

AN INTRODUCTION TO CUMULATIVE EFFECTS ASSESSMENT

Previous courses dealing with environmental impact assessment (EIA) have focused on the individual project. In this course, we are going to expand upon the EIA process and look at cumulative effects assessment (CEA). Cumulative impacts can be thought of as the additive and interactive effects of various projects and activities on an ecosystem over space and time. In other words, long-term changes in an ecosystem may occur not only as a result of a single action, but also due to the combined effects of successive actions.

Let's revisit the topic of ecosystem carrying capacity, or the maximum population size that a given ecosystem or region can sustain. A similar type of measure is the ecosystem's waste assimilation capacity or the sustainable yield of a particular resource.

Cumulative effects are intimately linked to all of these measures, as they represent an ecosystem's threshold level of tolerance to disturbance. Ecological systems cannot always cope with human disturbances without fundamental functional or structural change. The environmental impacts of a number of individual projects can effectively 'nibble' away at an ecosystem's ability to function and to sustain viable wildlife populations. Beyond a certain threshold level of impact, one or more important ecosystem functions may cease. Further exceedances of an ecosystem's disturbance threshold may lead to a near-collapse of that ecosystem. In



short, individually minor actions that are insignificant on their own can collectively result in significant impacts over a period of time.

OVERVIEW OF CUMULATIVE EFFECTS ASSESSMENT

Although the terms 'cumulative impacts' and 'cumulative effects' were mentioned as early as the 1970s in several countries' EIA legislation, regulations, or guidelines, it was not until the mid-to-late 1980s that they began to be incorporated in practice. In

this course we will use the two terms synonymously.

Accordingly, the purpose of this introductory lesson is to present an overview of the worldwide practice of CEA. The emphasis is on principles, procedures and methods.

The expectation is that certain elements of CEA will increasingly be applied in Mekong River Basin (MRB) riparian countries as they

respond to the challenges of managing multiple development activities impacting valued natural resources both in individual countries and Basin-wide. In this way, consideration of cumulative impacts as part of individual project EIA and of projects with potential transboundary implications can gradually become part of accepted practice in the Basin.

Definitions of Key Terms

Cumulative impacts, cumulative effects and cumulative environmental changes are terms often used

interchangeably. The following definitions for the terms 'cumulative impacts' or 'cumulative effects' are routinely applied in North America and in Europe:

- Cumulative impacts refer to the accumulation of human-induced changes in valued environmental or ecosystem components (VEC) across space and over time; such impacts can occur in an additive or interactive manner.
- In the United States, the Council on Environmental Quality (CEQ) regulations define cumulative impacts as the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what [government] agency or person undertakes such other actions." Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.
- In 1988, the Canadian Environmental Assessment Research Council (CEARC) defined cumulative effects as those effects which can occur when impacts on the natural and social environments take place so frequently in time or so densely in space that the effects of individual projects cannot be assimilated. They can also occur when the impacts of one activity combine with those of another in a synergistic form. The Canadian Environmental Assessment Act indicates that the EIA process should include the consideration of "any cumulative environmental effects that are likely to result from the project in combination with

other projects or activities that have been or will be carried out, and the significance of the effects."

Some common themes associated with these cumulative effects definitions include:

- The need to address multiple actions representing potential sources of adverse environmental impact-causing activities
- The consideration of multiple linkages (i.e., pathways) between such sources and receptors of impacts; and the recognition that such impacts may be additive, antagonistic, or synergistic (see Table 1).

CEA is a type of assessment that seeks to identify the consequences of more than one impact from a single development. CEA is also useful for assessing the interaction of a combination of impacts from one development with impacts from other developments occurring in the same ecosystem or region.

CEA involves predicting and assessing likely existing, past and reasonably foreseeable future effects on the environment arising from disturbances which are time and/or space-crowded, synergistic, indirect, or constitute 'nibbling'. Time crowding and space crowding were noted above. Synergisms are different types of perturbations occurring in the same area that may interact to produce qualitatively and quantitatively different impacts to a receiving environment. Cumulative effects can also be produced at some time or distance from the initial perturbation, or by a complex pathway; these are called indirect effects. Finally, nibbling refers to small changes from multiple similar actions.

In addition, CEAs are typically expected to:

- Assess effects over a larger area that may cross jurisdictional boundaries
- Assess effects over a longer period of time
- Consider effects on VECs due to interactions with other activities, and not just the effects of the single project under review
- Include other past, existing and future reasonably foreseeable actions
- Evaluate significance on a larger scale than just consideration of local, direct effects.

