# CUMULATIVE EFFECTS ASSESSMENT METHODOLOGY AND TECHNIQUES

MEKONG RIVER COMMISSION
MRC
FOR SUSTAINABLE DEVELOPMENT

# Lesson Learning Goals

At the end of this lesson you should be able to:

- Contrast project-level EIA and CEA methods
- Identify critical issues in undertaking a CEA
- Give an example of a cumulative assessment tool
- Understand the basic steps in conducting a project-level CEA
- Explain the importance of considering reasonably foreseeable future actions in CEA scoping

# Technical Requirements for Cumulative Effects Assessment

- Need to address multiple actions
- Need to consider linkages and interactions
- Need to consider additive and synergistic impacts

# Important Questions

- How do we avoid assessing everything?
- How do we identify what is important to assess?
- How large an area around the action under review do we have to assess?

# Important Questions (Cont'd)

- What other actions should we consider?
- Over what duration of time must effects be assessed?
- How is the significance of cumulative effects determined?

# Challenges in Evaluating Cumulative Effects

- Limited knowledge and understanding on the relationships and tolerances of ecological systems
- Predictions of what will happen (e.g., human influences and ecosystem responses) are highly uncertain

# Challenges in Evaluating Cumulative Effects (Cont'd)

- Extremely complicated analysis (i.e., must address multiple actions and additive or interactive effects at different time and spatial scales)
- Institutional barriers (e.g., legal mandates and organizational interests rarely match boundaries of cumulative effects problems)

# Key Differences in Methodology Between EIA and CEA

- Emphasis on combined environmental effects
- Larger scope of analysis for CEA
- A broader range of tools is applied
- Greater incorporation of qualitative assessment

# Selecting a Method for CEA

- Selecting an appropriate method for determining and quantifying cumulative impacts can be challenging (at best) and sometimes impossible
- A sound method for CEA should
  - be able to identify cumulative impacts
  - be reliable in the prediction of such effects

# Characteristics of CEA Methods

- In general, CEA methods should exhibit the following:
  - some representation of interaction
  - incorporation of impacts as they occur over time
  - incorporation of impacts as they occur over space
  - the ability to trace impacts from first-order, direct impacts to second-, third-, and fourth-order indirect impacts

# Specialized CEA Methods

- Additional criteria may be required for specific types of projects, or ones that occur in various environmental media
  - hydro-electric plants, pulp mills, metal mines, and waste water treatment plants all may require specific CEA guidelines
  - air, surface water, groundwater may require individual CEA guidelines to accompany the selected cumulative effects determination method

# Critical Issues in CEA Methods

## Defining Assessment Criteria and Indicator Targets

- ‘Scoping-outward’ to define potential large-scale effects
- Create target values for assessing significance
- Find mitigation options that meet ‘no-net change’ rules

# Critical Issues in CEA Methods (Cont'd)

## Assessing Significance

- Determine project costs and benefits
- Compare predicted impacts with targets
- Account for uncertainty

# Tools for CEA

- As with EIA in general, there is no one set of tools appropriate for all cumulative assessments
- CEA incorporates a wider array of tools than traditional EIA
- Quantitative tools are important, but CEAs also depend largely upon planning and qualitative assessment techniques

# A Continuum of Tools Used in Project-Level CEA and SEA

**Analytical**

**Planning**

- ➔ Mathematical modeling
- ➔ Interactive matrices
- ➔ Risk assessment
- ➔ Expert opinion
- ➔ Multi-criteria evaluation
- ➔ Stakeholder consultation

# Selecting Appropriate Tools

- There is no single tool to conduct CEA
- Each tool has its own features which make it appropriate for different situations and different stages (e.g., scoping versus impact analysis, regional versus local, policy versus project)
- A comprehensive assessment usually requires a mix of tools

# Selecting Appropriate Tools (Cont'd)

Optimal combination of tools depends on the:

- Nature of the problem
- Purpose of the analysis
- Access to and quality of data
- Availability of resources
- Community preference
- Type of impact

# Examples of Assessment Tools

## Environmental - Chemical

| | |
|---|---|
| Water, air, soil quality | ➔ Simulation model<br>➔ Air, water quality models |
| Toxicity levels (i.e., health) | ➔ Risk assessment<br>➔ Exposure analysis models<br>➔ Ecotoxicology |

