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Environment Component

REVIEW OF TONLE SAP BUILT STRUCTURES ENVIRONMENTAL IMPACT ASSESSMENTS (EIAs) WITH REGARD TO FISHERIES

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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
CDC	Council Development of Cambodia
CDRI	Cambodia Development Research Institute
CEA	Cumulative Effect Assessment
CNMC	Cambodia National Mekong Committee
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FACT	Fisheries Action Coalition Team
IEE	Initial Environmental Examination
IEIA	Initial Environmental Impact Assessment
JICA	Japan International Cooperation Agency
LEPNRM	Law on Environmental Protection and Natural Resources Management
MAFF	Ministry of Agriculture, Forestry and Fisheries
MOE	Ministry of Environment
MOP	Ministry of Planning
MOT	Ministry of Tourism
MIME	Ministry of Industry, Mines and Energy
MPWT	Ministry of Public, Wage and Transportation
MOWRAM	Ministry of Water Resources and Meteorology
MRC	Mekong River Commission
NGO	Non-Governmental Organization
SEA	Strategic Environmental Assessment
TA	Technical Assistance
WCS	Wildlife Conservation Society

1. INTRODUCTION

This study is part of the Environment Component of the ADB Technical Assistance (TA) 4669 “Study of the Influence of Built Structures on the Fisheries of the Tonle Sap”. The objective of the 10-month study is to improve the awareness and understanding of government agencies and policy-makers of the influence of built structures on the hydrological regime of the lake and on the fisheries of the Tonle Sap (Project Proposal Report). The Technical Assistance is led by the WorldFish Center and the Cambodian National Mekong Committee (CNMC). It is composed of several components identified across disciplines: hydrology, environment, fisheries ecology, livelihoods and socioeconomics, and communication to the public and policy-makers.

The Environment Component aims to assess the state of global and local knowledge on the impacts of built structures on aquatic ecosystems and fisheries. It builds on reviews of scientific literature on the impacts of built structures on tropical floodplains worldwide, and of scientific and grey literature on built structure environmental impact assessments (EIA) in relation to the fisheries of the Tonle Sap. Results will inform and support policy- and decision-making related to built structure development.

The report presents the review of local environmental impact assessments of built structures on the fisheries of the Tonle Sap. The study focuses on EIA - including their initial forms such as Initial Environmental Examination (IEE) and Initial Environmental Impact Assessment (IEIA) - of existing and planned built structure projects implemented in the Tonle Sap area. It highlights the strengths and weaknesses of EIA processes and outputs in order to identify how best to implement adequate and effective EIAs to assess the impacts of built structures on the Tonle Sap fisheries.

The report presents the review method and activities, the evaluation of EIA reports, discussion of results and recommendations for enhanced built structure EIAs with regard to fisheries. The review was conducted mainly in Phnom Penh by an international researcher (2 months) with the assistance of a local research support officer from the Ministry of Environment (4 months), based at the regional office of WorldFish Center, Cambodia.

2. METHODS AND ACTIVITIES

The review of environmental assessments is primarily based on the collection of secondary information but it also includes informal consultation of stakeholders in relevant government institutions, NGOs and other civil society groups. Methods and activities cover the identification of the review scope, consultation of stakeholders, collection of secondary data and identification of indicators for evaluation of EIA reports.

2.1 DEFINITION OF THE SCOPE OF THE REVIEW

The boundaries of the review are defined here in terms of environmental assessment type and geographical scope, and the range of built structures.

2.1.1 Environmental assessment categories and geographical scope

EIA can be broadly defined as a process for evaluating the impact of a project on the functioning of ecosystems and the well-being of humans. Various forms of environmental impact assessments exist and are derived from EIA: initial (such as IEIA, IEE), social (Social Impact Assessment, SIA), cumulative (Cumulative Effects Assessment, CEA) and strategic (Strategic Environmental Assessment, SEA).

While EIA usually includes the assessment of socioeconomic and livelihood impacts, independent Social Impact Assessments (SIA) may be conducted to increase the depth of social studies. Some countries in the Greater Mekong Sub-region refer to SIA as a complementary but separate process to EIA; others such as the MRC assume that EIA includes adequate analysis of social impacts (MRC 200X). The review will thus evaluate coverage of socioeconomic impacts in EIA while searching for SIA reports where available.

Initial and shorter forms of environmental assessments exist in order to screen significant impacts and determine whether a more comprehensive assessment through EIA is required. They are variously referred to as 'initial EIA' (IEIA) in local official documents, and 'Initial Environmental Examination' (IEE) in donor agency (e.g. the ADB) documents. In this report, therefore, the generic term 'EIA' is used to cover available IEIA and IEE.

In order to address all potential significant effects on the Tonle Sap fisheries, the spatial scope of the review must cover all projects affecting the Lake directly and indirectly, including the tributaries flowing into the Lake. Three relevant scales have thus been identified: 1) the Tonle Sap Great Lake (TSGL), 2) the sub-catchment draining into the Lake including the Lake's associated floodplain, and 3) upstream areas up to the boundaries of the Tonle Sap Basin (TA 4669 Inception Report 2006). While built structure projects far from the Tonle Sap catchment could have an indirect effect on the Tonle Sap fisheries, a comprehensive review of the whole basin is not feasible within this review. Main issues on larger scales will be addressed in relation to built structure EIA through a general review of Strategic Environmental Assessment (SEA) and Cumulative Effects Assessments (CEA).

2.1.2 Types of built structures

The Technical Assistance study (TA 4669 Proposal 2006) defines built structures as follows: "Built structures consist of constructions that: i) oppose water outflow (e.g. dams, weirs, irrigation schemes, dykes, levees); ii) prevent water inflow (e.g. embankments, polders, flood control works); iii) alter water inflow or outflow (e.g. roads, railways, drainage canals, agricultural works, bank modifications); iv) degrade water quality (e.g. plants with aqueous effluents, mining and mineral processing facilities, sewerage systems, and dredges)."

The Law on Environmental Protection and Natural Resources Management (12 December 1996) states that all projects and activities should be subject to an EIA. Because this would not be practical and cost-effective, a list of built structure projects requiring an Initial EIA (IEIA) and/or EIA was included in the Sub-decree on the EIA Process (see also Section 3.1). All activities included in the list are potential threats to the environment and are divided into separate categories. The following categories

require an IEIA or EIA: (a) hydropower; (b) irrigation systems; (c) port construction; and (d) dredging. Built structure projects that should require an EIA on the basis of the criteria defined in the Environmental Law (August 1999) and for which EIA is compulsory have been identified.

In principle most built structure projects can have an impact on fisheries, through changes to the biophysical (e.g. erosion, pollution) and social (e.g. livelihood changes, etc.) characteristics of the fishery system and the aquatic productivity of the ecosystem. Due to the short duration of the study and the difficult access to information (see Section 4.1), the review had to focus on built structures of key concern regarding the fisheries of the Tonle Sap. While structures such as airports and railways are covered by the study, they are not reviewed comprehensively. The structures identified as most relevant to this study are listed in the table below (Table 1).

Table 1: Main built structures under review

Sector or category	Built structure
Infrastructure	• Bridge and road construction (above 30 tons weight) • National road construction (longer than 100 km) • Railway construction (all sizes) • Port construction (all sizes) • Airport construction (all sizes)
Agricultural sector	• Irrigation systems (greater than or equal to 5,000 ha) • Drainage systems (greater than or equal to 5,000 ha) • Fishing ports (all sizes)
Structure degrading water quality	• Port construction (all sizes) • Irrigation systems (greater than or equal to 5,000 ha) • Drainage systems (greater than or equal to 5,000 ha) • Fishing ports (all sizes) • Industrial, waste water treatment plant

It must be noted that EIAs are not required for a range of structures likely to influence the fisheries of the Tonle Sap Basin such as small-scale irrigation and drainage systems, fishing gears, dikes and bunds in agricultural fields. These small structures contribute to the cumulative impacts on the ecosystem and thus on the Tonle Sap fisheries, which are considered in Sections 5.3 and 5.4. Large fishing gears are also included in the built structures studied by other components of the study (hydrology, fisheries and socioeconomic-livelihoods).

2.2 CONSULTATION OF KEY STAKEHOLDER INFORMANTS

The purpose of the stakeholder consultation is threefold: i) to enhance the collection of information and knowledge through key informants, ii) to increase awareness of this study, and iii) to learn the perceptions of stakeholders on the actual implementation of environmental assessments in Cambodia and improve the understanding of stakeholder issues and concerns.

