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Assessing the Assessments: Improving Methodologies for Impact Assessment in Transboundary Watercourses

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ABSTRACT *Transboundary impact assessment (TIA) has become an important environmental management tool, particularly where a project may have transboundary impacts. With the growing practice of TIA, it becomes important to consider the accuracy of the transboundary impact assessments that are being conducted. If TIA is a planning tool designed to provide a basis for making an informed decision, does it actually provide the necessary information? This paper summarizes lessons learned in pilot testing a methodology to assess the accuracy of TIAs.*

Introduction

Transboundary impact assessment (TIA) has become an important environmental management tool, particularly where a project may have transboundary impacts (Cassar & Bruch, 2004; Troell *et al.*, 2005). Over the past decade and more, a variety of international, bilateral and national laws, guidelines and institutions have adopted requirements that a TIA be conducted prior to making decisions on projects or activities with transboundary implications.

When used correctly, TIA can be a powerful decision-making tool. It can help to identify and assess the potential impacts of a proposed project or activity, analyze the impacts of alternative formulations of the project or activity, and provide an informed basis for determining whether and how to proceed.

While the practice of TIA has been growing, it is still irregular. In many cases, the requirements or guidelines governing a TIA are general and overly vague, and those who conduct the TIA have significant discretion in how to perform the analysis and undertake the public consultations. Lack of capacity and logistical challenges also affect whether, when and how TIAs are conducted. In some instances, TIA is viewed as a hurdle that

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is necessary to obtain funding or to satisfy legal requirements, rather than a useful planning process. This can lead to rushed, flawed or controversial TIAs and projects. In other cases, countries have undertaken a TIA in earnest and good faith.

With the growing practice of TIA, it becomes important to consider the accuracy of the transboundary impact assessments that are being conducted. If TIA is a planning tool designed to provide a basis for making an informed decision, does it actually provide the necessary information? TIAs have been performed, decisions made and projects implemented (with or without the required mitigation measures). Often, there is a post-project evaluation. However, there has been little effort to date to consider whether the particular analytic and procedural methodologies employed in preparing TIAs are accurate. Do they underestimate certain impacts? Do they overestimate impacts? What affects the accuracy of transboundary impact assessments? How does public participation affect the reliability of TIAs? Do members of the public raise issues that should be considered more thoroughly? Does the public tend to elevate comparatively minor issues? To most of these questions, the honest answer must be that we do not really know.

The University of Tokyo, the United Nations Environment Programme (UNEP), and the Environmental Law Institute (ELI) have undertaken a joint research project to remedy this gap in knowledge regarding TIAs. The partners worked closely with counterparts in Africa and Asia to develop and pilot test a methodology for comparing the impacts that were predicted in a TIA with the actual impacts that occurred. Five case studies were conducted, three in Africa and two in Asia. To facilitate comparison among the case studies, the case studies considered projects affecting international watercourses. This paper summarizes the findings of the various case studies and identifies lessons learned. The case studies examined TIAs with a range of accuracies, from fairly accurate to quite problematic. Significantly, not a single TIA examined over-estimated the impacts: more often, the TIAs under-estimated (sometimes significantly) the impacts of a proposed project. Accordingly, it is time to reassess the assessments. This paper provides practical suggestions regarding ways to improve the analytic and procedural methodologies for conducting TIA.

The next section provides a brief overview of transboundary impact assessment requirements and procedures. This is followed by a brief description of the methodology of the comparative analysis upon which this synthesis relies. The next section sets out the considerations in selecting case studies and summarizes the basic findings of the case studies. The complete case studies follow as independent papers in this issue of the journal. However, the summary of the case studies provides context for the subsequent references to them in the next section, which examines the lessons learned. This is followed by a discussion of the lessons learned from conducting the analysis, and a focus on the specific lessons learned regarding the accuracy of TIAs and the factors affecting their accuracy. The final section provides some concluding remarks, including the relevance of this research to other contexts.

