

Framework for Assessment of Environmental Condition through Environmental Risk Assessment

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Abstract— *This paper outlines an approach to Environmental Risk Assessment (ERA) with the aim of assisting in assessing and reporting environmental conditions. The approach will also be of use to resource managers, non-governmental organizations and others in land use planning or the review of development proposals. It is a process for estimating the likelihood or probability of an adverse outcome or event due to pressures or changes in environmental conditions resulting from human activities. The ERA is a complementary to methods used in Environment Reporting, Environmental Impact Assessment and Risk Management. The approach involves identification, analysis and presentation of information in terms of risk to environmental values to inform planning and decision making processes — it does not presume to provide all social and economic information relevant to making decisions, nor is the approach intended to supplant planning and management processes.*

ERA is a flexible tool that can be applied, at a variety of scales and levels of detail appropriate to those scales, for a variety of environmental issues, at various levels of funding and for short, medium or long-term time scales.

At the heart of ERA is an assessment of the interactions between management regimes and environmental values. The assessment and reporting of risk to environmental values can then be used to identify risk reduction strategies. Subsequent revisions to management plans and actions will then hopefully be undertaken to reduce risk.

Keywords— *Environmental Impact Assessment (EIA), Environmental Risk Assessment (ERA), Environmental Risk Reduction (ERR), Risk Index (RI), Risk Management (RM)*

I. INTRODUCTION

The Environmental Risk Assessment (ERA) is a process for estimating the probability of an adverse outcome or event due to changes in environmental conditions resulting from human activities. The ERA can be termed as complementary to the methods which are used for Environmental Reporting (ER), Environmental Impact Assessment (EIA) and Risk Management (RM).[12]

In many professions and countries, it is becoming more and more usual to communicate environmental information in terms of risk. It has become essential in many countries to use the outcome of risk assessment for a proposed project, for its selection and to set the priorities and budgets for Environmental Risk Reduction (ERR).[10]

Environmental risk forecasts could offer the fundamental knowledge required for resource development decisions that

are sustainable, but this information is frequently unavailable. The ERA is used strategically for measuring and reporting the environmental parameters, which are affected due to project and can be used at various scales or levels.

The ERA is a formal technique for detecting and quantifying the risk of environmental damage. It assesses the probability that negatively effects to environmental values, which may arise as a result of human intervention to existing environment.[8]

The ERA process may be initiated before making an important decision about a project. There are basically three stages to it:

- Preparation, which includes the gathering and scrutiny of relevant background, and establishing the emphasis for the risk assessment,
- Conducting the risk assessment,
- Interpretation and reporting of the risk assessment.

II. ERA - FRAMEWORK

ERA is a systematic process, which can be used in a range of circumstances, from those with few data and resources available to those with thorough inventories and intricate system modelling. The ERA can also be used to provide risk information to a formal legal process.[9]

By defining the range of risks associated with various options, the ERA provides information for making logical & rational decisions, however specific outcome may not be claimed. The ERA also provides a channel for managers to communicate anticipated risks associated with decisions, so that stakeholders and the general public are aware of the implications on the environmental values. [3]

Comparing environmental indicators across time as they change, forms the basis of ERA. The historical range of variation for those conditions is compared to the current and expected future ranges. Monitoring of undisturbed areas, examination of natural disturbance regimes, and historical records are used to define the base case. The cumulative effects of earlier development and disturbance cause the risk difference between the present and previous situations. The trends and long-term effects of maintaining current management or the anticipated results of prospective

alternative management options determine the conditions of the future.[2]

Environmental condition and indicator assessment is summed up in terms of a risk index (RI) and is typically reported using a number of risk classes. Determining precise criteria or a low risk benchmark based on best management practices may be helpful as part of the risk analysis (RA).[1]

III. STRENGTH & LIMITATION OF ERA

The ERA is valuable because it emphasizes that how the decisions have an impact on the environment. As a result, ERA moves the emphasis from defending the virtues of a certain course of action or strategy to illuminating possible outcomes and their desirability. The ERA mandates that hazards to the environment be acknowledged both before and after decisions are made. It is expected that decisions made as a result of risk awareness will encourage, the sharing of accountability and responsibility for managing that risk. ERA is a versatile tool that can be used for short, medium, or long-term time scales, at a range of scales and at appropriate levels on those scales, for a variety of environmental issues.

The following are some of the strength of ERA : [5,7]

- risk is well-understood by the general public, clearly illustrating the future effects of decisions;
- explicit criteria for decision-making, encouraging transparency and accountability;
- development of a framework for debate that clearly separates risk assessment from decision-making;
- reassuring stakeholders that the potential environmental changes brought on by human activity are being taken into account;
- developing an understanding of the connections between environmental change and human activity, identifying the effects of different management strategies,
- admitting the assumptions and data used, and ensuring scientific validity, justification, and replication.