Key stakeholders were identified in government institutions, civil society including non-governmental organisations (NGOs), donor agencies and to a lesser extent for such a review, local communities (see Table 2 below). The majority (but not all) of key

representatives are based in Phnom Penh where most meetings were organised. Informal discussions were carried out with a few villagers and provincial and district officers during a preliminary visit of the project team in Pursat province (25 May 2006).

A brief stakeholder analysis estimated the importance of stakeholders in the project and his/her influence in decision-making for built structure projects. The Ministry of Environment has been identified as the main actor, with support or involvement of the CNMC and all respective agencies implied in a built structure project. However, in practice the MOE and CNMC do not have much influence in enforcing and monitoring the implementation of EIAs (e.g. SEI and ADB 2002) (see further details in Section 3.1).

Table 2: List of key stakeholders met during the review

Stakeholder Category	**Organisation**
Government institutions	• Ministry of Environment (MOE) - EIA Unit - Biosphere Reserve Unit • Ministry of Agriculture, Forestry and Fisheries (MAFF) - EIA Unit, Department of Fisheries • MIME • Ministry of Water Resources and Meteorology (MOWRAM) • Provincial and District officials
Donor agencies	• ADB
NGOs	• FACT • OXFAM Australia • Nature Conservation Society
Local communities	• A few villagers (informal interviews during field visit)

2.3 COLLECTION AND REVIEW OF SECONDARY DATA

Collection of secondary information was carried out through various mechanisms:

- Internet-based search engines and use of specific websites belonging to local organisations and donor agencies (esp. the ADB) and local websites (NGOs, etc.)
- Library searches at the JICA, CDRI, ADB, and other libraries in line ministries
- Meetings with stakeholders (information and reports provided by stakeholders and/or their organizations).

The variety of ways adopted for collecting information from different sources (Internet, libraries and local knowledge) increased knowledge and enlarged its breadth. In particular, this ensured consideration of the different perspectives and perceptions of stakeholders, and integration of various types of knowledge (e.g., local documents in Khmer language, grey and international literature). Where possible this also allowed cross-checking of information; for example the facts, views and option issues from grey literature and stakeholder knowledge, respectively.

2.4 INDICATORS FOR EVALUATION

A comprehensive evaluation of built structure EIAs would compare the predictions or evaluations of impacts derived from EIAs with actual impacts. However, since monitoring of the actual effects of built structures during and after project implementation is not recorded or has not been implemented, the present review cannot evaluate EIAs on this basis. The review evaluates the actual implementation of the EIA process and impact assessment methods, analyses and recommendations with regard to fisheries.

Indicators for evaluation have been selected through an iterative process that allowed their refinement and adequacy to Cambodia built structure EIA through increased knowledge of Tonle Sap fisheries and built structure development in the Mekong Basin. The evaluation focuses on the quality of the EIA process and the impact assessment and management recorded in collected EIA reports. Selected questions and indicators are indicated in the table below (Table 3). Indicators broadly relate to the process of EIA implementation, impact assessment methods and results, and management recommendations. Justification for the selection of key indicators is briefly explained below.

Table 3: Questions and indicators for evaluation

Category	Question or Indicator	Justification
EIA Process		
Scope of the EIA	• Are fisheries issues addressed? • Temporal and spatial boundaries of the EIA	Fisheries have often been neglected in EIA built structure projects.
Participation of stakeholders	• Degree of participation if any • Forms of participation	Public participation is generally a requirement in EIA guidelines produced by donor agencies, notably by the ADB in Cambodia. However, literature shows that the practice of EIA in Cambodia differs and operational procedures make no mention of how or when these consultations should take place (McKenney 1999).
Transparency of process	• Communication of EIA process • Dissemination of EIA outputs	Communication and dissemination of process information and outputs is a prerequisite for the participation of different stakeholders and sufficient consideration of their concerns.

Impact Assessment		
Scope of fisheries assessment	• Aspects of fisheries and disciplinary fields covered • Time and spatial boundaries of fisheries assessment	Disciplinary coverage (hydrology, ecology, socioeconomy, livelihoods, management and governance) and spatial and time boundaries.
Method for impact assessment	• Type of method selected • Adequacy to fisheries issues and local resources • Collection and use of secondary data and other sources of information • Collection and use of primary data • Baseline situation	Type of method selected among existing ones (e.g. most commonly: ad-hoc, checklist, matrix, network, simulation modelling, expert system) or innovative methods. Selected methods will be evaluated on the basis of their adequacy with respect to fisheries issues and local resources, collection of data and information and assessment of the baseline situation such as, for example, the consideration of counterfactual effects.
Level of integration	• Across disciplines • Across sectors and scales	Mainly across disciplines and possibly across sectors and scales.
Participation of stakeholders	• Degree of participation if any • Forms of participation	Level and form of participation especially who participates.
Impact assessment results	• Are results qualitative or quantitative or both? • If qualitative, what is the quality of results and degree of subjectivity and uncertainty? • If quantitative, what is the quality of results and degree of uncertainty?	Quality of impact assessment results.
Management Recommendations		
Identification of measures	• Mitigation measures • Enhancement measures	Optimising the benefits of built structure projects includes mitigating negative effects and enhancing positive effects on fisheries
Adequacy and feasibility	• Adequacy to local resources and constraints • Cost-effectiveness • Monitoring of implementation	Management measures exist and the main constraint is the suitability to local characteristics and resources. Sustainability of measures.
Support for decision-making	• Evaluation of trade-offs • Implications for policy-making	Positive and negative impacts, various costs and benefits for the different options.

3. STAKEHOLDER CONSULTATION AND SECONDARY INFORMATION

This section first presents the background of EIA procedures in Cambodia and the results of the stakeholders' consultation. It then considers the evaluation of EIA reports.

3.1 EIA PROCESS IN CAMBODIA

Until recently, EIA in Cambodia was an *ad-hoc* activity with the Council for the Development of Cambodia (CDC) providing environmental (as well as overall) clearance for major investment projects. EIA was largely limited to public sector projects normally financed by organisations whose internal approval procedures mandated an environmental assessment (the ADB, World Bank, EU, bilateral agencies, etc.). A process was implemented for: i) transferring the responsibility for EIA from the CDC to the MOE; ii) transferring the initiative for conducting EIA from outside development agencies to Cambodian authorities; and iii) ensuring EIAs apply across all new and old activities in a systematic manner. The first step has virtually been accomplished while the other two require further substantial efforts (Urwin and Wrigley 2001).

The authority for EIA is currently vested in the Ministry of Environment as provided for by the Law on Environmental Protection and Natural Resources Management (LEPNRM). The scope of EIA has been extended to all investment projects, planned or existing. For existing projects approved at the Central Level of government, a screening application to determine whether EIA is necessary followed by the preparation and submission (if warranted) of an Initial EIA (IEIA) and an Environmental Management Plan (EMP) is required.

The preliminary screening criteria are qualitative and exempt a project from EIA if:

- project activities can be expected to have non-measurable or insignificant environmental impacts,
- the project appears to be in conformity with the objectives of the LEPNRM, the National Environmental Action Plan, regional environmental development plans (if adopted) and other laws relative to NRM, and
- the risk of environmental impacts during project construction, operation and closure are considered to be small (MOE 2000, Urwin and Wrigley 2001).

The Sub-decree on the EIA Process (11 August 1999) has delegated responsibility to the Ministry of Environment for establishing the EIA Guidelines but these have not yet been produced.

There are a number of obstacles to managing and enforcing EIA requirements in Cambodia. First, environmental assessment requirements are not well known and various sector ministries and project owners do not yet apply them. The authority of the Ministry of Environment to enforce the requirements appears to be limited by these circumstances. Another constraint is the limited capacity to conduct EIAs. There are few in-country specialists with experience in EIA reporting, and international consulting firms often have to be contracted, which is expensive and does not automatically increase local capacity to do this work.