Overview of Transboundary Impact Assessment

Environmental impact assessment (EIA) has become a near-universal requirement around the world for projects or activities that may affect the environment (Troell *et al.*, 2006). Building upon domestic EIA methodologies and the recognition that more effective approaches are necessary for considering potential international impacts, a rapidly growing body of law, policy and practice has established that transboundary impact

assessment is an essential environmental management tool (Cassar & Bruch, 2004; Troell *et al.*, 2006). Global conventions, regional initiatives, bilateral agreements, development banks policies, national laws and international jurisprudence frequently require that decision makers undertake an assessment of the potential transboundary environmental, social, and/or economic impacts before making a decision on whether to proceed. Together, this patchwork of requirements, declarations and nascent practice provides the normative context for this paper.

The basic TIA processes tend to follow the general approach of a typical domestic EIA, with a few key modifications (for a more detailed discussion of the TIA process, see Troell *et al.*, 2006). Notably, the transboundary dimension of TIA imposes additional political, administrative and regulatory layers to the process, frequently making it more complex than most EIA processes. To understand how these complexities can affect the development and implementation of TIA methodologies, it is helpful to briefly review the basic stages of the EIA process on which TIA is modelled. While differing political regimes, regional environmental priorities and cultural values have contributed to variations in EIA (and TIA) processes, the general elements are relatively consistent.

The EIA process usually begins with a determination of whether an EIA is necessary. This 'screening' step is a preliminary assessment of whether the proposed project triggers the EIA requirements and is usually conducted by the project proponent or responsible authority, as prescribed by domestic legislation or policy. If an EIA is necessary, the next step is 'scoping', in which the party preparing the EIA determines which impacts and alternative formulations of the project should be considered in the EIA. The scoping phase often sets out key mitigation measures to be analyzed as well. The alternatives generally consist of various arrangements for the proposed project (larger, smaller, in different locations, using different technologies, etc.) and often include a 'no-action' alternative. Next, the draft EIA is prepared. As part of this process, a study is frequently conducted to collect baseline data, identify potential impacts and evaluate those impacts and alternatives. The project proponent or a consultant then performs a more comprehensive environmental impact evaluation and quantification, comparing alternatives and their predicted impacts. At this point, members of the public and government agencies have an opportunity to review the draft EIA and the information upon which the EIA relied. They also have the opportunity to submit written and/or oral comments on the EIA supporting or criticizing the EIA methodology, information, analysis or conclusions. The EIA is then finalized, taking into account the comments received. It is important to note that the final EIA does not have to agree with the comments received, but generally the final EIA does need to take these comments into consideration.

At its core, an EIA seeks to gather information and explore alternatives to ensure that the environmental impacts of proposed activities or projects are understood, acceptable and managed appropriately. Thus, when making the decision on whether to approve the project, which alternative to approve, and whether to impose any mitigation requirements, the decision maker does not necessarily need to choose the alternative with the least impacts. The EIA process is a planning process. As such, certain aspects of a proposed project (such as the economic yield of the project) may suggest choosing one alternative over another, even if that alternative is not the one with the least impacts. However, it is important that the decision is an informed one.

One important aspect of the EIA process, although not universally applied, is post-EIA monitoring of project implementation and the actual environmental impacts of the project.

It assesses whether the required mitigation measures are actually and effectively implemented.

The EIA process usually includes both analytic and procedural components. Public involvement is a hallmark of EIA. This is critical to a more complete understanding of the environmental, social, cultural and economic relevance of the impacts, alternatives and mitigation options. In order to provide meaningful input, EIA regulations and guidelines usually state that the public has access to the relevant information with regard to project proposals and their potential impacts. This transparency engenders increased accountability, ensuring that conclusions are better reasoned. It can also build trust and encourage cooperation between the public and the authorities responsible for overseeing the EIA. Increased access to information can also improve public understanding of how decision-making processes work, which in turn can create a greater sense of empowerment and social responsibility. In contrast, the case studies illustrate that the failure to involve the public appropriately can contribute to public resistance to the project, increased administrative costs and a poorly designed and executed project.