# Examples of Assessment Tools (Cont'd)

## Environmental - Disturbance

**Ecosystem modification**

- ➔ Matrix analysis
- ➔ Network model
- ➔ Simulation models
- ➔ GIS analysis

**Habitat of key species**

- ➔ Matrix analysis
- ➔ Habitat evaluation model
- ➔ Gap analysis

# Examples of Assessment Tools (Cont'd)

## Quality of Life - Social Services

**Quality of life**

- ➔ Surveys
- ➔ Workshops
- ➔ Demographic profiles

**Social services**

- ➔ Integrated regional models
- ➔ Demographic models

# Examples of Assessment Tools (Cont'd)

Economic - Incremental; Redistributive

Incremental

- ➔ Input-output models
- ➔ Linear programming

Redistributive

- ➔ Cost-benefit
- ➔ Multi-criteria valuation
- ➔ Regional policy models

# Basic Steps in Conducting a Project-Level CEA

1. Scoping
2. Impact analysis
3. Mitigation
4. Determining significance of residual impacts
5. Follow-up

# Step 1: Scoping

- Identify issues of concern
- Identify VECs at various scales (e.g., local, regional, global - depending on objective of assessment)
- Set appropriate geographic and temporal boundaries
- Identify all sources of potential impacts (i.e., reasonably foreseeable future actions)
- Postulate cause-effect relationships and identify critical pathways or processes of impact accumulation

# Identifying Spatial and Temporal Boundaries

## Scoping is one of the greatest challenges in CEA and SEA

- If scope is too narrow, important pathways and linkages may be missed
- If the scope is too broad, uncertainty increases and assessments may lack sufficient detail to be useful for decision making

# Identifying Spatial and Temporal Boundaries (Cont'd)

- Different boundaries may be appropriate for different cumulative effects (e.g., air quality issues might require quite different scales of analysis than wildlife issues)
- Public consultation is an important mechanism to effectively identify appropriate boundaries

# Setting Spatial and Temporal Boundaries

Appropriate scales will depend on:

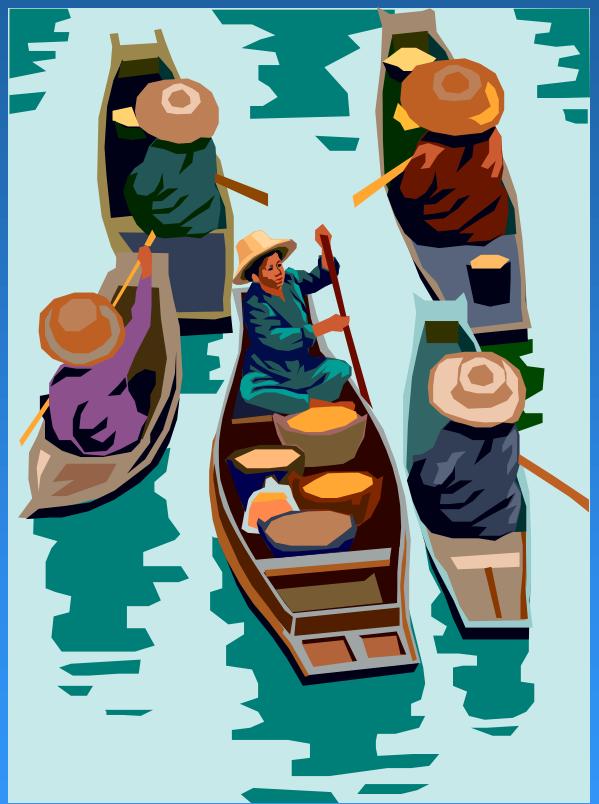
- Size and nature of the assessment (i.e., project-level CEA, regional CEA, SEA)
- Relevant ecological boundaries
- Nature of the receiving environment

# Setting Spatial and Temporal Boundaries (Cont'd)

- Size, nature and location of past and future projects and activities in the area and significance of their effects
- Availability of existing data and knowledge

# Reasonably Foreseeable Actions

Adequate consideration of cumulative effects within the EIA process includes an analysis of the proposed project or activity in view of past, present, and reasonably foreseeable future actions (RFFA)



# Reasonably Foreseeable Actions (Cont'd)

The question

"When does a contemplated action become reasonably foreseeable?"

has been argued for years in the countries that practice CEA

# Determining Reasonably Foreseeable Actions

Some guidelines for determining RFFAs include:

- Determining spatial and temporal boundaries
- Evaluating all project proposals within those boundaries
- Determine any possible connections between other proposals and the project of concern
- Examine planning documents that relate future activities to the project of concern

# Available Scoping Tools

- Hypothesis diagrams
- Network diagrams
- Ecological simulation models
- Checklists
- Project activity matrices
- Literature reviews
- Consultation with governmental agencies
- Public consultation
- Expert opinion

