles for the development of regional plans.

In the U.K., there are no specific regulations or legislation relating to EIA. Studies have been required on an ad hoc basis by local authorities who exercise planning control and regulation of pollution discharges. EIA studies have been mainly related to oil-related developments in Scotland. Although there are public hearings when the scale of a project warrants it, EIA reports are not generally made available to the public.

In The Netherlands, recent legislation introduced the NEPA type EIS process for certain projects. A main focus of the EIS requirement is the development of alternatives which is considered to be central to the exercise.

In Sweden, various enactments allow authorities to require the assessment of "environmentally disruptive industries". But the procedures are informal and are not mandatory. Approval of these projects are jointly exercised by the government and the concerned local authority (who exercises veto power). Major consideration is placed on compatibility with land use control and ecological policy. In operation this means that these projects must meet various standards and specific regulatory goals such as effluent limitations and impact on land use (i.e. recreation space, overcrowding, marshland, etc.). Public hearings are used as part of the review process.

In Spain, various agencies have been requiring some form of EIA in connexion with the granting of government approval for some projects, but there is no legislation covering the process.

In Japan, various laws relating to pollution control and siting of industrial plants provide for EIA as a part of project planning. Emphasis is placed on compliance with certain land use goals and ecological imperatives.

In New Zealand, projects requiring government licensing or subsidy are subject to EIA. Decisions relating to a project's approval are based on a balancing of technical, economic and environmental considerations.

Projects reviewed have been mainly related to energy development, sewerage schemes and transportation infrastructures. In operation, impacts are tested against town and country plans.

In Norway, a mandatory EIA process was proposed to cover certain major projects with potentially significant impacts on the natural environment and affected communities.

In the Philippines and Thailand, the EIA process has been introduced for certain selected projects.

At the regional level, the European Economic Community (EEC) issued a directive to its member states in 1985 suggesting the introduction of EIA as a requirement for certain selected projects.

Conceptually, the NEPA-like EIA approach most closely resembles a planning process. This is characterized by four operational elements:

(a) problem definition;
(b) the assessment is carried out to include evaluation of social and economic effects, either quantitatively or qualitatively;
(c) alternatives are explored;
(d) decision-making is based on a balancing of costs and benefits and the choice of the 'optimal' alternative.

In actual practice, the ideal procedural framework is constrained by environmental control standards or policy, relative to certain considerations (such as air quality) so that the implicit 'optimizing' choice-making applies only to issues that are not covered by such legislation.

Althouth most countries have regulations on land use and waste discharges, the EIA process is in principle an attempt to examine a wider range of environmental and social impacts. Otherwise, subject to the limitations of existing scientific methods and information base for assessment, the exercise becomes trivial. At the same time, no one should be surprised that the evaluation and choice-making problem can never be a purely mechanical or technological procedure. A common thread running through the EIA concept is social accountability. Thus, the involvement of the affected public is by definition essential in the identification and resolution of issues for assessment.

II Methodological Issues

1 Objective criteria for identifying projects needing assessment

Few governments could cope with a blanket requirement that all development projects be subjected to an environmental impact assessment. Aside from the administrative difficulties this would create, such an action is unnecessary and wasteful. Thus, a crucial methodological issue is how to prescribe criteria for identifying those projects or actions that should be subjected to EIA. For the health authorities, the essential question is how to ensure that all projects with potentially significant health effects are captured.

It is generally recognized that size is a key to defining 'significance' and thus determines whether a project falls within the EIA ambit. The most commonly suggested criteria are:

- scale of investment;
- size of land area occupied by project;
- quantity of effluents.

Size is, however, insufficient as a sole determinant. A project's environmental significance must be judged ultimately by the significance of the resultant cumulative impact and not just what it alone contributes. What counts is the significance of the action in the totality of the situation. Further, it depends on whether the impacts are transient or long-term.

Because of these considerations, threshold criteria are generally combined with other screening methods such as the following:

- *sensitive area criteria*: this viewpoint is conceptually valid since a country may have special cultural and environmental imperatives. It is also well embedded in the ecological principle that there are certain ecosystems which are more easily damaged or that have special qualities that make their preservation important.
- *positive and negative lists*: these are lists which indicate the types of project that are automatically excluded and those that are to be subjected to EIA or a preliminary screening process. The advantage of having lists is that they can accommodate all kinds of situations and can be easily adapted to new findings and priorities. Examples

of this type of listing used by The Netherlands, Sweden, The Philippines and Thailand are shown in Annex 4.

- *initial environmental evaluation (IEE)*: this is a brief review to determine whether a full-scale EIA is needed. The approach is not easy to implement objectively since it relies on the completion of a questionnaire and the judgement of the reviewing authority.

Having explicit rules for triggering an EIA requirement reduces the potential for costly litigations and delays in project execution, both of which are important in the context of developing countries. The reason usually cited for not having a uniform explicit set of criteria in the U.S.A. is that the extreme diversity of activities and public interests in a large country makes it very difficult to design a scheme that would provide an acceptable screen.

Developing countries (and also small countries) usually have a more easily definable range of significant development activities and national priorities which can be identified to provide a basis for formulating the selection criteria. In this context, and in view of institutional and personnel constraints, the sensible approach is to base the selection process on explicit criteria and lists of activities.

Projects with potential adverse human health impact can generally be categorized by the following characteristics:

- those that produce gaseous and liquid emissions;
- water resource developments that can alter the ecology of the breeding of vectors of disease;
- opening of new human settlements or new geographic areas that have potential for the introduction of disease vectors or parasites;
- processing, storage and disposal of hazardous and/or toxic chemicals and materials.

Secondary health and socio-economic effects are ubiquitous in all projects of significance that affect population growth and movements. These types of impact are generally subject to exogenous events that are probabilistic or underterminable.

Evaluation of impact is not limited only to the consideration of adverse environmental effects but also projects that produce desirable impact. Examples of these are water supply and waste collection and disposal projects.

2 Scoping

The purpose of this process (see Annex 5) is to determine the scope and focus of the EIA and the extent of analysis necessary for an informed decision. All the impact identification procedures, such as checklists, matrices and networks are essentially techniques to aid scoping. Checklists can be made either comprehensive or selective and as detailed as required and are generally more useful in providing guidance, particularly

	Rural Roads	Electrification	Water Supply/Sanitation	Small-scale Irrigation	Small-scale Industry
1. African Sleeping Sickness	•	•		•	
2. Dysentery (Bacillary and Amoebic)			•	•	
3. Chagas' Disease	•	•			•
4. Cholera			•		•
5. Dengue	•	•		•	
6. Filariasis[a]	•	•	•	•	•
7. Guinea Worm Disease			•	•	
8. Haemorrhagic Fever					•
9. Hookworm Disease	•	•		•	•
10. Malaria[a]	•	•	•	•	•
11. Leishmaniasis[a]	•	•			
12. Leptospirosis			•	•	•
13. Onchocerciasis	•	•		•	
14. Plague	•	•			
15. Rabies	•	•			•
16. Relapsing Fever	•	•		•	
17. Schistosomiasis[a]			•	•	•
18. Typhoid and Paratyphoid Fevers	•	•			•
19. Scrub Typhus	•	•		•	
20. Yellow Fever	•	•			

[a] One of six major diseases in the World Health Organization Special Programme for Research and Training in Tropical Diseases.

Figure 1 Tropical diseases likely to be affected by rural development projects

Source: U.S. AID (1980)

to non-specialist personnel. Matrices and networks give the appearance of a more scientific approach but it is doubtful that they give any more insight. Of these methods, the Leopold type (Annex 6) is the only one that has gained some popularity. Its main value may be as a graphic display. Screening tables that interrelate specific aspects of development such as their potential influence on major diseases (Figure 1) provide more useful information. This type of checklist can be developed by individual countries to reflect their own priority problems.

From a planning standpoint, the central issue in scoping is to identify those factors that are important to the affected public and decision-makers. It is not a 'one time' exercise but may be extended to ensure that subsequent planning activities do not prematurely foreclose reasonable alternatives and new public interest that may be identified during the planning cycle. There is no single best technique and in many ways good scoping is more an art than a mechanical procedure.

In practice, scoping must generally rely on a mixture of interagency consultations, scientific reviews and study of case histories of similar actions and of field conditions. The participation of the general public is essential to identify their concerns. Checklists are used only at the earliest stages of the procedure. The following elements are usually included in a scoping exercise:

- identification of the concerned public and officials and determination of public interest;
- definition of the significant human health and environmental issues and alternatives to be examined (including the elimination of insignificant issues);
- identification of relevant environmental control standards and policy constraints;
- establishing evaluative factors or criteria;
- identify local agency requirements which must be addressed.

Conceptualization of alternatives is the most important and critical part of the scoping exercise. Without viable alternatives, the range for decision-making is limited. Ortolano (1974) states that "the design of alternative actions rests on a set of assumptions, either explicit or implicit, regarding which goals, objectives, constraints, etc., the action will attempt to deal with. Different sets of planning assumptions (commonly referred to as 'design criteria' or planning objectives) represent different conceptions of what the future will be like, that is, they represent 'alternative

Table 1 Conceptualization of alternative futures
Based on Evaluative Factors from the Carmel Valley "Transcript"

Evaluative Factor	Constraint Set No. 1	Constraint Set No. 2	Constraint Set No. 3
Flood damage reduction	Protect against standard project flood	Protect against 50 yr flood	Utilize flood proofing, flood insurance and zoning—no "structural measures"
Water supply "requirements"	Supply safe yield of 40,000 AF/yr	Supply safe yield of 20,000 AF/yr	Reduce future demand by limiting local growth
Reservoir-based recreational opportunities	Supply recreational facilities consistent with regional demand and project type	Supply recreational facilities consistent with local demand and project type	Supply no reservoir-based recreation facilities
Tourist population	—	—	Use zoning to control motel and commercial development
Development of view site lots	—	—	Control via zoning and subdivision regulations
Development of flood plain lands	—	Zone flood plain to limit more intensive development	Zone flood plain to prohibit more intensive development
Visual appearance of flood plain (cottonwoods)		Prohibit channel modification works	Prohibit channel modification and minimize visual changes
Recommendations in County general plan	—	—	Carry out recommendation re: flood plain zoning

Source: Ortolano (1974)

futures'. These alternatives are evolved which satisfy different constraint sets. The 'no action' set must always be considered since it is the reference used for comparing the impacts of other alternatives. An example of these alternative futures is shown in Table 1.