The public is involved in the EIA process at different stages. A few EIA systems enable the public to contribute at the screening stage. It is more common to involve the public in the scoping phase, at which point they can raise concerns and suggest potential alternatives and mitigation measures to be considered. The most widespread mechanism for involving the public in the EIA process is to make the draft EIA and supporting documentation available to the public for comment. The means for eliciting comments range from publication in a government gazette to active dissemination in local communities without access to media, accompanied by public meetings. Typically, comments may be submitted orally or in writing. EIA systems differ in the timing and length of the public comment period and whether and how comments should be accounted for in the final EIA. Some EIA systems require that the final document be made available for public inspection.

The systems for TIA and transboundary environmental impact assessment (TEIA) build on the basic EIA process, including the ways in which the public is involved. However, there are a few important differences that are worth noting. While EIA and TEIA focus on environmental impacts, TIA often examines a variety of impacts, including environmental, social, cultural and/or economic impacts.

The transboundary dimension of TIA imposes additional diplomatic, political, administrative and regulatory layers to the process, which can make TIA more complicated than its domestic counterpart. In addition to domestic law, international agreements, institutions, politics and principles of international law come into play. These principles include, for example, the duties to avoid causing harm to other countries and to consult with other countries that may be affected (Knox, 2002). With more than one country involved, there are more governmental agencies. Coordination among the different agencies, project proponents and affected communities becomes more complicated. Indeed, it is often less clear who is responsible for undertaking the various requirements for TIA.

While the TIA process indicates an increasing recognition of the need to minimize or mitigate the negative transboundary environmental impacts, this recognition does not negate a country's sovereignty over its territory. Furthermore, TIA, like EIA, often is inherently a procedural safeguard, and it does not necessarily dictate that the ultimate decision should be the one with the least impacts. Trying to weigh the 'no-harm' principle against sovereign rights can become a serious political and diplomatic challenge,

as witnessed in many controversies, including the Gabčikovo-Nagymaros case (Bratspies & Miller, 2006).

Logistically and administratively, often the TIA is more complicated. It can be more difficult for a project proponent in one country to identify the potential affected communities in another country. There are also questions with regard to which language or languages the TIA and supporting documents should be translated into, who pays for the translation, and who is responsible for involving the public in a potentially impacted country. There are also questions concerning which procedures for involving the public should be used: those of the country of origin or of the affected country/countries. In some cases, it may be possible to consult directly with the affected communities; however, in most instances it is necessary for the government of the affected country to coordinate such consultations. This government-to-government coordination and diplomacy adds another dimension to an already difficult process.

Significant legal issues can arise with regard to the rights of the respective countries. If the country of origin considers that a TIA is not necessary, can one be requested or demanded by a potentially affected country, by members of the public in the potentially affected country if their government does not make such a request or demand? If such rights are granted, or if the ultimate decision in a TIA is opposed in a potentially affected country, what rights are there to appeal the decision? What should be the forum for such an appeal? Several TIA instruments address these issues by providing specific procedural requirements, either within the instrument itself or through guidelines. Current TIA practice appears to favour either the harmonization of national practices in general as a pre-emptive mechanism for avoiding these conflicts in TIAs or a 'non-discrimination' principle, in which rights that are afforded within the country of origin (particularly those related to public notice and comment) are also afforded to the government and public of the country in which there are potential transboundary impacts (Cassar & Bruch, 2004).

Many of these issues are also found in the domestic context, such as who should be involved, institutional coordination, rights of appeal, etc., but the transboundary nature of proposed projects can complicate the process, often delaying the start of the project and adding costs. But it is precisely to address the more complicated context that TIA has become an important tool for planning and managing projects with transboundary impacts.