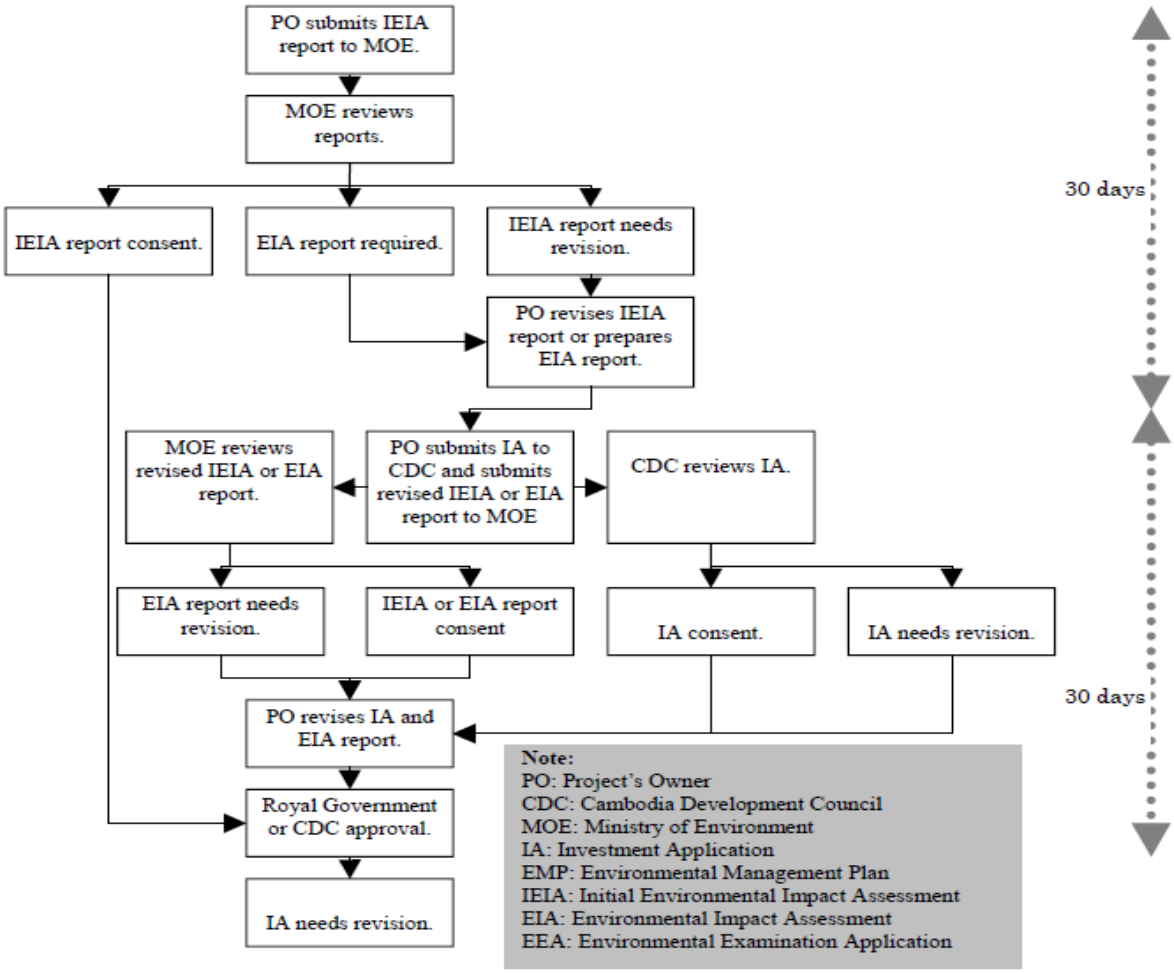

Figure 1: EIA process in Cambodia – Source: MOE 1999

The EIA principles of the donor agency (e.g. the ADB, World Bank, EU) and the host country should also be observed. The project proponent pays for the EIA, and a consultant is hired by the project proponent to conduct the EIA. The MOE reviews the documents with contribution of CDC and respective line ministries. As an example, ADB documentation (e.g. Lohani *et al*. 1997) describes EIA as a multi-step process by which a range of issues are taken into account to determine whether, or under what terms and conditions, a project should be undertaken. The screening process for the ADB categorizes loan projects into three groups, each of which requires a different level of environmental review (SEI and ADB, 2002):

- Category A: potentially serious environmental impacts, which require an EIA;
- Category B: potentially significant environmental impacts, which require an IEE but not an EIA;
- Category C: unlikely to have significant environmental impacts, which do not require an IEE or EIA.

ADB guidelines cover the environmental assessment requirements and environmental review procedures of the ADB (1993), environmental guidelines for selected infrastructure projects (1993), guidelines for incorporation of social dimensions into ADB operations (1993) and a handbook for incorporation of social dimensions into projects (1994).

3.2 STAKEHOLDER PERCEPTIONS AND ISSUES

The local review was somewhat limited and the results of the informal stakeholder consultations were not designed to be comprehensive. Instead they provide indications of key issues and concerns raised by relevant individuals and agencies involved in the EIA process at the implementation or institutional level. Results are derived from both direct communication with key stakeholder informants and the review of local and regional documents including the reports of the civil society.

Most stakeholders expressed a particular interest in the study topic, especially for improving the understanding of the impacts of built structures on the Tonle Sap in order to balance the social and economic development of Cambodia with the preservation of goods and services provided by the Tonle Sap ecosystem. Through numerous studies, awareness has increased of the potential negative impacts of built structures (especially large scale hydropower development) on the fisheries of the Tonle Sap, in particular by changing the river flow and its timing (e.g., Lamberts and Bonheur 2006). It is generally perceived that damaging the Tonle Sap ecosystem will in turn have negative social and economic impacts on communities dependent on the resources provided by this ecosystem.

Perception of impacts, issues and concerns may vary widely with the type of stakeholders (local stakeholders, civil society and government officials) interviewed. Key issues and concerns raised by stakeholders are summarised in the table below (Table 4).

Despite the increased emphasis on fisheries in development projects implemented in the Tonle Sap area, supported by the fisheries policy and EIA requirements set by donor agencies (especially the ADB and World Bank in Cambodia), the implementation and practice of built structure EIA shows insufficient consideration of fisheries issues, and no assessment has been carried out in accordance with the fisheries policy. The former ADB policy on fisheries states that the impacts of ADB projects on fisheries (notably the potential impacts of large-scale structures, especially dams) must be thoroughly assessed and eliminated or mitigated (ADB 1997).

Donor agencies and civil society call for increasing the scope of EIAs in order to address broader issues and the potential implications of project impacts at larger scales (esp. cumulative impacts). This contrasts with the general lack of financial and human resources in developing countries such as Cambodia. Beyond the issue of funding (by project proponent) and capacity building of local agencies, this review will show that there are also scientific issues in the definition of the scope (esp. boundaries) and priorities of EIAs (see also Section 4.3).

Table 4: Key issues and concerns per category of stakeholders

Stakeholder category	Issues and concerns
Local stakeholders, Civil society	• Negative impacts of built structures on fisheries tend to be underestimated • The scope of EIAs is too narrowly defined or applied; in particular social impacts, health and risk factors, and cumulative effects are generally not considered or inadequately addressed • Lack of scientific evidence, especially quantitative assessments of impacts on fisheries • Lack of participation of stakeholders in the EIA process; when stakeholders are involved, there are concerns with regard to representativeness (referring to the selection of stakeholders)
EIA implementers	• Scope of EIA is too broad • Quantitative assessments cannot be achieved
Government agencies	• cope of EIA is too broad (esp. perceived by MOE and MAFF officers) making assessment of impacts difficult • Lack of capacity to monitor and evaluate EIA implementation, analysis and results • Inadequate guidance and consistent enforcement of the EIA process • Inefficient, time-consuming, and costly EIAs relative to the benefits delivered • MOE lacks resources to conduct EIA
Donor agencies	• Lack of institutional coordination • Lack of political commitment

The various perspectives of key stakeholders highlight the need to balance the competing needs for socioeconomic development and especially the development of built structures, while preserving the Tonle Sap ecosystem goods and services, especially the benefits issued from its fisheries. This shows that positive and negative effects of built structure development urgently need to be clarified, assessed and valued.

However, the significance of EIAs is not fully recognised by many of the government ministries responsible for infrastructure or industrial and agricultural development, and environmental and social concerns are not always adequately considered in built structure project decision-making. The patron-client relationships often appear to be a more dominant force than the rule of law (SEI and ADB 2002). EIA is not sufficiently integrated with decision-making notably at the project preparation phase or with other supporting policy, planning and regulatory processes. At present there is a significant gap between public policy targets and laws and their implementation.

4. EVALUATION OF EIA REPORTS

This section first introduces the nature of the information collected and then provides the results of the evaluation in terms of the scope of EIAs, methods for impact assessment, results and management recommendations.