In the evaluation of alternatives, the following are usually considered:

- alternative project design;
- alternative technologies;
- alternative sites.

The record of the results of the scoping exercise is appropriately called an EIA implementation plan. An outline example is shown in Annex 7. The systematic laying out of foreseen impacts as shown in the example is essential in helping to crystallize the significant problems needing detailed analysis and the information requirements. Participation by health authorities during this phase of the EIA process is the key to ensuring that human health and welfare effects are given full weight in subsequent planning activities.

3 Methodological reach

Figure 2 shows in schematic the depth of analysis conceptually required to fulfil the purpose of having an EIA study. The assessment methods span three analytic functions: identification, prediction and evaluation. It is, however, generally either difficult or impossible to carry the analysis beyond the determination of the first order effects without resorting to very crude estimates or qualitative ordering.

Assessment involving the effects of potentially toxic chemicals or carcinogens which are explicit, narrow-focused health effects evaluation studies have come to be called risk assessment. These types of study generally require intensive review of scientific research data and may even require laboratory testing. The elements of this form of assessment study are shown in Figure 3. It is generally the case that the procedure is used in study of health effects where thresholds are assumed not to exist. When a threshold effect is assumed, the primary focus of the analysis is to determine the 'safe' or no effect level of exposure. This is usually designated as the 'no observable effect level' (NOEL) or 'lowest

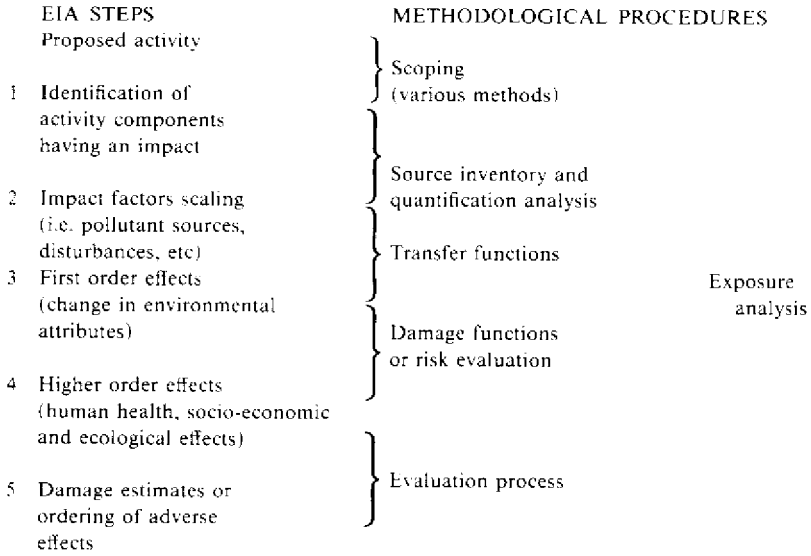


Figure 2 Methodological reach of EIA

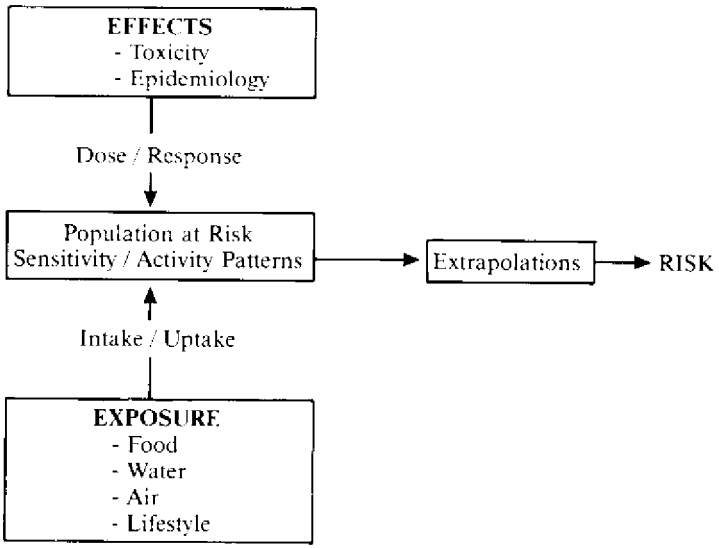


Figure 3 Elements of risk assessment

observed effect level' (LOEL). Such levels when divided by uncertainty factors become criteria for acceptable exposure level and may be expressed as 'acceptable daily intakes' (ADI). Results of risk assessment are called scientific criteria.

In practice, risk assessment is primarily undertaken to establish acceptable or safe exposure criteria from a regulatory standpoint. The overall process for this type of assessment is shown diagrammatically in Figure 4. Operational EIA studies use these criteria as input, in the determination of health impact. There are instances (such as in EIA involving the use of pesticides) when, for all practical purposes, the process is primarily a risk assessment.

Epidemiological studies are typically based on time series and cross-sectional records of observations. The cause–effect relationships are obtained by multiple-regression analysis which only hints at statistical correlation, not causality. Thus, the statistical nature of quantitative estimates and certain unquantifiable nature of health effects must be recognized.

The evaluation of impacts is best considered as providing only a framework for ordering information on various alternatives.

4 Evaluation process

In the real world, evaluation and decision-making are intrinsically bound together. EIA is only a component of a broader plan-making process and decisions are taken in this context.

As noted by Ortolano (1974), decision criteria which drive the planning engine are the evaluative factors. These criteria can be public interest goals or public health standards. In this milieu, cost-benefit or more commonly cost-effectiveness analysis invariably (albeit implicitly) occupies a central position.

The relationships between impact assessment and other planning activities are best illustrated in terms of information flow as shown by Ortolano in Figure 5. The process is continuous and the activities are iterative (Figure 6).

Although various methods have been advanced for weighting environmental values and evaluating alternatives, none has gained wide acceptance. On the other hand, U.S. courts have embraced cost-benefit analysis (CBA) as an appropriate technique for decision-making within the broader EIA framework.

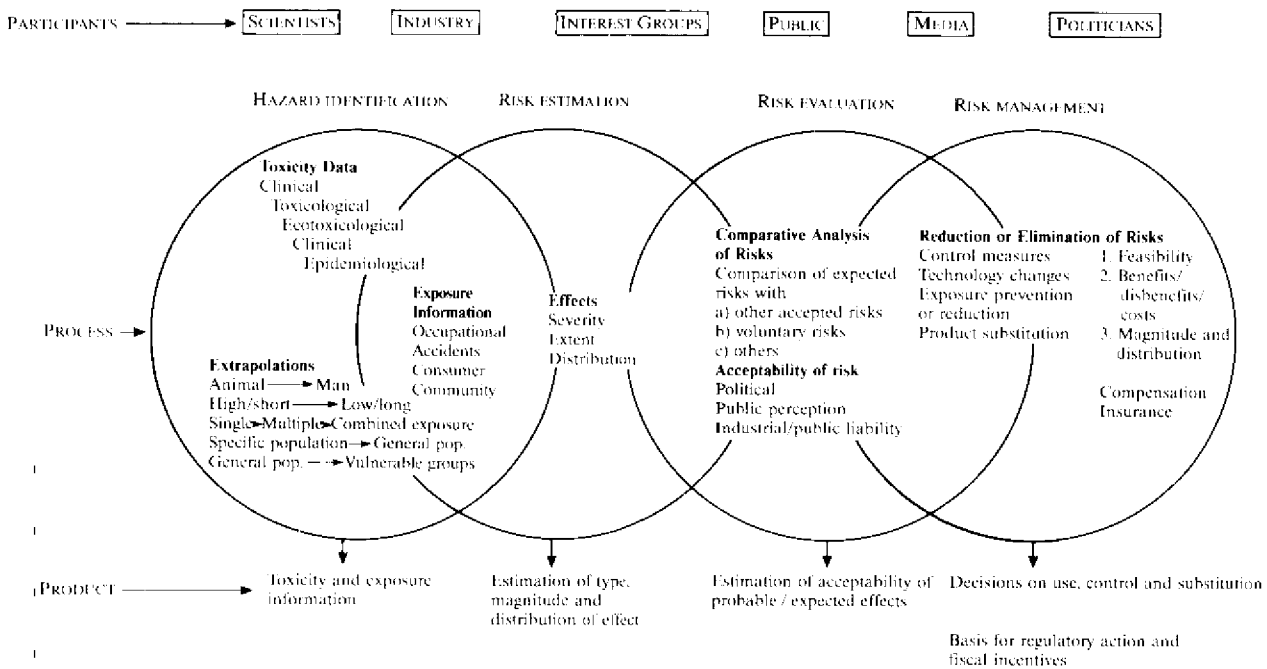


Figure 4 The risk management process

Source: WHO-EURO (1983)