Methodology of the Study

In order to facilitate comparison of lessons learned across case studies in comparing impacts predicted in a TIA with the actual impacts, the project partners developed a common analytic template. The template and research methodology built upon earlier similar efforts to compare predicted with actual impacts (Nakayama, 2005). The template provides three basic sections: (1) an overview of the project; (2) an examination of the accuracy of the TIA (comparing predicted with actual environmental, socio-cultural and economic impacts); and (3) a review of the factors affecting the accuracy of the TIA (including legal, policy and institutional frameworks; public involvement; and other factors).

In conducting their analysis for the case studies, the authors reviewed the impact assessment, examined data collected since the project (to the extent that it existed), and surveyed anecdotal evidence that was available in academic journals, the media and reports of key bodies (including governments, development banks and river basin

organizations). Where necessary, the researchers visited the relevant sites and interviewed stakeholders to identify more clearly the actual impacts, as data often did not exist or were not available. The stakeholders included affected communities, government officials, NGOs and developers.

Overview of Case Studies

In order to test the methodology, five case studies were selected on the basis of several criteria:

- The project or activity should have transboundary impacts.
- The case studies may entail domestic impact assessments that considered transboundary impacts, including instances where the impact assessment predicted 'no transboundary impacts' (implying that they were considered) and there actually were impacts.
- The particular case studies should also have enough information about the predicted and actual impacts to analyze the accuracy of the assessment and the factors affecting the accuracy.
- Finally, the case studies represent a cross-section of different project types and different impacts.

Based on the criteria, five initial case studies were selected, three from Africa and two from Asia. These include the following five (with the countries listed in the brackets):

- Navigation Channel Improvement Project of the Lancang-Mekong River from China-Myanmar Boundary Marker 243 to Ban Houei Sai of Laos (project in China, Laos, Myanmar and Thailand; with potential impacts also in Cambodia and Vietnam);
- Yali Falls Dam and Hydropower Development in the Se San River Basin (project in Vietnam, with potential impacts in Cambodia);
- Emergency Action Plan for the Control of Water Hyacinth in Lake Victoria (project in Uganda, with potential impacts in Kenya and Tanzania);
- Lesotho Highlands Water Project, Phase 1B: Mohale Dam, Matsoku Weir, Delivery tunnels to the Katse River, and Access Roads and other Infrastructure (project in Lesotho, with potential impacts in South Africa and Namibia); and
- Epupa Dam (project in Angola and Namibia).

These case studies represent a diversity of projects, geography, governing legal regimes, stages of projects and results. They include two hydropower dams, one water diversion project, a project to remove water hyacinth, and a project to improve navigation. The case studies are drawn from Southeast Asia (two), East Africa (one), and Southern Africa (two). The legal regimes governing the conduct of the impact assessment included the national law of one country, a combination of national laws from two countries, and procedures established by international bodies. In fact, the assessment undertaken for the Epupa Dam was done ostensibly for political and environmental management reasons, not because it was required. Three of the projects have been completed, one is under construction, and for one project the decision has yet to be made (although the TIA has been instrumental to the decision-making process).

The subjects of the case studies have varying results from relatively accurate and effective to inaccurate and controversial. Following the brief summary of the various case studies below, this paper examines some of the specific lessons learned in comparing the predicted with actual impacts for the case studies.

Navigation Channel Improvement Project of the Lancang-Mekong River

The Navigation Channel Improvement Project seeks to upgrade large vessel navigation for passenger and cargo transportation on the upper Mekong River (Muramachi & Nakayama, 2007). The project will remove reefs, shoals and rapids by blasting activities in three phases. The first phase was completed in 2004, with the core construction completed in April 2003. The impact assessment focuses on this phase in which 10 major rapids, 1 shoal, and 10 scattered reefs were removed to facilitate navigation of 100–150 Dead Weight Tonnage vessels.