4.1 NATURE OF THE INFORMATION

EIA reports are scattered across various ministries, provincial and district government agencies, and with the project proponents. Access is generally difficult and very few reports are available within the MOE and other relevant ministries. EIAs are not systematically recorded and classified. As a result, a relatively small number of built structure EIA reports have been collected. Most EIA reports that are available refer to projects funded by international donors (grant or loan). No built structure Social Impact Assessments (SIAs) have been identified. The list of reviewed reports is indicated at the end of this report.

As a result of the small sample under review, the study had to broaden its initial emphasis on the evaluation of collected EIA reports in order to clarify why access to information was difficult. Possible reasons are that most EIA reports are not accessible and/or only few EIA projects have been carried out. Further stakeholder consultation showed that both were relevant for the following reasons:

- The Ministry of Environment does not access and record all EIA reports received by the various ministries and government agencies.
- Many projects are conducted with decision at the provincial level, sometimes without informing the head ministries, and local implementation of EIA is not fully controlled.
- The collection of reports from project proponents would require more time and resources to carry out field visits and further stakeholder consultations at the local level.
- A significant (but non-quantifiable) number of built structure projects do not provide EIAs. This is supported by MOE documentation (MOE 2000).
- The significance of EIA is not fully recognised by many government ministries responsible for infrastructure or industrial and agricultural development. The need for environmental assessment is still widely considered as secondary to the need for development.

In such a context, the study could not estimate the total number of existing EIAs and thus the representativeness of the study sample.

The scarcity of available EIA reports contrasts with the profusion of EIA guidelines and procedures disseminated worldwide, including specific guidelines for the Mekong River Basin and the Asia region. This reflects the discrepancy between the promotion of EIA by donor agencies and actual implementation of assessments.

4.2 PARTICIPATION OF STAKEHOLDERS IN THE PROCESS

Participation of stakeholders can occur during the EIA process and/or during the impact assessment (see Section 4.4). This section focuses on participation of stakeholders during the EIA process commonly called 'Public participation'.

Participation of stakeholders is generally very limited and there is no systematic mechanism for the involvement of stakeholders, including communities, provincial authorities, local or international NGOs. This raises issues of transparency throughout the process, of communication and dissemination of information (in both Khmer and English) at local and national levels, and of allocation of resources to these activities.

The general conclusion drawn by stakeholders is that while the requirement for participation and consultation in EIAs is clearly stipulated it does not occur in practice in Cambodia. Again the practice of EIAs in Cambodia shows significant discrepancies with guideline requirements.

4.3 SCOPE OF EIA

Most built structure projects implemented in the Tonle Sap area that may have a significant direct effect on water resources have considered potential or actual effects on fisheries in their EIAs. This reflects the awareness and well-known importance of this sector in the economy of the country, in the livelihoods of at least 2 million people and in the environment, notably its aquatic resource diversity and productivity.

The appreciation of capture fisheries has increased with the increased awareness that the threats to Tonle Sap fisheries are not only coming from the sector itself but also and possibly mainly from the development of built structures (especially large-scale irrigation, hydropower and road construction) within the catchment and Mekong River Basin, in particular upstream of the Tonle Sap. For example, the planned proliferation of dams in the Upper Mekong presents high levels of risk of irreversible negative impacts on endemic and commercially valuable fish biodiversity. In the very short-term, it is likely that the effect of proposed irrigation projects in the Tonle Sap ecosystem will be more severe than the effect of expected changes in seasonal fluctuations in lake levels from the impact of hydropower projects on the Mekong River and its tributaries (SEI and ADB 2002).

Regarding temporal and spatial scales, the scope of EIA is initially project-specific and it is assumed that the project needs to assess and manage its immediate (e.g. during construction) or short-term impacts within the immediate area (e.g. the command area of an irrigation scheme). While longer and larger scales are recommended - for example, the ADB (2004) indicates that long-term impacts should be considered prior to expanding irrigation and hydroelectric projects - they have not been considered by local EIAs. Strategic Environmental Assessments (SEA) and Cumulative Effects Assessments (CEA) would address these issues as they are conducted at catchment and river basin levels, and often have a longer-term perspective. A major SEA has been identified and recently conducted for the Mekong (SEI and ADB 2002).

4.4 METHODOLOGY FOR IMPACT ASSESSMENT

4.4.1 Coverage of fisheries aspects and scope of fisheries assessments

Coverage of fisheries aspects in EIA reports under study has been evaluated on the basis of the criteria (or 'situational variables' in the baseline situation) indicated in the table below (Table 5).

Table 5. Coverage of fisheries impact assessments

Fisheries aspect and scale of assessment	Coverage
• Physical habitat	High In most EIA reports
• Ecology of fisheries production	High In most EIA reports
• Biodiversity	Medium Focus on fish species diversity
• Ecological integrity	Very Low Only a few components of the ecosystem considered
• Exploitation of fisheries	Medium Focus on fishing effort
• Livelihood of fishers and fishing communities	Low Focus on a few livelihood assets and functions
• Institutional arrangements	Low Not much considered
• Management of fisheries	Low Not much considered
• Consideration of other key relevant sectors	Low Most EIA are sectoral
• Spatial scales	Very Low Focus on project boundaries
• Temporal scales	Very Low Focus on short-term impacts

The coverage of fisheries impact assessments tends to be sectoral and within project boundaries, and it tends to have a general focus on biophysical changes in the short-term: species diversity, hydrology, ecology and aquatic resource production. It must be noted that only a few EIAs mention aquatic resources other than fish, e.g. crab, shrimps, snails, aquatic plants, etc. despite their potential importance as a source of food for livelihoods, particularly for the poorer.

Socioeconomic and livelihood aspects are not systematically addressed and there are wide variations in EIA coverage. Overall, despite increased awareness and knowledge of the connection between biophysical and socioeconomic systems, socioeconomic effects are insufficiently considered and analysed in most EIA reports. Consideration of other sectors related to built structure development (esp. irrigation, hydropower, road construction) is limited or absent.

In terms of spatial scale, fisheries assessments are often limited to specific water bodies, essentially the main river(s) or stream(s), the Great Lake and the reservoirs for dam irrigation schemes. This provides a partial estimation of fisheries (esp. production and

productivity) in the project area. Consideration of all major water bodies in the catchment, upstream and downstream of the built structure would provide a more accurate estimation of fisheries production and its significance in livelihoods at the various locations.

Assessments focus on short-term impacts and neglect longer-term effects of built structures on the ecosystem and fisheries dependent livelihoods. As a result, potential trade-offs between immediate and long-term costs and benefits are not made explicit.

4.4.2 Method for impact assessment

Checklists of impacts, with or without their estimated significance per sector or per impact category, are most commonly used. The comparison of the situation before and after the project, prediction of impacts or ex-post impact assessment, is also frequently invoked. However, since most reports do not describe the methodological steps leading to results it has generally been difficult to identify the methodological rationale underlying impact assessments.

The description of the baseline (or pre-project) situation is often a major part of the assessment. A comprehensive evaluation of project impacts requires a thorough understanding of the situational variables for the pre-project situation and how these have evolved over time. However, in most cases, there is very little collection of primary data – and none in many cases - and recycling old data and information is common. Collection of primary data is usually carried out to larger extent in donor funded projectEIAs, such as Stung Chinit and Northwest Irrigation projects.

The lack of scientific data and of baseline information in particular are often mentioned as major constraints to assessment, especially where the impact assessment method is based on a comparison of the situation before (baseline) and after the project (predicted scenario). Apart from physical changes that can be directly observed in the field, the main source of information may need to be the recall of individual or group interview respondents (see also Lorenzen *et al*. 2005). Participation of stakeholders in the assessment, e.g. in rapid and participatory appraisals, is generally limited yet higher than in EIA processes (see Section 4.2).

It may also be possible to compare the characteristics of the project and the impacted area with other similar projects for which fisheries impacts have been considered, or with comparable areas without irrigation development.

4.5 ASSESSMENT RESULTS

Evaluation of assessment results has been based on the description and analysis of the baseline situation (before implementation of the project), and the identification and prediction of possible changes or evaluation of actual changes.

4.5.1 Baseline situation

The description and assessment of the baseline situation should provide sufficient and adequate information to understand the potential impacts of built structures and causation pathways. This should support later assessment and discrimination of built structure impacts from other changes. The baseline situation is essentially descriptive

and based on secondary information. Some EIAs have carried out collection of primary data for specific information in the project area. Notably due to a lack of adequate monitoring of the state of these floodplain systems, estimation of fisheries production and indicators of productivity are “incomplete at best and very problematic in most instances” (Lamberts and Bonheur 2006).