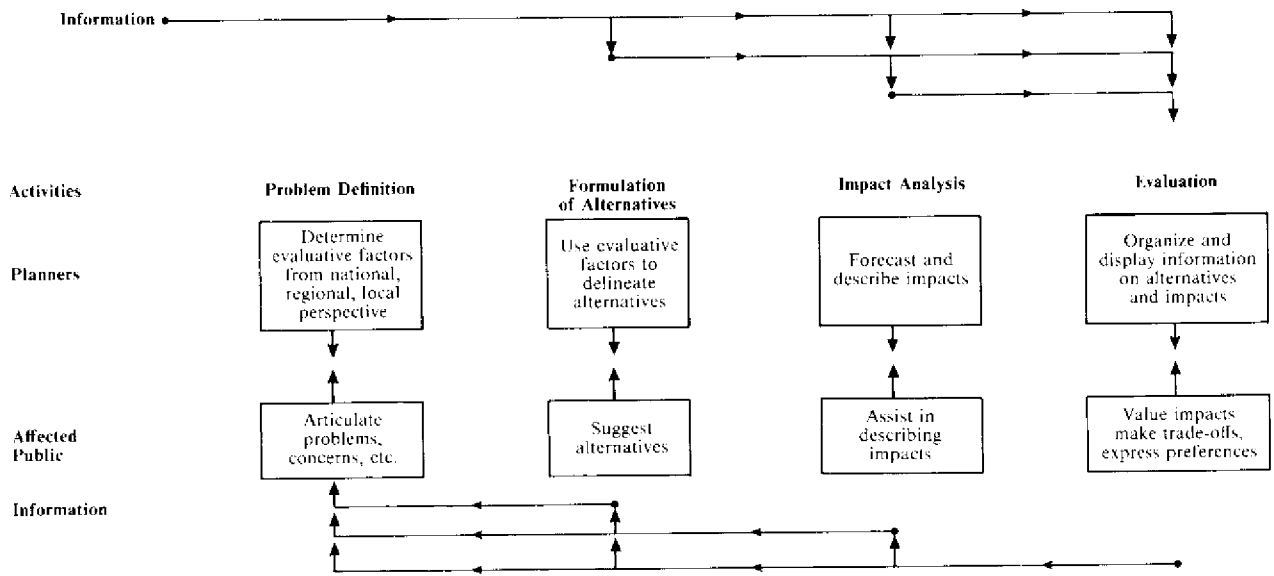


Figure 5 Information flow during any particular stage of the process

Source: Ortolano (1974)

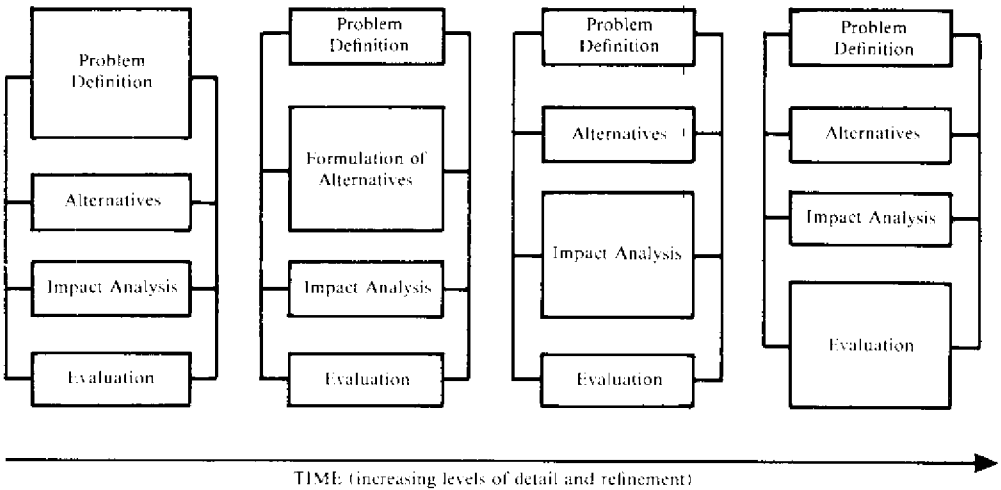


Figure 6 A suggestive representation of the planning process over time

Notes: (a) The lines between boxes summarize information flows noted in Figure 1.
(b) The sizes of the various boxes suggest the emphasis placed on the four activities at any one point in the process.
(c) The figure does not show all possible variations in the way emphasis on activities may shift over time.

Source: Ortolano (1974)

It is important to understand that when CBA is used to rank alternatives it is not the sole criterion for decision-making. CBA does not address problems of equity or ecological imperatives and represents only the quantitative side of the calculus. The framework provides a basis for aggregating only those impacts that can be assigned monetary values. The decision rules are, however, widely applicable at many planning levels. At the decision apex, CBA provides a means for weighing environmental goals against economic costs.

The major obstacle in applying a multi-criteria evaluative framework is in devising the weighting scheme to be adopted. Button (1979) states that "CBA may be seen as a special case of the multi-criteria approach in this context, with monetary values being employed as weights". Further, "... despite the practical difficulties of evaluating intangibles and the problems of equality, the CBA method is possibly more readily accepted than some of the alternative schemes suggested for multi-criteria procedures".

The 'evaluation dilemma' is that to understand the implications of a proposed action or project, it is useful to divide the impacts into many component parts. But to aid judgement about the desirability of a project, it is necessary to reassemble or synthesize the parts into an understandable whole to provide an integrated viewpoint (McAllister 1982).

5 Worst case analysis

The requirement for preparing a 'worst case analysis' is to address the problem of incomplete or unavailable information in environmental analysis. The methodological concept was first articulated by the Council on Environmental Quality (CEQ) in the U.S.A. Although it is not known why the council chose the 'worst case analysis' construct, it was apparently intended as a device to prevent agencies from using these types of situation as a pretext to avoid drafting an EIS or the need to consider uncertainties in decision-making. A major area for consideration of this type of analysis relates to low probability accidents or failures that can produce high consequence health risks. Examples are toxic chemical spills and radiation hazards from nuclear power plants.

The original CEQ regulation stipulated that:

"If (1) the information relevant to adverse impacts is essential to a reasoned choice among alternatives and is not known and the overall costs of obtaining it are exorbitant or (2) the information relevant to

adverse impacts is important to the decision and the means to obtain it are not known (for example, the means for obtaining it are beyond the state of the art) the agency shall weigh the need for the action against the risk and severity of possible adverse impacts were the action to proceed in the face of uncertainty. If the agency proceeds, it shall include a worst case analysis and an indication of the probability or improbability of its occurrence."

The 'worst case analysis' dilemma is an extension of the issue regarding the reach of an EIA. To what extent should one reasonably carry out the analysis of environmental consequences?

The problem of applying this requirement is exceedingly complex however. How does one define the 'worst case' scenario? How can threshold standards be established to trigger the need for preparing this type of analysis? Should thresholds be based on the severity of the consequences or the probability of the event happening? As subsequently noted by the CEQ, in fact, the very nature of the inquiry is almost limitless as one can always conjure up a worse 'worst case' to a hypothetical scenario. Experts in the field of risk analysis claimed further that this type of analysis lacks defensible rationale and that no one really knows how to do it.

In view of the various conceptual problems related to the application of the 'worst case analysis' rule, CEQ undertook an intensive review of the methodological framework. The council subsequently concluded that the procedural requirement is an unsatisfactory approach to the analysis of potential consequences in the face of missing information. It was felt that the requirement, particularly when interpreted broadly by judicial decisions, challenges the agencies to speculate on the 'worst' possible consequences of a proposed action that is inconsistent with the 'rule of reason' principle: that of defining and analysing a particular set of hypothetical consequences which can be imagined as the 'worst' possible result of a proposed action, without regard to support from scientific opinion, evidence and experience.

Moreover, CEQ also concluded that "in the institutional context of litigation over EIS(s) the 'worst case' rule has proved counterproductive, because it has led to agencies being required to devote substantial time and resources to preparation of analyses which are not considered useful to decision-makers and divert the EIS process from its intended purpose."

A new approach has been proposed by CEQ to deal with the problem of incomplete or unavailable information in lieu of a 'worst case analysis'.

The revised guideline retains the duty of agencies to analyse and describe the consequences of a remote, but potentially severe impact, but grounds that duty on the evaluation of scientific opinion rather than in the framework of a *conjectural* 'worst case analysis'. The emphasis is on a good faith analysis of credible scientific evidence of the reasonably foreseeable low probability/high consequences disasters.

III Substantive Issues

1 Adequacy of EIA study

It has been aptly said that it is easier to recognize an inadequate EIA rather than define adequacy, which may change from case to case.

The following tests have generally been applied by U.S. courts to determine whether an EIS is adequate (Delogu 1974):

- the statement is not cursory but meets the principle of 'full disclosure';
- is the degree of detail provided 'reasonable';
- was there sufficient consideration of reasonable alternatives to the proposed actions.

Although depth should mean a serious attempt to carry the assessment to the evaluation of costs and benefits to the extent possible, Delogu pointed out that "one can never literally disclose fully or deal with all alternatives because one never has total information at his disposal."

Another generally agreed requirement is that an EIA should include consideration of cumulative and secondary (i.e. those induced by associated investments and changed patterns of social and economic activities) impacts of a project. Secondary effects, through their impacts on existing community facilities and activities, through inducing new facilities and activities, or through changes in natural conditions, may often be even more substantial than the primary effects of the original action itself. For example, the effects of a project on population growth may outweigh the direct impacts. Further, the interrelationships and cumulative impacts of the proposed project and other pre-existing and related activities must be analysed. These effects were usually ignored in early EIAs or were dealt with very superficially. Delogu noted that "agencies often neglected secondary effects analysis because they felt that they had neither responsibility for nor the power to control such effects."