# Step 2: Impact Analysis

- Collect regional baseline information - assess the status of the receiving environment
- Assess effects of individual potential sources
- Assess the cumulative effect considering all current sources, past stressors and probable future development proposals

# Example Issues to Consider for a Hydropower Dam

- Potential environmental effects of the project (e.g., changes in water level, flow patterns, water temperature, disturbance to fish habitats)
- Environmental effects of other existing relevant activities (e.g., other hydropower projects, adjacent agricultural practices)
- Environmental effects of other future projects and activities (e.g., increased urbanization downstream)

# Determining Likely Impacts

- Panel evaluations
- Intra-agency consensus-building
- Professional judgement
- Multi-criteria evaluation
- Ecological risk assessment
- GIS and spatial analysis
- Modeling and expert systems

# Determining the Significance of Cumulative Impacts

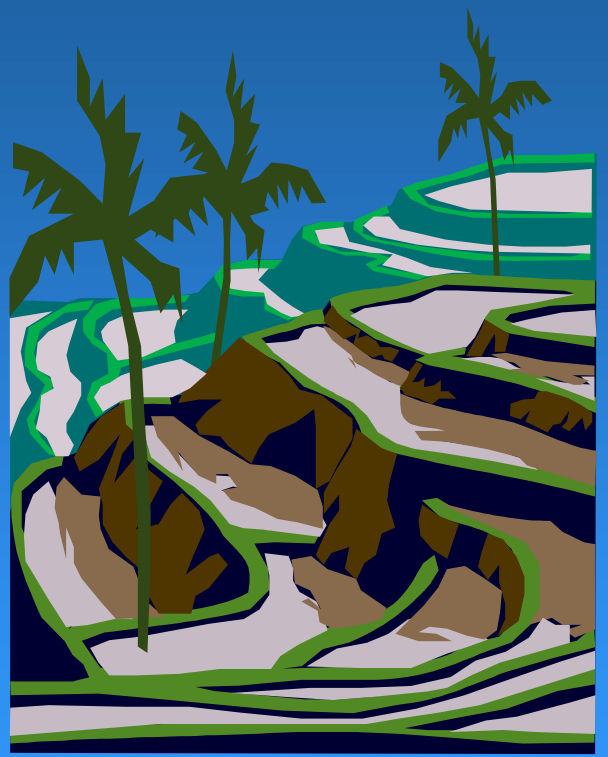
- The significance of potential cumulative impacts can be evaluated against an ecosystem's threshold disturbance level
  - threshold refers to the point at which added disturbances within the ecosystem or region will result in major system deterioration or collapse
  - can be qualitative or quantitative (i.e., such as a numerical standard)
  - thresholds are related to an ecosystem's carrying capacity

# Significance of Cumulative Impacts (Cont'd)

- Carrying capacity within the context of CEA can be thought of as the ability of a natural system to absorb the effects of development or human population growth without significant degradation or breakdown
- Determining an ecosystem's threshold level of disturbance can be very difficult, due to the inherent complexity of natural systems

# Significance of Cumulative Impacts (Cont'd)

Finally, societies need to determine the limits of acceptable change in environmental components resulting from natural resource extraction and development



# Step 3: Mitigation

Examples of mitigation measures might include:

- Changes to the project (e.g., relocation to less sensitive areas, incorporation of pollution control devices, changes in manufacture, process, technology, use or waste management practices)
- Changes to the receiving environment (e.g., engineered structures such as fish ladders for dam projects)
- Changes to future policy and projects

# Step 4: Determining Significance of Residual Impacts

- Depends on ecological thresholds and carrying capacity
- Depends on existing environmental conditions

# Determining Significance of Residual Impacts (Cont'd)

- Consider existing environmental standards, guidelines and objectives
- Where possible, consider the carrying capacity or tolerance level of the natural system(s)

# Step 5: Follow-Up

- Evaluate the accuracy of the cumulative environmental impact assessment
- Evaluate the effectiveness of any mitigation measures
- Respond to unanticipated events and effects

# Concluding Thoughts

Important points to remember are:

- Scoping is most challenging aspect of CEA; must avoid overlooking critical impacts while limiting assessment to relevant and meaningful parameters
- CEA techniques are less prescriptive that for project-level EIA; combine both qualitative and quantitative tools
- Interdisciplinary approaches to CEA are likely to be most successful; drawing on a wide range of expertise to fully understand potential impacts