Baseline situations usually refer to the hydrological importance of the Tonle Sap system, its uniqueness and exceptional fisheries productivity. The Tonle Sap is among the most productive fishery resources in the world, and is important in terms of biodiversity, productivity and its role in livelihoods. Because this high fisheries productivity is strongly related to the specific hydrological patterns (timing of the flow, specific seasonal and daily fluctuations, flow reversal, etc.) of the Tonle Sap, these fisheries are sensitive to changes not only within the catchment but also in the Mekong Basin. The Mekong mainstream, tributaries and associated lakes are characterized by high fish biodiversity, including a substantial number of endemic species.

Increasing human impacts in floodplain areas, including various built structures (especially hydropower dams upstream on the Mekong), has led to flow modification, floodplain habitat alteration or destruction and water pollution. These factors have been defined as the three main causes for loss of freshwater biodiversity worldwide (e.g. Kruskopf in press).

The socioeconomic situation and human well-being in the Tonle Sap area are strongly connected to natural resources and other ecosystem services due to the majority of livelihoods directly and largely dependent on natural resources. Rice cultivation and fishing are the most important occupations in the Tonle Sap area (Keskinen 2003). They are supplemented by a variety of other livelihood activities of which many are directly dependent on natural resources, such as firewood collection and hunting. Therefore, a high number of poor people remain vulnerable to environmental change because of their dependence on natural resources and the lack of livelihood alternatives.

Most EIA reports do not refer to indicators of sensitivity, vulnerability and resilience of the ecosystem and livelihoods in respective areas - simply stated, a resilient ecosystem is likely to be more resistant (and thus less vulnerable) to natural or human disturbances. Notably, while the significance and importance of fisheries and the Tonle Sap ecosystem are largely recognised and documented it is not always possible to assess the degree of sensitivity of specific locations in the ecosystem (e.g. built structure projects), apart from general knowledge of sensitivity to changes in environmental flows and biodiversity.

4.5.2 Identification of impacts of built structures on fisheries

Impacts of built structures on fisheries can be direct or indirect; they may affect the ecological characteristics of the Tonle Sap fisheries, and/or the livelihoods and socioeconomic and institutional baseline situation.

Table 6: List of direct and indirect impacts mentioned in EIA reports

Impact Category	Impacts indicated in EIA reports
Direct impacts	• Blockage or impedance of fish migration • Changes in river flow • Changes in aquatic habitats • Disruption of connectivity between aquatic habitats • Changes in water quality (nutrients, agrochemicals, metals, etc.) affecting the primary productivity, fish production and species composition • Distribution and transportation of sediment • Distribution and transportation of nutrients
Indirect impacts	• Degradation of water quality • Land use changes • Distribution and transportation of sediment • Distribution and transportation of nutrient inputs, especially through changes in the flood pulse • Changes in access to wetlands and water bodies

Blockage and impedance of fish migration are the most commonly identified impacts of built structures on fisheries. However, the migratory characteristics of fish species in the impacted area are rarely identified, with the notable exception of the Stung Chinit irrigation project. The Stung Chinit EIA indicates that fish populations in the project area are both migratory and non-migratory and that estimated impacts will likely be positive on non-migratory fish (due to increased availability of water) and possibly negative on migratory fish (due to impedance of migration).

The availability and quality of aquatic habitats and the connectivity between them may result from changes in river and stream flows and from land use changes. Disrupted connectivity affects the ability of aquatic organisms to move between riverine areas. The transfer of terrestrial organic matter to the aquatic phase through the flood pulse involves a variety of pathways, including ingestion and digestion by aquatic organisms, bacterial decomposition, biofilm formation and metabolism, and leaching of photosynthesis products (Lambert and Bonheur 2006).

In Stung Chinit, two major environmental concerns associated with the project are the impacts of restored weirs on migratory fish and the impacts of pesticides and fertilizers in the project area. Pesticides are of concern not only because of their impacts on the health of farmers in the project area who work in the fields and consume the rice but also because of the impact on downstream rice-fish paddies and on livestock and waterfowl. Another threat is increased use of fertilizers and the resultant runoff into the lake and its tributaries, poisoning the fish and the people who live on them.

Impacts on livelihoods are usually deduced from changes in fisheries productivity. However, even where productivity is maintained, built structures (esp. roads, dams) may change the pattern of access to water bodies and although rarely considered, consequences on livelihoods may be more negative than productivity changes. In turn, improved access due, for example, to reduced incidence of flooding, improved road networks and subsequent increased human habitation caused by new infrastructure in floodplain areas, will lead to increased destruction of forest resources and habitats through increased commercial activities facilitated by road construction. If negative, both

types of change may act to worsen the absolute position of poor people in terms of poverty, vulnerability and equity.

4.5.3 Predictive and analytical capabilities

The quality and accuracy of impact assessments are highly variable and most results on the impacts of built structures on fisheries are essentially descriptive. Most assessments focus on discrete factors or a few components of fisheries, especially fish migration and fish species diversity. Changes in connectivity between aquatic habitats and water quality and other characteristics (composition, temperature, etc.) are more difficult to assess.

Table 7: Identification of predicted or evaluated variables

Category of variable	**Predicted or evaluated variable**
Hydrological regime	Extent of water withdrawal and depletion Total flow changes
Aquatic habitats	Extent of flooded area
Connectivity between aquatic habitats	Some qualitative but no quantitative estimation
Fisheries production and productivity	For a few water bodies: - Reservoir: potential production through stock enhancement or aquaculture - Floodplain: no quantification - Lake: no quantification
Biodiversity	Fish species diversity: identification of species before and after the project
Water quality changes	Composition Temperature
Socioeconomic	Economic contribution of fisheries sector
Livelihoods	Loss of livelihood functions Income changes
Institutions	Changes in institutional arrangements

Assessments of the influence of built structures on fisheries tend to focus on the impacts as outcomes, with limited information on why they may arise as predicted, and causal explanations of impact pathways is usually lacking. When considering social and economic outcomes, the number of possible pathways that could be the root cause is even greater (see also Lorenzen, Smith *et al*. 2005). The lack of causal explanations also has implications for the identification of mitigation measures (see Section 4.6.1).

Most assessments of built structure impacts on fisheries are essentially descriptive and lack analytical and predictive capabilities. This leads to weak interpretations, and conclusions tend to be made quickly, with a high degree of subjectivity and strong reliance on expert judgement. While using expert judgement is often required at various degrees in data-scarce contexts, built structure impact assessments are not sufficiently transparent and/or detailed to allow evaluation of the degree of expert judgement. This leads to excessive use of vague qualitative statements such as ‘slight eventuality’, ‘no major impact’ without indication of their rationale and justification for such results.

Local literature indicates that EIA results are difficult to translate and weigh against the quantified net benefit of the built structure project, essentially provided by cost-benefit analysis (CBA) of built structure projects. The EIAs considered do no attempt to value environmental, social, health and other factors, and results cannot feed into CBA methodology and practice. This is critical given the central role that CBA plays in decisions about whether or not to implement a proposed built structure project (e.g. McKenney 1999 on dam projects).

4.5.4 Degree of integration across disciplines and across sectors

The degree of integration has been evaluated across disciplines (hydrology, ecology, socioeconomics, livelihoods, governance) and across sectors (fisheries and key relevant sectors, e.g. agriculture in case the of irrigation projects). Fisheries are strongly dependent on interactions with other sectors especially agriculture and all water related activities. This is especially evident in the Tonle Sap where the majority of livelihoods rely on water-related natural resources (e.g. Keskinen 2003, Nikula 2005).

Built structure EIAs mostly assess impacts on discriminate characteristics and variables of fisheries and they tend to neglect subsequent or simultaneous changes that originate from interaction between variables. This is an issue for all EIAs since the environment is traditionally divided into manageable components or categories (e.g. water quality, biodiversity, soil fertility, air quality) and such clustering underlies common checklist frameworks.

However, such EIA frameworks cannot encompass ecological processes such as floodplain processes as these can be affected by changes occurring in different components of an EIA (e.g. soil fertility, surface water quality and level, and groundwater dynamics). As a result, effects of built structures on the Tonle Sap floodplain are partially or inadequately assessed except in rare cases where potential cumulative effects between EIA sectors have been considered (Lamberts and Bonheur 2006). The authors conclude that this leads to incomplete and inaccurate assessments of the impact of man-made flow changes.