2 Consideration of human health impact

Throughout history, insidious health hazards and disease have been introduced by man through development projects. The aqueducts of

Rome brought the populace not only water but also toxic lead. Similarly, irrigation schemes have spread schistosomiasis and other diseases. Coal-fired smog hanging over London in years past wrought crippling rickets and respiratory illnesses. The epidemiology of rickets is particularly interesting in that although widely regarded as a dietary deficiency disease resulting from a lack of 'vitamin D', it is suspected that it resulted, in fact, from a lack of sunlight in smoky cities in England during the Industrial Revolution. It was thus one of the earliest air-pollution diseases (Loomis 1970). These examples leave no doubt that a primary focus of EIA must be concerned with potential human health effects.

In the instances cited, health effects were direct and present no conceptual problem for including within the EIA assessment framework. The only limitation is the shortcoming of scientific knowledge of cause-effect and dose-response relationships. For example, in the case of chemical contaminants, the health effect links are usually not known except for the few that have been studied out of the tens of thousands of chemical products that are commercially produced. Epidemiological data are few and difficult to develop because most diseases caused by chemical contaminants show symptoms only after a long period of latency.

Although the legislative history and the policy statement of NEPA assigned the highest priority to human health and welfare effects, the dominant theme of U.S. EISs and impact studies in other countries relates to effects on natural systems. Litigations relating to human health consequences have been rare under NEPA.

Health impacts are generally second and higher order effects of a project and involve consideration of the depth to which an EIA has to be carried. According to Dougherty (1983), two questions must be addressed:

- what kinds of human health effects constitute 'environmental' effects; and
- when do the indirect health effects of a given action become so *attenuated* that they may be disregarded within an EIS analysis?

It is generally agreed that 'obvious' cases such as those already cited and aerial spraying of herbicides or pesticides must address the effects upon the health of those who may be exposed. But even when health claims are valid issues that come within the scope of an EIA, it still leaves open the question of how to limit the inquiry.

The rule established by U.S. courts on this question is that there must be "a reasonably close causal relationship between a change in the physical environmental and the health effect at issue". In this context, perception of risk and the resultant psychological health problems and injuries do not represent an actual environmental effect because it is too remote and need not be considered in an EIA study. Psychological stress and other human ills are, however, encompassed within the concept of health and these effects should be incorporated in an EIS if they flow directly from physical impacts and *not* remote speculation. For example, the risks of cancers and deaths that may be caused by radiation discharges are well established and must be taken into account in an EIS.

In evaluating the effects of health impact, the following questions must also be asked:

1. How does one define human health impact?
2. What is the decision framework for evaluation?

Health impact is quantitatively defined by different levels of physiological response and the affected population size. The concept is diagrammatically represented by a pyramid of biological response, as shown in Figure 7. A demographic profile of the affected population is further needed for estimating economic losses.

The decision framework for evaluating health impact is shown in Figure 8. Ideally, the minimum acceptable level of health is that level necessary to protect people from illness and premature death. The region of social decision-making is the zone of incrementally higher level of health protection bounded between the acceptable minimum health need and the practical technological and economic limit of considerations. In practice, complete avoidance of increased morbidity or mortality risks is not possible.

Predictions of health impact are always order-of-magnitude estimates that are based on statistical inference. The framework for this analysis is shown in Fig. 9.

Estimates of the increased risk of disease are based on scientific criteria (for toxic substances and carcinogens) and site specific epidemiological knowledge and experience. These are all based on probabilities and hypothesized scenarios. Thus, there is always a margin for error. This, however, should not deter planners from attempts to analyse potential adverse health consequences.

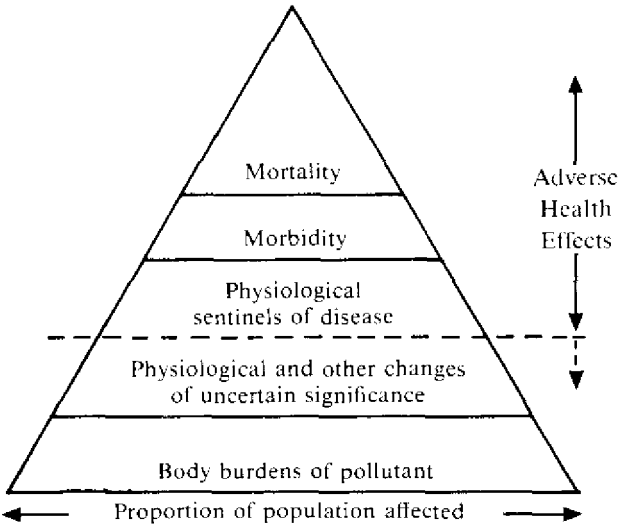


Figure 7 Schematic spectrum of biological response to pollutant exposure

Based on a diagram in United States Congress Document No. 92-241 (1972)

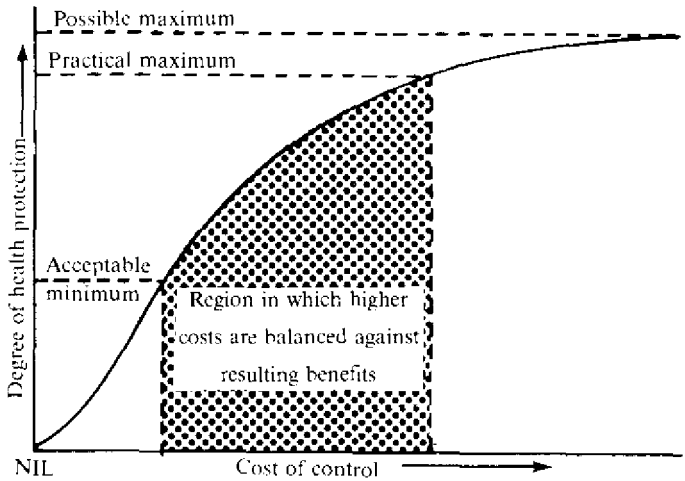


Figure 8 Schematic representation of degree of health protection as a function of cost

Source: WHO (1972)

Table 2 Health effects of major water related developments

Date of Completion	Project	Health Effects	Prevalence Pre-project	Prevalence Post-project	Timescale
1933	Tennessee Valley River Project, U.S.A.	Increase in Malaria			
1958	Kariba Hydro-electric Power Scheme, Zimbabwe	Increase in Schistosomiasis. Sporadic increases in Trypanosomiasis	Low	70% (in children)	in 10 years
1960	Gezira-Managil Irrigation Scheme, Sudan	Increase in Schistosomiasis. Short term increases in Malaria	5%	80%	in 29 years
1963	Ord River Dam, Northern Australia	Potential increase in Arboviruses			
1965	Soe Dam, Ghana	Increase in Onchocerciasis			
1966	Volta Dam, Ghana	Increase in Schistosomiasis	3%	70%	in 2 years
1968	Sugar Estate Irrigation, Tanzania	Increase in Schistosomiasis	Low	85% (in fieldworkers)	in 1 year
1969	Kainji Dam, Nigeria	Increase in Schistosomiasis	Low	30% 70%	in 1 year in 3 years
1969	Aswan High Dam, Egypt/Sudan	Increase in Schistosomiasis	10%	c 100%	
1970	Ubolratana Dam Complex, Thailand	Increase in Intestinal Parasitic Infections: - Helminths - Protozoa Increase in Opisthorchiasis		52–80% 9–20% 27–70%	
1970	Kisumu Rice Irrigation Scheme, Kenya	Increase in Malaria. Increase in Arbovirus infections (e.g. Onyongyong Fever)			
1970	Nagarjunasagar Dam, India	Introduction and increase in Genu Valgum (bone disease)			
1974	Guyama, Guajataca and Lajas Valley Water Development Schemes, Puerto Rico	Increase in Schistosomiasis			
1974	Lesotho Water Supply Improvements, Southern Africa	No effects on the prevalence of faecal-oral or skin diseases			
1974	El Bir and Foum Gleita Reservoir Schemes, Mauritania	Potential increase in Schistosomiasis			
1975	Tana River Basin, Kano Plains, Yala Swamp and Taveta Irrigation Schemes, Kenya	Potential increase in Schistosomiasis			
1978	Malumfashi Agricultural Development Project, Nigeria	Increase in Schistosomiasis	Low	65% (males 15–20 years)	in 1 year
1978	Srinagarind (Chao Nen) Dam, Thailand	Increase in Malaria	16%	25%	in 5 years
1979	Gambia Estuary Barrage, Gambia	Potential increase in Schistosomiasis, Malaria, Filariasis and Enteric diseases. Possible introduction in Trypanosomiasis			
1980	St. Lucia Water Supply Improvements, St. Lucia, Caribbean	Reduction in Schistosomiasis	Infections reduced: 78% by chemotherapy 55% by molluscicides 50% from improved water supplies		

Source: WHO/EURO (1983)

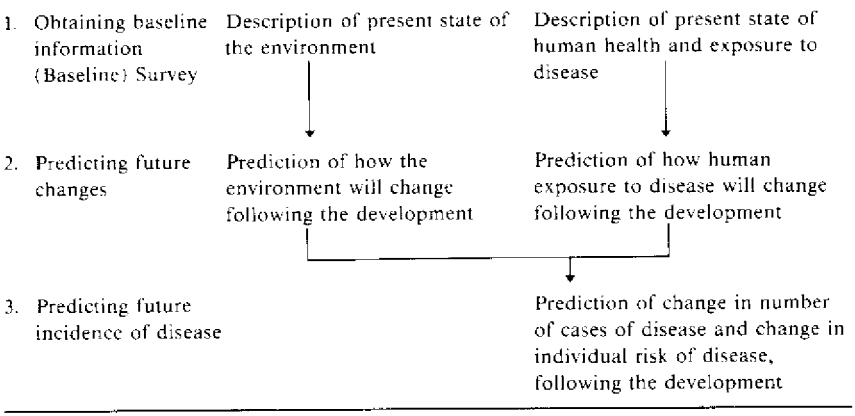


Figure 9 Steps in predicting health effects

Source: WHO/EURO (1983)

Retrospective study of the experiences of past developments are almost always essential to assess the scale of potential health impact. These kinds of data for selected water projects are shown in Table 2. Health agencies should give particular attention to the need for post project monitoring and assessment in order to build up an epidemiological database to guide future EIAs.