ERA clarify the risk to the environment from a decision, but it will not be able to set an acceptable threshold of risk. The determination of acceptable risk is an issue of risk management. The risk assessment is a basis for judgments about impacts but not for judgments on the acceptability of impacts. The decision-makers must choose a desired or acceptable level of risk.[8]

The ERA has the following limitations :[5,7]

- Risk tolerance is relative – individuals and institutions have differing perceptions about the tolerance and acceptance of risk;
- Isolating the risks associated with a decision can be difficult – there is a range of natural variability within ecosystems, differing tolerances to stress, and varying rates of recovery.

IV. LINKAGE AMONG ER, EIA & RM

The ERA complements the evaluation and reporting techniques currently, which are commonly used in environmental audits such as Environmental Reporting (ER), Environmental Impact Assessment (EIA) and Risk Management (RM).

Environmental Reporting (ER)

The ER is the method for reporting environmental conditions and is frequently used to pinpoint large-scale patterns that are relevant to or interesting to the broader audience. It is a crucial instrument for identifying baseline conditions and trends and can act as an early warning system to spot important environmental problems and related management difficulties.[2] The basic issues which should be incorporated in ER are;

- What is going on in the environment?
- Why is it happening?
- What makes it a matter of concern?
- How are it would be addressed?

The above mentioned questions can be answered by using ERA to report environmental conditions. Although the ERA is distinct from ER, as it reports on environmental risk. The ERA looks ahead and forecasts potential future environmental risks coming from today's decisions regarding new policies, practices, or developments, whereas ER focuses on the current state of the environment and trends resulting from past management.

Environmental Impact Assessment (EIA)

The EIA process has stages that are outlined in government law and policy. The most frequent application of EIA is as a framework for analyzing the effects or outcomes of large-scale projects that are being considered for development.[4]

In contrast to EIA, the ERA places more emphasis on current environmental circumstances before examining the variables, driving these conditions to change.

EIA concentrates on a specific project and the type of environmental consequences, which it would have.

Risk Management (RM)

The main goal of the risk management is to give managers, a context for making decisions that will enable them to :

- achieve optimal or at the very least acceptable levels of risk, where benefits flowing from a particular action or decision outweigh the potential loss or damage;
- avoid unacceptable levels of risks, where the likelihood and magnitude of the potential loss or damage outweigh the expected benefits;[14]

Risks to economic, social, and environmental values are taken into account in the risk management framework along with other variables including the track record of the development proponent's performance.

V. STEPS IN THE ERA APPROACH

The ERA process can be as intricate, time-consuming, and data-focused depending upon the cases. Enough time and resources are needed for ERAs. On the other hand, there are circumstances where managers need assessments to be done quickly. The ERA approach offers a framework for the specialist to apply expert opinion in certain circumstances. The ERA process requires the risk data to be gathered timely, methodically, and should be suitably qualified. The ERA to be conducted in six steps, three for preparation, two for assessments and one for presenting the results.[11]

(A) Preparation

Step - 1 : Establish the Context for ERA

- Identify decision processes that would benefit from ERA information.
- Prepare a preliminary list of what may be at risk in the environment.
- Confirm the scope and scale of the items for risk assessment.
- Identify data inputs, assessment methods and presentation opportunities.
- Identify resources required for ERA (expertise, personnel, time, funding, scheduling)

Step – 2 : Identify and Characterize Key Environmental Pressures

- Determine pressures causing changes in ecosystem processes, functions or attributes that may directly or indirectly impact the environment at macro scale and directly or indirectly.
- Review past and potential future management regimes that influence these pressures, and characterize the “cause-and-effect” relationships up to the possible extent.

Step – 3 : Specify Environmental Values & Indicators for the ERA

- Select environmental values from the preliminary list for risk assessment, based on consideration of –
 - Significance of ecosystem role;
 - Economic or social value;
 - Likelihood for increasing risk and strength of relationship to pressures identified;
 - Feasibility of availability of data, understanding of requirements;
 - Scale appropriate to the level of reporting or decision-making.
- Determine indicators that best link pressures to changes in risk based on:
 - Strength of relationship between the indicator and risk to the environmental value;

- Sensitivity to change from human-caused management-related pressures; and, availability of data.

- Provide a rationale for the selected assessment items and indicators.

(B) Assessment

Step – 4 : Characterize Environmental Trends, Indicator Relationships & Establish Risk Classes

- Describe the range of conditions for the selected environmental values, including:
 - Base case;
 - Current condition, with a summary of cumulative impacts of past development;
 - Predicted future status;
 - Low risk benchmark;
 - Predicted thresholds
- Choose methods for risk analysis based on ability to model relationships, track changes to indicators and describe risks to the environmental values being assessed.
- Define risk classes (i.e., the types of risks and their specific ranges).