In particular, Lambert and Bonheur (2006) demonstrate that EIA methodological frameworks have been superseded by cross-cutting patterns such as the flood pulse. They propose a framework to show the variety of environmental effects on fisheries across EIA components in contrast to the important aspects of the aquatic ecosystem and fisheries omitted by other EIA frameworks. Another potential bias is that the effects of a project on each component may be small, but the overall cross-cutting damage to the flood pulse may be significant.

While the importance of the biodiversity and productivity of the Tonle Sap ecosystem has been recognised and demonstrated, the development and application of such integrative processes is a prerequisite for effective built structure EIA with regard to the Tonle Sap fisheries. Ecologists suggest developing ecosystem impact assessments (see also Section 5.3) especially where floodplains are concerned.

4.6 MANAGEMENT RECOMMENDATIONS

The evaluation of management recommendations involves analysis of the mitigation and enhancement measures identified and their utility and adequacy.

4.6.1 Identification of mitigation and enhancement measures

To compensate for the effects of built structures on fisheries, mitigation and enhancement measures have been proposed by EIA studies. A relatively wide range of mitigation and enhancement measures are proposed for the large variety of built structures, and it is likely that the review of the EIA sample does not provide a comprehensive list of existing measures. These have been grouped in relation to the mechanisms or principles of change they propose to act upon (Table 8).

Table 8: Identification of mitigation and enhancement measures

Category of measure	Measures identified in EIA reports
Mitigation measures	• Technical and engineering measures to ensure fish migration routes through structures such as fish passes and culverts (Lim and Lek 2005) • Minimise loss and degradation of flooded areas • Establish minimum dry season flow • Protect fisheries and habitats by establishing protected areas • Convert borrow pits (during road construction) into fishponds or ponds with water for gardening • Strengthen management institutions, and develop monitoring, forecasting and information dissemination
Enhancement measures	• Stock-enhancement • Aquaculture • Rice-fish farming

However, despite their potential variety, most management recommendations target two main means for action: the mitigation of river fish migration and the enhancement of fisheries production in reservoirs (for dam irrigation and hydropower schemes) and fish ponds, and to a lesser extent the establishment of minimum river flows.

To mitigate the impact on migratory fish, a fish pass structure will be constructed at the Stung Chinit weir with a minimum slope allowing fish to migrate upstream. The Stung Chinit project has also proposed establishing a minimum flow. In the absence of quantitative studies, minimum environmental flow releases of at least 10% of the mean monthly flow have been recommended to maintain healthy aquatic habitats in temperate countries. Given the diverse nature of tropical fish faunas and the generally higher temperatures, this may not be sufficient for the Stung Chinit. However, much of the water diverted from the river channel will be distributed throughout the same area through paddies, secondary and tertiary canals and drains, and some will return to the river course through this system (Lim and Lek 2005).

4.6.2 Utility and adequacy of management measures

Utility and adequacy of mitigation measures is highly variable and can only be evaluated at a general level. There is not much consideration of the location of projects and their design at the planning stage since late remedial action (at the implementation stage) is generally not feasible. Cost efficiency of management measures cannot be evaluated in this study. EIA estimates should be incorporated into the overall CBA of the project. The costs of mitigation measures, in particular, should be included in overall project costs.

In general, management measures are recommended without much consideration of the whole project and potential trade-offs between different management and development options, notably the difficult balance and complex understanding of both positive and negative impacts of built structure development. “The lack of awareness of the presence and significance of a floodplain and the inextricable unity between floodplains and their main water bodies, combined with flawed impact assessment practices, lead decision makers to believe that mitigation of negative impacts on floodplain ecosystems is possible.” (Lambert and Bonheur 2006).

While standard practice in ADB activities, individual projects must be considered in the larger context within which the intervention is undertaken. Future planning should examine the cumulative impacts of individual interventions in view of overall resource management. For example, the individual and cumulative impacts of projects involving irrigation, water resource use, and rural development can be accounted for through integrated basin planning (SEI and ADB 2002) (see also Section 5.3 and 5.4).

5. DISCUSSION

The discussion aims to provide insights and recommendations for enhancing local EIAs in light of existing knowledge available locally and worldwide. Comments are made within the scope of the review, with consideration of its limitations due to both the difficulty of accessing information and the short duration of the study.

5.1 LACK OF DATA AND INFORMATION

As in many developing countries, the lack of data and information is strongly felt and it is a common constraint for research studies, especially for integrated fisheries assessments and quantitative assessment results, since these are generally resource and time consuming. While it is not feasible and practical to establish a comprehensive collection of baseline information for every project, improved data collection systems are needed, in particular the recording of all built structure projects (date, type, location, etc.) and key fisheries characteristics (gears used, main livelihood characteristics of fishers) at district, provincial and national levels.

Most EIAs do not provide any alternative to the scarcity of information such as, for example, the search for other sources of information, i.e. comparative studies, strategic analyses, and stakeholders’ perceptions and knowledge (including local ecological knowledge, e.g. Baird, 2003 and Poulsen, 2003). In addition, the use of knowledge, especially local/traditional knowledge and scientific knowledge, are not optimised. While knowledge needs to increase worldwide, especially in the quantification of the magnitude

of impacts (see Kruskopf, in press), significant literature now exists on the influence of certain built structures on aquatic ecosystems and fisheries, especially for large-scale dam irrigation schemes. Generic knowledge such as the ecology of fisheries, ecosystem functioning, and fisheries functions in livelihoods can be transferred and extrapolated for use in specific built structure EIAs (see further development in Section 5.3).

Therefore, the lack of data and information tends to be overemphasised as a reason for partial impact assessments that target official agreement for project implementation. Various ways for improving the accuracy and predictive capability of results have been identified. Essentially, beyond improvement of data collection systems, EIAs should enhance the use of, or identify the need to develop, methodologies and processes that are able to adapt to local conditions and optimise the use of existing knowledge and available data.

5.2 SCOPE OF ENVIRONMENTAL ASSESSMENTS

Despite the recognition of the need for inter-sectoral and inter-institutional coordination and partnership, most EIAs are essentially sectoral and project-focused. Scientific literature on the impact of human development on fisheries in Cambodia (e.g. Lambert and Bonheur 2006) shows that EIAs insufficiently cover adequate spatial scales, especially the necessary trade-offs and potential conflicts between the upstream and downstream effects of built structures on fisheries.

However, in practice, EIA studies often face difficulties in defining the boundaries of the study area. The critical need to cover upstream and downstream areas requires a catchment perspective. At the river basin level identification of the geographical scope (Upper and Lower Mekong River Basin) would be even more complex due to potential regional effects, especially trans-boundary effects between countries, such as effects on fish migration, sediment transportation and hydrological changes. The planned proliferation of dams in this sub-region presents a high level of risk of irreversible negative impacts on endemic and commercially valuable fish biodiversity. Environmental assessments conducted in the Lower Mekong Basin have mainly focused on pollution problems but they have not been used for assessment of macro-level issues such as land use conversion, soil erosion, catchment area treatment, illegal resettlement, conflicting uses of natural resources, etc. (SEI and ADB 2002).

There is an urgent need to develop and use frameworks that can exploit the results of project environmental assessments in sectoral and regional approaches such as SEA and CEA. This is even more critical in the case of the Tonle Sap Basin (including the river, lake and associated floodplain) where extensive studies show the connections between river flow patterns and fisheries production.

5.3 ASSESSMENT OF THE IMPACTS OF BUILT STRUCTURES ON FISHERIES

The complex and dynamic ecosystem of the Tonle Sap and its fisheries (and respective livelihoods) may not be understood and adequately evaluated by existing impact assessment. Beyond the lack of information and knowledge developed in Section 5.2, the review has highlighted the potential for improvement in increased exploitation of available knowledge (locally and worldwide) and use of adequate impact assessment methods, especially those that integrate multiple disciplines and consider interactions and linkages with key relevant sectors and scales.

As introduced in Section 5.1, the potential for increased use of local and worldwide knowledge is generally neglected. Enhanced use of local knowledge including traditional knowledge involves choosing the appropriate form and degree of stakeholder participation in impact assessments. Participation may also support the resolution of conflicting issues and a commitment to solving these issues (see also Section 5.4.2). In turn, insufficient participation and use of local knowledge could have strong implications for the quality of impact assessments (especially where affected people have not been adequately consulted) and the sustainability of management measures derived from assessment results.