To what extent have human health effects been explicitly analysed in past EIAs? In the typical project covered under NEPA, health impact is not a major issue except when it is incidental to more serious and easily established pollution problems. When health was given attention, the analysis was usually descriptive rather than attempts at quantification. A recent study (1986) commissioned by the WHO Regional Office for Europe reviewed thirteen EIAs related to proposals for chemical industrial developments in various countries. The study showed few of the case studies selected referred to health effects and only one devoted a section to the consideration of public health. Although analyses of the impacts on air and water quality were usually included, there were no serious attempts to extend the analyses to the evaluation of potential human health impact. A major conclusion of the review was that the weight given to the evaluation of health effects in an EIA is largely determined by the perception of these issues by the EIA study team and

the permitting authority. Thus, the key to ensuring that health issues are addressed is the involvement of health authorities in the 'scoping' process.

3 Decision-making

It should be recognized at the outset that development decisions are generally dominated by other socio-political considerations and that EIA plays only a balancing role.

Whether the process involves a simple 'yes' or 'no' decision or the more complex choice-making of alternatives, the dilemma of the decision-maker(s) is to decide if the benefits expected from a proposal justify the commitment of public funds and other resources or more generally what is good for society. The decision is ultimately always a value statement.

In the hierarchy of decision-making, objective criteria, such as CBA decision rules, can be routinely used at the tactical level to guide the plan-making process. Alternatively, other constraint criteria, such as standards and engineering codes of practice, can be used to evaluate project elements. Even when faced with valuation problems concerning environmental impacts, it is still usually not difficult to evaluate the design problem by means of analysing cost effectiveness.

It is at the apex of decision-making where the dilemma of balancing objective criteria (that is, economic efficiency) against other social goals or intangible considerations and public perceptions is encountered. Politicians or people who have public accountability make these choices. Ashby suggests that these people rely on hunch to guide their decisions. He further states that "a decision-maker's hunch about an issue depends on two parameters: his beliefs about the issue and his attitude to these beliefs, that is, the weight he attaches to them." Thus, "objective information has to be combined with the pressures of advocacy and with subjective judgements to produce a formula for a political decision."

If EIA and planning in general is to have any relevance, it has to be assumed that decision-makers are not all capricious and that they are motivated by a need for scientific guidance. The information derived from the process clarifies issues and serves as fuel for public debate.

In environmental decision-making, it can be generally accepted that the dominant characteristic in play is risk aversion on the part of politicians and the public. Risk by nature involves probabilities and subjective perceptions. These kinds of estimates and statistics are important inputs to political judgements and public acceptance. For example,

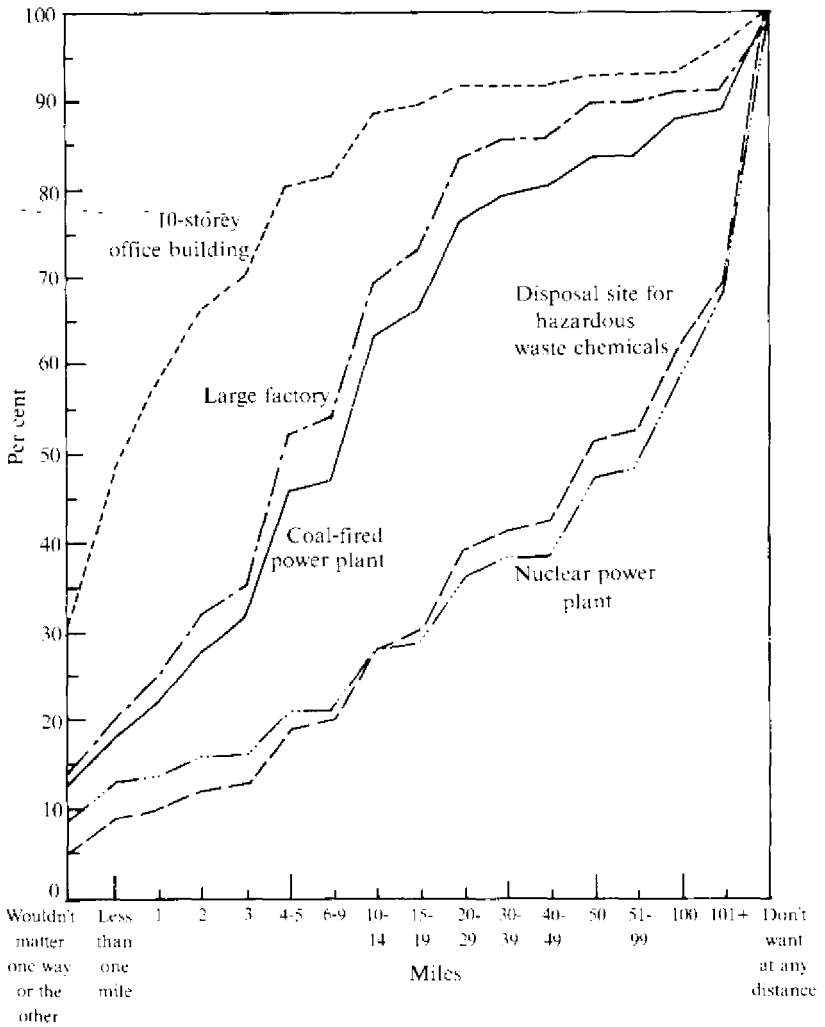


Figure 10 Cumulative percentage of people willing to accept new industrial installations at various distances from their homes

Source: CEQ (1980)

public opinion surveys, such as that shown in Figure 10, which polled public attitude towards the recurrent issue of industrial siting, can provide valuable information for guiding decision-making. The data give the decision-makers a handle to make trade-offs and articulate costs.

If risk can be estimated, risk-benefit comparison can serve as a guide for decision-making. This kind of analysis is appropriate when the problem is to balance different degrees of risk against the economic benefits of an activity. The approach thus is particularly relevant for the evaluation of health effects.

IV Summing-up

There is unquestionably a serious and pervading need for knowledge in all aspects of environmental impact analysis and more specifically on the quantification of human health effects. The problem is, however, extremely complex because of the stochastic nature of physical and biological processes and the fact that the most important health consequences are frequently dependent on undeterminable or probabilistic factors and exogenous events.

The lack of absolute and precise scientific information is, however, not as important as an understanding of the planning issues that are central to the concept of EIA. Addressing these issues and clarifying the appropriate framework for considering human health effects are the primary goals of this report. It is hoped that this will facilitate dialogues and bridge the gaps between health authorities and development agencies. Inadequate communication between these agencies is a common phenomenon in the developing countries and has often been coloured by ignorance of the issues each faced.

The role of the health authorities in the EIA process is primarily one of review and advocacy. This can only be effectively discharged when health agencies actively participate in the planning process by articulating human health concerns and ensuring that the methodological procedures are adequate to capture significant projects and able to weigh their health implications.

The quality of the outcome of applying the EIA methodology to planning does not depend so much on the scientific precision of the assessment of impacts as on the development of viable alternatives. However, even though precise data are generally not available, attempts should be made to the extent possible to weigh health effects quantitatively. The beginning point is the involvement of health authorities in the EIA process and a willingness to confront the issues.

THIRTY-FIFTH WORLD HEALTH ASSEMBLY WHA35.17

14 May 1982

COLLABORATION WITH THE UNITED NATIONS SYSTEM—GENERAL MATTERS

Health implications of development schemes

The Thirty-fifth World Health Assembly,

Recalling resolution WHA17.20 on the importance of paying special attention to the health implications of large-scale socioeconomic development schemes;

Recalling further resolution WHA18.45 on the same issue;

Noting that many development projects carry major potential health hazards and dangers to the environment; that frequently insufficient resources are made available and/or applied in the planning and implementation of development projects to assess these hazards and to prevent their occurrence;

Noting further that, on occasions in the past, the health of populations and the environment have deteriorated as a result of development projects especially those associated with water resources development projects;

1. PLEDGES WHO's total commitment to work with Member States, international and national agencies and financial institutions to incorporate the necessary preventive measures into development projects to minimize the risks to the health of populations and the environment;

2. URGES Member States, national and international agencies and financial institutions, in the planning and implementation of development projects, especially those involving water resources development projects;

(1) to analyse in detail the possible health hazards and environmental dangers of existing and proposed development projects;

(2) to incorporate into project plans and their implementation adequate measures to prevent, to the greatest extent possible, the occurrence of health and environmental hazards;