These descriptions of CEA focus on the process of identifying and quantifying cumulative effects, and on appropriate considerations in assessing the significance of such effects. Environmental management within defined spatial and temporal boundaries is also an important element of CEA. The larger goal of CEA is to develop

appropriate management strategies for cumulative effects. Further, the combined objectives of CEA and resource management planning are to generate logical, scientific and timely problem analyses; to bring government agencies together to develop an overall management plan and; and to develop comprehensive species and habitat maintenance and enhancement plans for the ecosystem of concern.

CEA is currently specified in the EIA legislation of several countries, including Australia, Canada, New Zealand, and the US. Country legislation, regulations, and/or guidelines may either directly specify CEA, or they may infer that cumulative effects should be considered within the EIA process.

The fundamental premise is that CEA represents an issue that should be an integral part of the EIA process. In other words, CEA should typically be included as part of the EIA process for a proposed project or activity, and not as a separate study or assessment.

Table 1 Common terminology in cumulative effects assessment

ADDITIVE EFFECTS	Repeated disturbances of a similar nature that eventually overwhelm an ecosystem's capacity to absorb the disturbance
INDIRECT EFFECTS	Disturbances initiate a chain of events that produce effects delayed in time or space from the original disturbance
SYNERGISTIC EFFECTS	The interactions of different types of disturbances produce effects qualitatively and quantitatively different from the individual disturbances. The combined impacts are more severe than the sum of the individual effects
TIME-CROWDED	Disturbances occur sufficiently close in time that the system does not recover in the time between
SPACE-CROWDED	Disturbances overlap in space and/or occur so close together that their effects are not dissipated in the distance between
NIBBLING	Disturbances produce effects by small changes, i.e., incremental effects

Types of Cumulative Effects

Cumulative effects can result from multiple pathways and can be manifested on both biophysical and socio-economic resources. Figure 2 illustrates the importance of functional pathways that contribute to the accumulation of cumulative environmental impacts related to multiple actions and both additive and interactive processes. For example, the second pathway can include biomagnification of chemicals within various organisms associated with terrestrial or aquatic food chains.

Further, cumulative effects can be categorized as follows:

- Incremental: repeated additions of a similar nature ($a + a + a + a \dots$)
- Interactive processes: results in a significant impact ($a + b + c + n \dots$)
- Sequential effects
- Complex causation
- Synergistic impacts
- Impacts that occur when a threshold is passed as a consequence of some 'trigger effect'
- Irregular 'surprise effects'
- Impacts triggered by a feedback process ('antagonistic' – feedback which reinforces a trend; or 'ameliorative' – feedback which counters a trend).

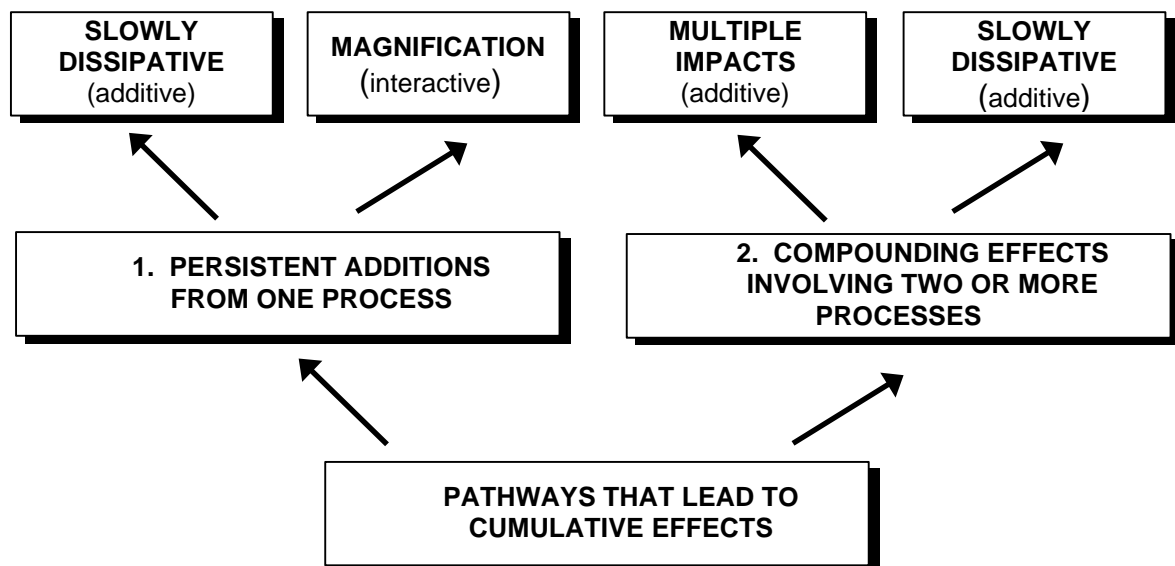


Figure 2 Basic functional pathways that contribute to cumulative effects