While key gaps have been identified in relation to built structure impacts on fisheries (see also Kruskopf in press), the worldwide knowledge base of riverine and floodplain ecosystems has significantly increased and improved the understanding of complex ecological processes. Beyond increased knowledge of aquatic ecosystems, this knowledge provides the basis for comparative analysis, e.g. cross-check comparisons between local estimates and average productions in comparable ecosystems or water bodies. It also allows the use of appropriate assessment methods and tools, such as: i) modelling tools that may support quantification of some processes and identification of impact scenarios, and ii) methods and approaches that are able to generate information in contexts of data scarcity and uncertainty such as precautionary approaches.

Traditionally, EIAs have considered air quality, water resources, wildlife and human communities as separate entities for analysis. This separation of resources and sectors has neglected linkages with key relevant sectors, e.g. agriculture for dam irrigation schemes, transport and tourism for harbour construction, and has omitted or obscured many cumulative effects (e.g. Lambert and Bonheur 2006). EIA methodologies predominantly draw from checklist frameworks, and this review has highlighted the need for more integrative frameworks. While checklists of potential effects of built structures may enhance coverage of fisheries aspects (and usually the respective relative weight of the impact) they are likely to provide discrete evaluations that neglect cause-effect relationships and other interactions between factors of influence, e.g. feed-back effects.

The resulting description of impacts tends to be a multi-sectoral but static ‘snapshot' that does not reflect longer-term impacts and undervalues the chain of impact causality. Thus, it may miss possible management actions that may significantly change the outcome of a built structure development (Nguyen-Khoa *et al*. 2005). Recognition of the interconnectedness of land, water and human resources has driven several developed countries to undertake ecosystem or watershed approaches to environmental protection. The ecosystem approach explicitly addresses the ecological interactions and processes necessary to sustain ecosystem composition, structure and function. Ecosystem

assessments address the full spectrum of indicators of ecological conditions ranging from the genetic to species to local ecosystem to regional ecosystem levels.

Better linkages with larger scales can be exploited through the use of natural and not just project boundaries. This leads to ecological regions, such as watersheds and eco-regions, that encompass ecosystem functioning and landscape-scale phenomena such as habitat fragmentation and that address resource or ecosystem sustainability. Increasingly, ecologists promote ecosystem approaches in order to provide the broad regional perspective needed in regional planning and the holistic thinking needed for impact assessment of fisheries and especially to address key principles of cumulative effects (SEI and ADB 2002).

5.4 MANAGEMENT MEASURES

5.4.1 Utility and adequacy of recommended measures

The management of built structures for the mitigation or enhancement of fisheries generally focuses on technical and engineering measures (esp. fish passes, fish ladders) and stock-enhancement in reservoirs for dam irrigation projects.

Often mitigation and enhancement measures are the end-product of built structure EIAs and neglect potentially effective interventions throughout the causality chain of impact, from its root causes to outcomes. As indicated in Section 5.3 on assessment, results do not provide sufficient information on cause-effect relationships and hence they do not support identification of management measures throughout key pathways of impacts. In addition, where quantifiable, the environmental, social, health and other impacts that cannot be mitigated should be added to total project costs.

Management measures are often afterthoughts, and changes in the design may not be possible. This constraint is particularly critical with technical and engineering measures. Also, proposed management measures omit or fail to adequately address local constraints to implementation, such as lack of resources or the need for institutional reforms (Nguyen-Khoa *et al*. 2005). For example, the implementation of built structures may offer a 'window of opportunity' to introduce institutional or other changes that can mitigate the problem.

5.4.2 Analysis of trade-offs and support for decision-making

Adequate design, location and management decisions with regard to built structures require appropriate analytical and decision-making processes. Competing demands are often raised by the needs for infrastructure development and the overall pressure for rapid socioeconomic development (short-term objectives) to the likely cost to the environment and natural resources (long-term objectives of sustainability). Within the fisheries sector, tensions may arise between the need for increased fisheries production and potential development of aquaculture and the conservation of aquatic resources requiring protected areas.

Present built structure EIAs in Cambodia would better support evaluation of these trade-offs if they made explicit the weight of the different environmental and socioeconomic factors and management options. This implies valuing environmental services and social

preferences for the present and future through identification of trends and possible scenarios of built structure development and consequent changes in fisheries. In addition, participation of stakeholders in the selection of the most desirable or acceptable options is likely to improve the sustainability of implementation of management measures.

The local capacity and coordination between relevant agencies, especially in the ministries and in particular the MOE, needs to be enhanced in order to improve the holistic understanding of the development of built structures and their potential effects on fisheries production, biodiversity and livelihoods. At present, due to lack of information, awareness and experience, the MOE may lack critical judgement and necessary authority in the evaluation of built structure EIA reports.

5.5 RECOMMENDATIONS FOR TONLE SAP BUILT STRUCTURES EIAS WITH REGARDS TO FISHERIES

In accordance with the results of the review, recommendations are made separately for the EIA process and for the assessment of built structure impacts on Tonle Sap fisheries.

5.5.1 Built structure EIA process

- Ensure knowledge of Strategic Environmental Assessments (SEA) and Cumulative Effect Assessments (CEA) conducted in respective catchments, sub-basins (Upper or Lower Mekong) and river basins.

- Adopt a holistic approach to defining EIA scope: define spatial and time scales and key linkages between built structures impacts on fisheries and other relevant main sectors.

- Increase participation of stakeholders: strengthen public consultation in particular.

- Learning and adaptation: iteratively improve the process and integrate lessons back into the EIA process during implementation and for further EIA.

- Increase transparency of the built structure EIA process.

- Increase coordination between relevant government agencies: need for a shared commitment throughout project planning and implementation.

- Enhance and support political commitment of the Government of Cambodia.

5.5.2 Assessment of impacts on fisheries

- Adopt a holistic approach to defining the scope of fisheries assessment: to identify key issues and key interactions with relevant sectors.

- Carry out an integrated impact assessment: to understand and assess the whole fishery system and interactions, e.g. the ecosystem approach, especially for complex ecosystems such as the Tonle Sap.

- Use and develop methods (and enhancement of their use) that can deal with lack of data and scientific uncertainty

- Increase and optimize the use of available knowledge, including stakeholder knowledge and international scientific knowledge. The significant knowledge of fisheries ecology and socioeconomy in floodplain ecosystems can be better exploited.

- Promote the production and exchange of data on built structures and fisheries: design and implement simple data collection systems.

- Enhance participation of stakeholders in fisheries impact assessments.

- Improve valuation of Tonle Sap fisheries and respective ecosystem services.

- Adopt a holistic and integrated approach to identifying management measures and provide measures that are both feasible and efficient.

- Assess trade-offs between costs (including social and environmental) and benefits of built structure projects. Ultimately, this aims to inform CBA to support decision-making related to built structure development.

- Produce assessment and management results that can feed into regional assessment frameworks such as Strategic Environmental Assessment (SEA) and Cumulative Effect Assessment (CEA).

- Develop specific guidelines on assessment and management of impacts of built structures on Mekong fisheries.

6. CONCLUSION

The review of local built structure project EIAs with regard to the Tonle Sap fisheries has highlighted key constraints and limitations to performing impact assessments and processes. Limitations have been identified at various levels: some are specific to the scope and assessment of built structure EIAs, while others relate more generally to the EIA process conducted in Cambodia. The relatively short duration of this review did not allow either in-depth analysis or broad coverage of built structures because of the poor availability of information and difficulty in accessing local EIA reports. Strengthened stakeholder consultation and increased searches in relevant government agencies are critically needed.

The review shows that built structures are likely to have negative impacts on the Tonle Sap fisheries but they may also have positive impacts. Effects may originate from the built structure itself but also from the operational system (e.g. irrigation) and – although

less considered in the EIAs under study - from the effects of subsequent economic development in the area (potential population increases, development of other smaller structures, etc.) triggered by the implementation of built structures, especially the construction of roads, dams and harbours. The principal negative effects arise from changes in river and tributary flows, the connectivity among aquatic habitats, and the degradation of water quality. Positive effects may result from increased production in irrigation reservoirs and decreased fishing efforts resulting from new livelihood alternatives brought by the built structure.

The review of EIA has highlighted the need for integrated assessment and management methods that can encompass the fishery system and key linkages with relevant sectors, especially farming for irrigation schemes. Management needs to assess and possibly quantify negative but also positive impacts in order to balance effects and analyse respective trade-offs. This would clarify the range of options available to stakeholders and support the decision- and policy-making relate to built structure development.