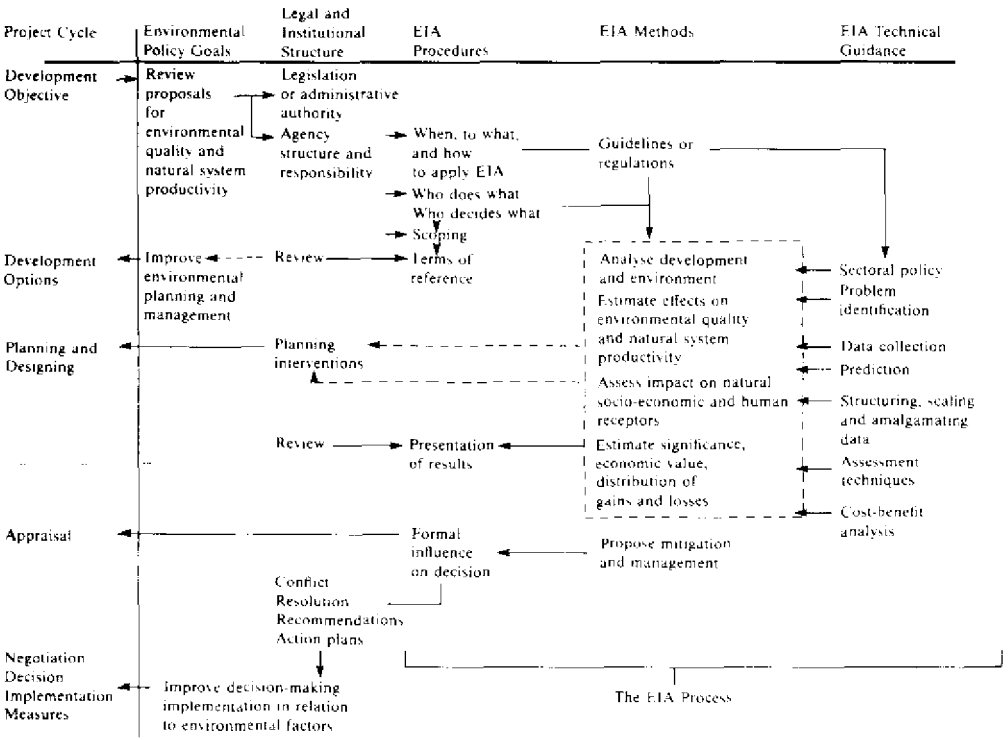
(3) to make adequate provisions for the implementation of the necessary preventive measures in the financing of the relevant development projects;

3. APPEALS to donor countries and relevant financial institutions to assist developing countries in the implementation of the resolution.

Thirteenth plenary meeting, 14 May 1982
A35/VR/13

Annex 2

Overall Simplified Framework for Application of the EIA Process to the Project Cycle



Source: Horberry (1984)

Foreword

There is a growing awareness worldwide of the need to assess the implications for human health of many major development projects and policies. The belief that 'prevention is better than cure' was never more applicable than in the assessment of potential damage which can occur when implementing these projects, particularly in developing countries. Sound development planning and the application of acceptable guidelines are essential at the outset to avoid damaging health effects.

A series of major guidance documents has been developed at MARC in co-operation with the World Health Organization for the assessment of broad human health and welfare effects in the context of the Environmental Impact Assessment process. These documents highlight substantive issues relating to decision-making and the evaluation of impacts. The aim is to provide a compact source of references that gives a quick perspective of the important issues for different types of projects and information that helps to guide the evaluation of impacts and alternatives. Case studies will be outlined where possible to provide a practical perspective to the conceptual framework.

One set of guidance documents addresses the methodological issues and substantive problems of decision-making and provides background information. The second series of documents, also in the MARC series, will provide specific guidance relating to design proposals that focus on classes of projects that affect human health and welfare.

The documents are designed to assist health agency officials and decision-makers in developing countries in dealing with human health and welfare issues related to development projects. Graduate students gaining experience in effective impact management will also find the documents of use either in their training course or when they assume wider responsibilities for community development projects.

P. J. Peterson
Director

Environmental Impact Assessment

An analysis of the methodological and substantive issues affecting human health considerations

by Frank C. Go

An EIA Guidance Document

Prepared jointly by

Monitoring and Assessment Research Centre
King's College London, University of London

World Health Organization

With the support of
Global Environment Monitoring System
United Nations Environment Programme

ISBN 0 905918 37 1

Usual Human Health and Welfare Concerns

1 Health Impact

- increased risk of morbidity and mortality from air pollution;
- contamination of water supplies and recreation water;
- contamination of shellfish harvesting areas and food chains;
- stress resulting from congestion and adverse environmental factors;
- management of wastes and hazardous substances;
- risk and safety from hazards.

2 Welfare Impact (these are commonly referred to as induced socio-economic effects)

- noise;
- aspects of air and water quality problems affecting amenity and economic value of the resources;
- outdoor recreational services;
- public nuisance;
- demand on municipal infrastructures and services;
- aesthetics and social amenities;
- psychological features;
- population growth;
- open space and privacy;
- natural productivity.

Annex 4A

Examples of activities considered environmentally significant

I The Netherlands*

- discharge of toxic substances into the air; discharge of large quantities of substances into the air which cause serious pollution, photochemical smog or serious ecotoxicological impacts;
- accidental discharge of inflammable, explosive, toxic or radioactive substances which may affect human health in a serious way;
- discharge of toxic substances directly to ground or surface water, or via the soil; discharge, in large quantities, of substances to ground or surface water which cause serious pollution or affect the functional use of soil or water in a serious way;
- discharge of waste material which is difficult to process; discharge of waste material in large quantities which because of its characteristics or by the context causes serious negative impacts;
- discharge of non-ionizing substances with large-scale, serious negative radiation impacts;
- bringing about of serious interference in the composition and structure of the ground-water table;
- serious interferences in the composition and structure of the soil, including those which may affect soil functions;
- important changes in the macro- or micro-climate;
- serious injury to the diversity, coherence, visual manifestation or culture-historic aspects of town and countryside (landscape);
- harmful influence on the biotic environment so that species or ecosystems, especially those which are unique or rare, are endangered;
- influence of sensory intrusion, especially that caused by excessive emissions of noise or vibrations, perceived risk of personal hazard, the adverse visual manifestation of an activity (an 'eyesore'), or noxious odours.

* Reference: U.N. Economic Commission for Europe

II Sweden*

- iron and metal works;
- large sawmills;
- factories producing organic and inorganic chemicals;
- plants for processing nuclear fuel;
- oil refineries;
- fossil fuel power plants exceeding 500 mw;
- production of fertilizers;
- cement works.

* Reference: U.N. Economic Commission for Europe.

The Philippines*

Proposed Areas and Types of Projects for Proclamation as Environmentally Critical within the Scope of the EIA System

---

A Environmentally critical projects

I. Heavy Industries:
   (a) Non-ferrous metal industries
   (b) Iron and steel mills
   (c) Petroleum and motor-chemical industries including oil and gas
   (d) Smelting plants

II. Resources Extractive Industries:
   (a) All forms of mining and quarrying activities
   (b) Forestry Projects
      1. Logging
      2. Wood processing
         - saw milling
         - plywood, wallboard mills
         - pulp and paper mills
      3. Introduction of fauna (exotic animals) in public/private forests
      4. Forest plantations
         - industrial plantations
         - agro-forestry
         - monoculture plantations
      5. Forest occupancy
      6. Extraction of mangrove products
      7. Grazing
   (c) Fishery Projects
      Dikes for/and fishpond development projects

* The Philippines has had a legal requirement for EIA covering development projects since 1977.

III. Infrastructure Projects
   (a) Major dams
   (b) Power plants (fossil-fueled, nuclear-fueled, hydro-electric or geothermal)
   (c) Major reclamation projects
   (d) Major roads and bridges
      (i) which will bisect or traverse any highly developed urban areas and would require raising level of the roadway, and/or acquiring additional right of way, and/or widening of the roadway;
      (ii) in highly developed urban areas which would result in substantial alteration of traffic patterns in the vicinity; and
      (iii) which will disturb tourist spots, parks and critical watersheds.

B Environmentally critical areas

1. All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries.
2. Areas set aside as aesthetic or potential tourist spots.
3. Areas which constitute the habitat of any endangered or threatened species of indigenous Philippine wildlife (flora and fauna).
4. Areas of unique historic, archaeological, or scientific interests.
5. Areas which are traditionally occupied by cultural communities or tribes.
6. Areas frequently visited and/or hard-hit by natural calamities (geological hazards, floods, typhoons, volcanic activity, etc.).
7. Areas with critical slopes.
8. Areas classified as prime agricultural lands.
9. Recharge areas of aquifers.
10. Water bodies characterized by one or any combination of the following combinations:
    (a) tapped for domestic purposes;
    (b) within the controlled and/or protected areas declared by appropriate authorities;
    (c) which support wildlife and fishery activities.
11. Mangrove areas characterized by one or any combination of the following conditions:

(a) with primary pristine and dense growth;
(b) adjoining mouth or major river system;
(c) near or adjacent to traditional fry or fishing grounds;
(d) which act as natural buffers against shore erosion, strong winds and storm floods;
(e) on which people are dependent for their livelihood.

12. Coral reefs characterized by one or any combinations of the following conditions:
(a) with 50 per cent and above live coralline cover;
(b) spawning and nursery grounds for fish;
(c) which act as a natural breakwater of coastlines.