Step – 5 : Evaluate Changes to Indicators and Risks

- Assess the range of proposed development options. For each option identify:
 - The intensity, scale and duration of the various management activities;
 - Predicted future pressures resulting from those activities; and,
 - Consequent changes in selected indicators linked to the values being assessed.
- Assess the degree of risk (by class), at various future times, for the range of management options (including cumulative impacts)

(C) Results

Step – 6 : Report Results and Develop Risk Reduction Strategies

- Interpret the assessment results; identify low risk options and risk factors.
- Identify risk reduction strategies:
 - Identify actions to decrease pressures linked to high risks, and actions to support or enhance activities linked to low risks; and,
 - Propose management strategies, policy options or development scenarios that could reduce or minimize risk.
- Report the assessment results; including assumptions, limitations, uncertainty, and a full explanation of the consequences of risk levels.

The ERA process can be as complex, intensive and data oriented as the situation demands. The detailed ERAs will require sufficient lead time and resources. At the opposite extreme, there are situations where managers require assessments on a rapid response basis. In these situations the ERA approach provides a framework for the specialist to apply expert opinion. Following the ERA steps ensures that

risk information is timely, systematically compiled and appropriately qualified.[13]

All the elements of ERA framework are shown in the Fig.1

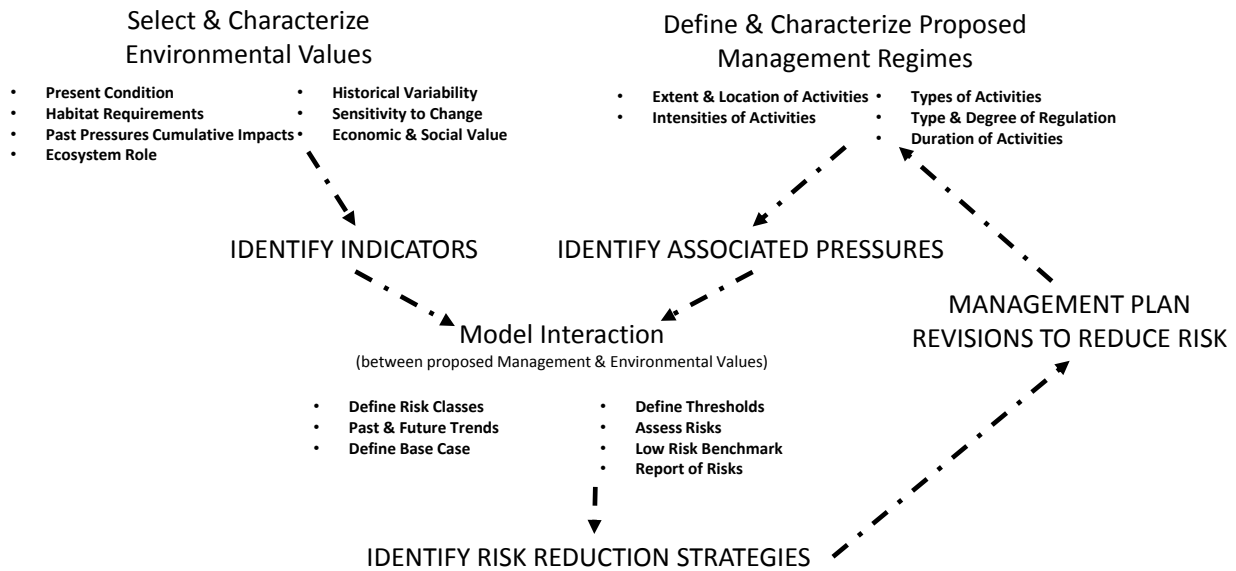


Fig. – 1 : Environmental Risk Assessment Framework

VI. CONCLUSIONS

Providing review and comment on resource management or development proposals has been part of the responsibilities of Government. The ERA as a tool assist the planners, managers and construction professionals more effectively in identifying and communicating potential impacts and outcomes of decisions affecting the environment. It is an underlying assumption that better informed decision makers will lead to more explicit accounting for environmental values in decision making processes, as well as consideration of means and measures to reduce risk to the environment resulting from human actions.[11]

The ERA assessment framework can be used by all stakeholders in decision making processes. It facilitates the wider understanding and routine reporting on causal factors and changes in risk to the environment and thus leads to a more environmentally sustainable future. In the absence of environmental risk information, decision makers are often compelled to “make decisions in the dark” – with the impacts of human activity unaccounted for due to uncertainties or complexities around environmental values and processes. This framework introduces environmental risk assessment as an effective and efficient means within decision making processes to rigorously acknowledge, clarify and account for risk to the environment. Even in situations where time or resources for assessment are scarce, ERA can provide an effective means of presenting available environmental information. As decision making processes begin to routinely address the probability of sustaining these

values, the result will be better informed decisions and improved accountability for the environment.

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