While increased integration and a holistic approach to the fishery system is required, EIA methods need to be feasible and appropriate to local resources, especially in balancing the accuracy of prediction that requires significant resources with achievable outputs and outcomes. This may be resolved in a two-speed process providing practical EIAs that assess key impacts on Tonle Sap fisheries while progressing towards more complex integrated assessments of fisheries impacts in the context of built structure development in the whole Tonle Sap ecosystem.

Increased transparency of EIA processes is urgently required, and making EIA reports widely available would be a useful first step. Public participation is needed to facilitate constructive debate, initiate resolution of difficult trade-offs and support stakeholder consensus on development choices. Increased local capacity in the EIA process should support improved monitoring of EIAs and exchange of information, as well as improved influence and authority of the MOE with the support of relevant ministries (esp. the MAFF, MOWRAM and MIME) to preserve the Tonle Sap aquatic ecosystem and fisheries.

In conclusion, improvements in EIA process and methods have a high potential for optimising the benefits of built structure projects while sustaining the aquatic ecosystem and fisheries of the Tonle Sap. This critically requires integrated impact assessment methods, enhanced participation of stakeholders, increased transparency of the process and political commitment for the institutional uptake of EIA procedures in a long-lasting way.

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ANNEX 1: List of projects that require IEE or EIA

Source: Annex of sub-decree No 72 ANRK.BK, 11 August 1999

Industry

I. Foods, Drinks, Tobacco
II. Leather tanning, Garments and Textiles
III. Wooden production
IV. Paper
V. Plastic, Rubber and Chemicals
VI. Mining production other than metal
VII. Metal industries
VIII. Metal processing industries
IX. Other industries
X. Agriculture
XI. Tourism
XII. Infrastructures

Foods, Drinks, Tobacco

• Food processing and canning	> 500 tons/year
• All fruit drink manufacturing	> 1,500 liters/day
• Fruit manufacturing	> 500 tons/year
• Orange juice manufacturing	All sizes
• Wine manufacturing	All sizes
• Alcohol and beer breweries	All sizes
• Water supply	> 10,000 users
• Tobacco manufacturing	> 10,000 boxes/day
• Tobacco leaf processing	> 350 tons/year
• Sugar refineries	> 3,000 tons/year
• Rice and cereal grains mills	> 3,000 tons/year
• Fish, soy bean, chilli, tomato sources	> 500,000 liters/year

Leather tanning, Garments and Textiles

• Textile and dyeing factories	All sizes
• Garment, washing, printing, dyeing	All sizes
• Leather tanning and glue	All sizes
• Sponge rubber factories	All sizes

Paper

• Paper factories	All sizes
• Pulp and paper processing	All sizes

Plastic, Rubber and Chemicals

• Plastic factories	All sizes
• Tire factories	> 500 tons/year
• Rubber factories	> 1,000 tons/year
• Battery industries	All sizes
• Chemical production industries	All sizes
• Chemical fertiliser plants	> 10,000 tons/year
• Pesticide industries	All sizes
• Painting manufacturing	All sizes
• Fuel chemicals	All sizes
• Liquid powder, solid soaps manufacturing	All sizes

Mining production other than metal

• Cement industries	All sizes
• Oil refineries	All sizes
• Gas factories	All sizes
• Construction of oil and gas pipelines	> 2 km
• Oil and gas separation, storage facilities	> 1,000,000 liters
• Fuel stations	> 20,000 liters
• Mining	All sizes
• Glass and bottle factories	All sizes
• Bricks, roofing tile manufacturing	> 150,000 pieces/month
• Flooring tile manufacturing	> 90,000 pieces/month
• Calcium carbide plants	All sizes
• Producing of construction materials	> 900 tons/month
• Motor oil manufacturing	All sizes
• Petroleum study research	All sizes

Metal industries

• Mechanical industries	All sizes
• Mechanical storage factories	All sizes
• Mechanical and shipyard enterprises	All sizes

Metal processing industries

• Manufacturing of barbed wires, nets, etc	> 300 tons/month
• Steel, iron, aluminium mills	All sizes
• All kinds of smelting	All sizes

Other industries

• Waste processing, burning	All sizes
• Waste water treatment plants	All sizes
• Power plants	> 5 MW
• Hydropower	> 1 MW
• Cotton manufacturing	> 15 tons/month
• Animal food processing	> 10,000 tons/year

Agriculture

• Forest concessions	> 10,000 ha
• Logging	> 500 ha
• Land covered by forest	> 500 ha
• Agriculture and agro-industrial land	> 10,000 ha
• Flooded and coastal forests	All sizes
• Irrigation systems	> 5,000 ha
• Drainage systems	> 5,000 ha
• Fishing ports	All sizes

Tourism

• Tourism areas	> 50 ha
• Golf courses	> 18 holes

Infrastructure

• Urbanization development	All sizes
• Industrial zones	All sizes
• Construction of bridge-roads	> 30 tons-weight
• Buildings	Height > 12 m or floor > 8,000 m2
• Restaurants	> 500 seats
• Hotels	> 60 rooms
• Hotels adjacent to coastal areas	> 40 rooms
• National road construction	> 100 km
• Railway construction	All sizes
• Port construction	All sizes
• Airport construction	All sizes
• Dredging	> 50,000 m3
• Dumping sites	> 200,000 people

ANNEX 2: List of EIA reports identified in the main relevant ministries

Ministry of Environment

Public projects (2 approvals and 4 monitoring)

1) EIA report on the Greater Mekong Sub-region (GMSR) project about communication in Kandal province, Takeo province, Kampot province and Sihanoukville of Ministry of Post and Telecommunications, which was approved on 12 January 2005.
2) EIA report on Water Supply project at Tbong Khmum village and Kangmeas village in Kampong Cham province of MIME, which was approved on 05 May 2005.
3) EIA report on the Built structure of Economic area project especially SEZ at autonomous port in Sihanoukville, which it is monitoring.
4) EIA report on Construction road 64 project from intersection of road number 6 in Kampong Thom through Preah Vihear province of MPWT, which it is monitoring.
5) EIA report on Electricity network of the Greater Mekong Sub-region (GMSR) Link from Vietnam to Phnom Penh Electricity of Cambodia, which it is monitoring.
6) IEIA report on master plan of water supply in Phnom Penh (2^{nd} degree), which Phnom Penh Authority Supply is monitoring.

Private projects (9 approvals and 2 monitoring)

7) IEIA report on Golf course project for 18-hole golf playing at Poun village in Siem Reap for Royal report company and KANTRI Club Co. Ltd. which was approved on 13 September 2005.
8) Environmental and Social Impact Assessment report on Gem Commercial project in 3 villages are Lumphat and Ratanakiri province for Seoul Digem Cambodia Co., Ltd, which was approved on 22 September 2005.
9) Environmental and Social Impact Assessment report on Gem Commercial project at Patingthom area, Tinchak commune, Borkeo district in Ratanakiri for Ultra Marine Kiri (Cambodia Co., Ltd.) which was approved on 22 September 2005.
10) Environmental and Social Impact Assessment report at Sen Chao area in Samlot district in Battambang province for Ultra Marine Kiri (Cambodia Co., Ltd.) which was approved on 22 September 2005.
11) IEIA report on Development Eco-tourism project in Ream Park area in Sihanoukville for Yee Jia Development Company, which was approved on 23 September 2005.
12) IEIA report on Development of Eco-Tourism at Tetek Puf in Kampong Speu province for NewCosmos Development (Cambodia) Co., Ltd, which was approved on 23 September 2005.
13) Environmental and Social Impact Assessment report on alkali commercial project at Prak Mountain area, Oral district in Kampong Speu province for Future Environment Co., Ltd, which was approved on 23 September 2005.
14) IEIA report on Construction of Petroleum and Pump Petroleum project at Otre in Sihanoukville for Tela Petroleum Group Investment Co., Ltd, which was approved on 19 October 2005.
15) Environmental and Social Impact Assessment report on sand construction commercial project in Kuntheavy Island, Lekdek district in Kandal province and Check Island, Peamchor district in Prey Veng province for Khmer Dynastic International Co., Ltd, which was approved on 20 October 2005.
16) EIA report on Granted Land Project at Botum Sakor Park in Koh Kong for Greenrek Co., Ltd, which it is monitoring.
17) IEIA report on project of restaurant construction of NEXUS NAGA HOTEC in Phnom Penh for NAGA Resorts and Casinos Limited, which it is monitoring.