Thailand*

Proclamation of Types and Sizes of Projects Requiring EIA (July 1981)

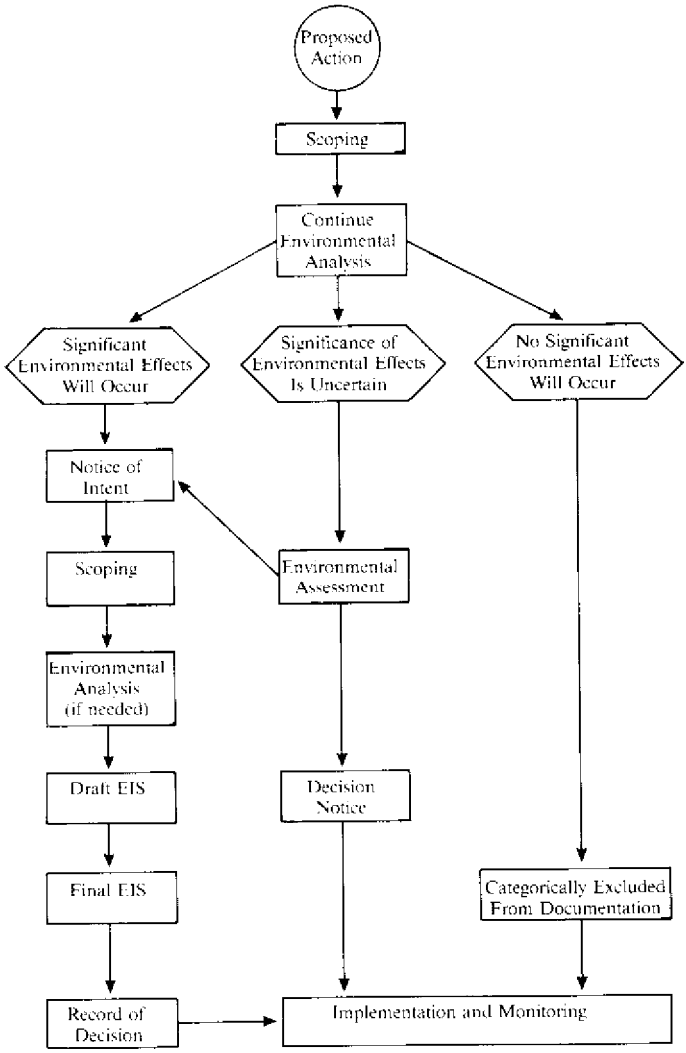
Type of Project	Size
1. Dam/reservoir	Maximum storage volume greater than 100,000,000 cubic metres or surface area greater than 15 square kilometres
2. Irrigation	Greater than 80,000 rai (1 ha = 6.25 rai)
3. Airport	All
4. Beach, ocean front, river front hotel or hotel adjacent to or within national parks	More than 80 rooms
5. Rapid transit system	All
6. Mining	All
7. Industrial estate	All
8. Harbour	For ships bigger than 500 gross ton
9. Thermal power plant	More than 10 MW maximum design production capacity
10. Industries	
(a) Petrochemical industry	Raw material requirements: 100 ton/day or more.
(b) Oil refining industry	All
(c) Natural gas industry	All
(d) Iron and steel industries	Production capacity 100 ton/day or greater, or total capacity of furnaces 5 ton/batch or greater.

(e) Cement industry	All
(f) Smelting industry	Smelting capacity 50 ton/day or greater.
(g) Pulp industry	Production capacity 50 ton/day or greater.

* The 1978 amended Improvement and Conservation of National Environmental Quality Act requires that for certain projects a report be prepared "concerning the study and measures for the prevention of and remedy for the adverse effect on the environmental quality . . ."

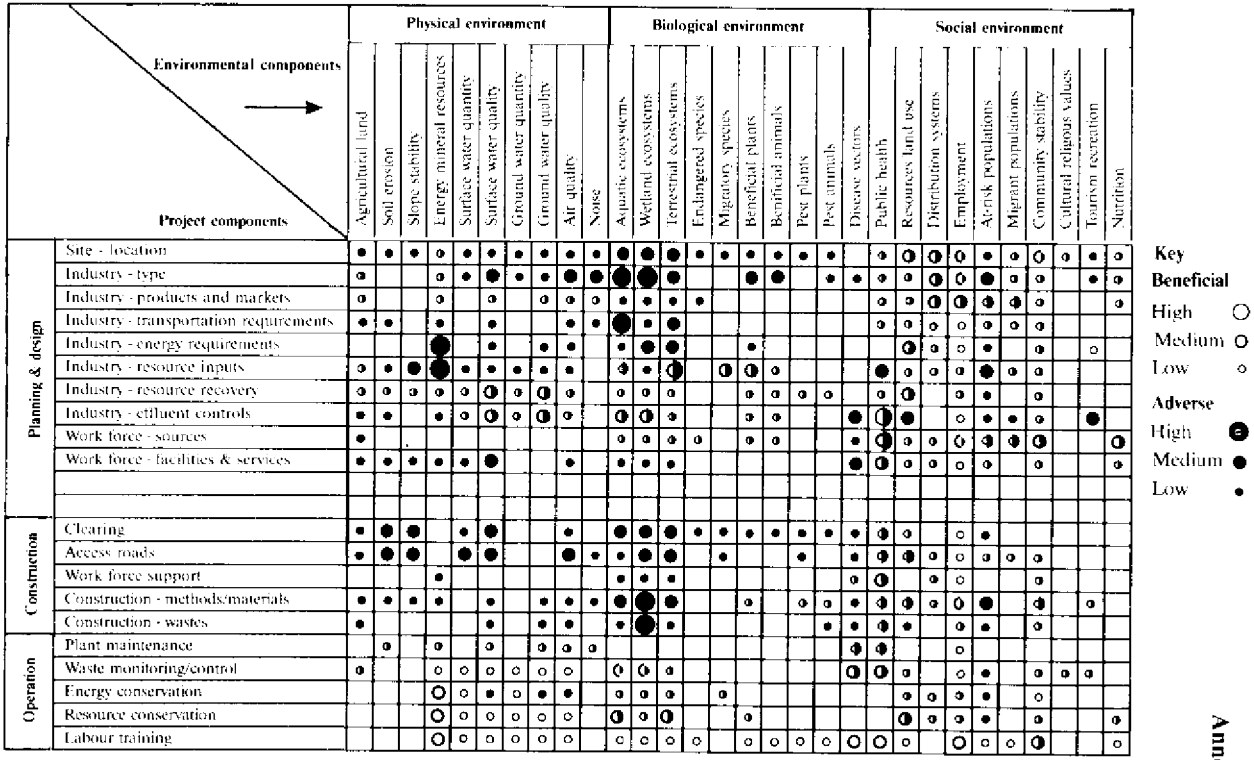
Annex 5

Environmental Analysis, Documentation, and Implementation Overview



Source: Federal Register volume 50, number 121 (1985)

Small-scale Industry Potential Impacts



Source: U.S. AID (1980)

Sample Scoping Report*

Nature of action

To consider a proposal to issue a prohibition order to stop the combustion of petroleum or natural gas as the primary fuel source for a power plant unit (no. 7) and to require its conversion to utilize coal.

Table 1 Summary of concerns expressed in the public scoping process

Issue of Expressed Concern
Air quality deterioration
Water contamination
Ash and sludge disposal
Compliance with air and water standards
Increase in acid rain
Impact on pinelands
Impact on aesthetics
Increased noise from coal transport and handling
Degradation of wildlife areas
Administrative co-ordination (ERA and Regional EIS)
Availability of coal
Adequacy of coal transport facilities
Alternative energy sources
Implementation of control technology
Economic considerations

* Outline of an Implementation Plan developed for a project pursuant to the Powerplant and Industrial Fuel Use Act of 1978.

Reference: Environmental Compliance Guide, U.S. Department of Energy (1981)

Table 2 Alternatives and options identified

Alternative	Option Class	Option
Issue Prohibition Order (Proposed action)	Alternative fuels	Compliance coal
		Coal with precleaning
		Coal with flue-gas desulphurization
		Coal/oil mixture
		Miscellaneous other fuels:
		– Coal/gas mixture
		– Refuse-derived fuel
		– Petroleum coke
		– Wood
		– Others
	Shutdown Unit 7	Shift load to other plants
		Other energy approaches:
		– Conservation (demand reduction)
		– Solar
		– Wind
		– Geothermal
		– Nuclear
	Temporary exemption	Peak load use only
		Retire Unit 7 before end of exemption period
		Delayed compliance
	Permanent exemption	Special public interest gas rule
		Exemption on economic, physical, environmental, or legal grounds
Do Not Issue Order (No action)	Continue as present	Burn No. 6 residual fuel oil (0.5% sulphur)
	Voluntary conversion	See alternative fuels options listed above

Table 3 Determination of the significance of issues

Issue	Concern Expressed in public Scoping	Concern due to Context and Intensity of Potential Impacts
Air Quality		
Regulatory compliance	Moderate	Moderate
Sulphur dioxide	Moderate	Moderate
Particulates	Low	Moderate
Nitrogen oxides	Low	Moderate
Carbon oxides	Low	Low
Ozone/Hydrocarbons	Moderate	Low
Fugitive emissions	Low	Moderate
Visibility degradation	Low	Moderate
Brigantine refuge	Low	Low
Acid rain	High	Moderate
Control technology	Low	Not applicable
Heavy metals	—	Moderate
Solid Waste		
Dredge spoil	—	Low
Ash and sludge	Moderate	Moderate
Transport	Low	High
Regulatory compliance	Low	Moderate
Water Quality		
Regulatory compliance	Low	Moderate
Surface water consumption	Low	Moderate
Dredging and spoil disposal	—	Low
Waste water treatment	Low	Moderate
Construction runoff/Erosion	Low	Moderate
Site flooding	—	Low
Groundwater consumption	—	Low
Coal pile leachate	Moderate	Moderate
Dredge spoil leachate	—	Moderate
Solid waste leachate	Moderate	Moderate
Land use		
Land use planning	—	Low
Off-site requirements	—	Low
On-site requirements	—	Low
Change in land use	—	Low
Indirect effects	—	Low
Socio-economics		
Economic effects	—	Low
Social effects	—	Low

Table 3 (Continued)

Issue	Concern Expressed in public Scoping	Concern due to Context and Intensity of Potential Impacts
Historical/Archaeological		
Identified sites	—	Low
Indirect effects	—	Moderate
Human Health		
Air quality	Low	High
Water quality	—	Moderate
Noise		
Coal transport	Low	Moderate
Coal handling	Low	High
Other operations	—	Moderate
Waste trucking	—	Moderate
Construction	—	Moderate
Ecology–Aquatic		
Dredging	—	Low
Cooling water	—	Moderate
Waste water	—	Moderate
Runoff water	—	Moderate
Solid waste leachate	—	Low
Endangered species	—	Low
Ecology–Terrestrial		
Air quality	—	High
Forest and woodland	Moderate	Low
Habitat pollution	—	Moderate
Endangered species	—	Moderate
Coal storage	—	Moderate
Agricultural Lands		
Crop yield	—	High
Crop sales	—	High
Floodplains/Wetlands		
Habitat removal	—	Low
Habitat pollution	—	Low
Miscellaneous		
Availability of coal	Low	(Outside scope of EIR)
Coal transport facilities	Low	(Outside scope of EIR)
Non-fossil energy sources	Moderate	(Not an alternative to prohibition order)
Co-ordination with broader EISs	High	(Co-ordination will occur)

Table 3 (Continued)

Issue	Concern Expressed in public Scoping	Concern due to Context and Intensity of Potential Impacts
Alternative fuels and control technology	Moderate	(Included in alternatives)
Electricity rates/reliability	Moderate	(An analysis of rates/ reliability will be included in the EIS by DOE/LRA).

References

Ahmad, Y. J. and Sammy, G. K. 1985 *Guidelines to Environmental Impact Assessment in Developing Countries*, Hodder and Stoughton.

Anderson, F. R. 1973 *NEPA in the courts—A legal analysis of NEPA*, the John Hopkins University Press.

Ashby, E. 1977 *Reconciling Man with Environment*, Oxford University Press.

Bakus, G. J., Stillwell, W. G., Latter, S. M. and Wallerstein, M. C. 1982 Decision making: With applications for environmental management, *Environ. Manage.* **6**(6).

Barrett, M. 1979 Environmental statements, *J. Omega* 7(5), Pergamon Press.

Button, K. J. 1979 Models for decision making in the public sector, *J. Omega* 7(5), Pergamon Press.

Cheremisinoff, P. N. and Morresi, A. C. 1977 *Environmental Assessment and Impact Statement Handbook*, Ann Arbor Science Publishers.

Clark, B. D., Chapman, K., Bisset, R., Wathern, P. and Barrett, M. 1981 *Assessment of Major Developments: A Manual*, HMSO.

Coates, J. F. 1974 Some techniques and methods for comprehensive impact assessment, *Technol. Forecasting Soc. Change* **6**, 341–357.

Cooper, C. 1981 *Economic Evaluation and the Environment*, Hodder and Stoughton.

Council on Environmental Quality (CEQ), U.S.A.

- Regulations for implementing the procedural provisions of NEPA 1978 43 FR 55978-56007.
- Guidance regarding six topics in the NEPA process.
- Public opinion on environmental issues 1980.
- Proposed amendment to 40 C.F.R. 1502.22, 1980.
- Annual reports of the CEQ 1976–1984.
- Preparation of environmental impact statements: Guidelines, 38 Federal Register 20550-20562, Aug. 1, 1973.
- Environmental impact statements, An analysis of six years experience 1976.

Delogu, O. E. 1974 *U.S. Experience with the Preparation and Analysis of Environmental Impact Statements*, NEPA, IUCNNR.

Dickert, T. G. 1974 Methods for Environmental Impact Assessment: a Comparison. In *Environmental impact assessment guidelines and commentary* T. G. Dickert and K. R. Domeny (Eds), University Extension, University of California, Berkeley, California.

Dougherty, James, B. 1983 The application of NEPA to agency actions affecting human health, *Environ Law Rep.* 13 ELR 10181.

ECE, various documents of Group of Experts on EIA.

Environmental Law Institute 1981 *NEPA in Action—Environmental Offices in Nineteen Federal Agencies*, A report to the CEQ.

Federal Register June 24, 1985 Volume 50 (121).

Giroult, E. 1985 *The Health Component of EIA*, WHO/EURO paper.

Hirsch, A. O. undated *EIA Experience in the U.S.A.: Some Lessons from NEPA's First Fifteen Years* and *Effectiveness of EIA(s) in Reducing Community Tensions Related to Difficult-to-site Facilities*, U.S. EPA Papers.

Horberry, J. 1984 Status and application of EIA for development, In: *EIA for development, proceedings of a joint DSE/UNEP international seminar.*

Loomis, W. F. 1970 Rickets, *Sci. Am.* **223**, 76–91.

McAllister, D. M. 1982 *Evaluation in Environmental Planning*, The MIT Press.

McHarg, I. L. 1971 *Design with Nature*, Doubleday and Co. Inc.

McSwiney, M. 1985 *EIA and the European Communities*, presented to Intl Seminar on EIA, 1985, CEMP, University of Aberdeen, Scotland, U.K.

Mariner, U. and Feldman, M. H. 1985 *Possibilities of Environmental Impact Assessment Application Within the Priority Action Program*, paper presented at EIA Meeting, Split, Yugoslavia.

OECD 1979 *Environmental Impact Assessment.*

OECD 1986 Environmental assessment and development assistance, *Environ. Monogr.* **4**.

O'Riordan, T. 1976 *Environmentalism*, Pion Ltd.

O'Riordan, T. and Derrick Sewell, W. R. 1981 *Project Appraisal and Policy Review*, John Wiley and Sons.

Ortolano, L. A. 1974 A process for federal water planning at the field level, *Water Resour. Bull.* **10**, 766–778.

SCOPE 5, 1979 *Environmental Impact Assessment*, R. F. Munn, (Ed.), John Wiley and Sons.

Troast, Judith undated *The Evolution of the EIS Process and Issues under NEPA*, EPA paper.

UNEP and International Association on Legal Science 1979 *Manual on environmental legislation.*

UNEP 1980 *Guidelines for Assessing Industrial Environmental Criteria for Siting of Industry*, Industry and Environment Office, Paris.

UNEP 1981 *Evaluating the Environment*, Y. J. Ahmad, (Ed.), UNEP Studies 6.

UNEP 1983 *Environmental Decision-making*, Y. J. Ahmad, (Ed.), Volume 1

U.N. Economic Commission for Europe. Various dates. Various restricted reports of the Group of Experts on EIA.

U.N. Economic and Social Commission for Asia and the Pacific 1982 *Review and Appraisal of Environmental Situation in the ESCAP region.*

U.S. Agency for International Development 1980 *Environmental Design Considerations for Rural Development Projects*, prepared by Harza Engineering Company.

U.S. Congress 1975 *The National Environmental Policy Act of* 1969, as amended.

U.S. Department of the Army 1975 *Handbook for Environmental Impact Analysis.*

U.S. Department of Energy 1981 *Environmental Compliance Guide.*

U.S. EPA 1984 *Risk Assessment and Management; Framework for Decision Making.*

U.S. EPA 1985 *A Manual for Evaluating Predicted and Actual Impacts of Construction Grants Projects.*

U.S. EPA Office of Federal Activities 1985 *Guidelines Concerning Scoping.*

WHO 1972 *Air Quality Criteria and Guide for Urban Air Pollutants*, Technical Report Series 506, Geneva, Switzerland.

WHO 1972 *Health Hazards of the Human Environment*, Geneva, Switzerland.

WHO 1982 *Rapid Assessment of Sources of Air, Water and Land Pollution*, Geneva, Switzerland.

WHO 1985 *Environmental Pollution Control in Relation to Development*, Technical Report Series 718, Geneva, Switzerland.

WHO Various dates *Environmental Health Criteria Documents*, Geneva, Switzerland.

WHO/EURO 1983 *Risk Assessment and its use in the Decision Making Process for Chemical Control*, Report on a planning consultation, Copenhagen, Denmark.

WHO/EURO 1983 *Environmental Health Impact Assessment of Irrigated Agricultural Development Projects*, Copenhagen, Denmark.

WHO/EURO and Centre for Environmental Management and Planning (CEMP) 1984 *Course on Environmental Health Impact Assessment Notes*, University of Aberdeen, Scotland, U.K.

WHO 1983 Panel of Experts on Environmental Management for Vector Control (PEEM) Report VBC/83.4 *Proceedings of the International Workshop on Exposure Monitoring* published by University of Nevada.

WHO/EURO 1986 *Case Study Analysis of Environmental Assessments of Chemical Industry Projects*, draft, Copenhagen, Denmark.

Whyte, A. V. and Burton, I. 1980 *Environmental Risk Assessment*, SCOPE 15, John Wiley and Sons.

World Bank 1979 *Environment and Development*, Washington, D.C., U.S.A.

World Bank 1983 *Environmental Health & Human Ecological Considerations in Economic Development Projects*, Washington, D.C., U.S.A.

World Bank 1984 *Environmental Requirements of the World Bank*, Washington D.C., U.S.A.

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