The assessment was conducted by the Joint Experts Group on EIA of China, Laos, Myanmar and Thailand in September 2001. The *Report of Environmental Impact Assessment* includes a range of impacts to the ecological environment, hydrology, water quality, noise, solid waste production, accident risk and social impacts. Since a multinational body was responsible for the report, transboundary impacts on all four countries involved were examined. However, the two downstream countries not included in the project—Cambodia and Vietnam—have been affected as well.

In the EIA report, water velocity and quantity were assessed in the short term, and only the immediate periods during and after the blasting were considered. The impacts were forecast to be minor, causing no severe impacts that should be addressed by mitigation measures. Even though hydrology was considered, analysis of other environmental aspects on wildlife or vegetation was scant. For example, the ecological impact on the fish was considered to be almost non-existent macroscopically. No impacts to bird life were predicted. The report stressed the positive social impacts of the project, generally forecasting that enhanced trade would lead to improved living standards. Adverse impacts such as the spread of diseases were expected to be minor.

The predicted impacts of hydrology did occur, although more severe and on a larger scale. Many regions in Thailand experienced river fluctuation. In addition, increased velocity was observed. Erosion of the riverbanks has changed the river ecology and also the lifestyle of communities along the banks. Loss of housing and income-generating vegetation has been reported since the initial blasting. Social impacts also occurred that were not predicted, including the disappearance of local knowledge due to a breakdown of angler groups from changed river ecology and illegal trafficking.

In short, the EIA was flawed both in scope and method, resulting in an insufficient report. Several reasons can be attributed to the failure. The timeframe of the impact assessment was too short. In addition, no standard methodologies or requirements were referenced in the EIA report. Although public participation was incorporated, this was done in a very short time with no disclosed consistent methodology for the four countries. Moreover, there was no participation from Cambodia or Vietnam.

Yali Falls Dam

The second case study focused on the Yali Falls Dam on the Se San River, a tributary to the Mekong River. The case study placed the experience of the Yali Falls Dam in the broader

context of hydropower development in the Se San River Basin, which provided a more complete picture of the TIA and the constraints in conducting TIA in the basin.

The Se San River is among the largest tributaries of the Mekong River, with significant hydropower potential (Wyatt & Baird, 2007). Approximately 90 000 people live in the Se San River Basin. They rely on a diverse range of activities for their livelihoods, from small-scale subsistence farming to plantation and cash cropping.

Yali Falls Dam was conceived, constructed and operated to meet energy needs during peak times. It was the first of a series of dams planned in the Se San basin. Two EIAs were carried out by European consultants in 1985 and 1993. However, both studies covered an area only 8 km long and 1 km wide downstream of the dam. These studies predicted no significant impacts, and failed to address downstream impacts in Cambodia.

Downstream villages along the Se San River in Vietnam were adversely affected, but the greatest impacts have been experienced in the two downstream Cambodian provinces of Ratanakiri Province (70 km downstream), and Stung Treng Province (250–300 km downstream). Approximately 20 000 people or 3500 households live along the Se San River in Ratanakiri Province. These villages have seen significant daily fluctuations in the river as water is released to generate power in the evenings during peak demand. The riverbanks and edges of forest flood and recede unnaturally as a result of daily fluctuations in river level due to the operation of the Yali Falls Dam. Rainy season flooding has intensified. Some villages reported being flooded up to three times a year. The resolution of the controversy has been complicated for many reasons, including the fact that Vietnam will not provide detailed information regarding water releases.

The villages have suffered material losses. From 1996 to 1999, sudden floods from Yali Falls Dam's water releases resulted in losses, such as lost livestock and fishing gear, worth approximately US$ 800 000 (about US$237 for each household). It is estimated that villagers have lost more than 40 000 chickens, thousands of pigs and ducks, and hundreds of buffaloes and cows since 1996.

The aquatic ecosystem also suffered damage. At least 14 varieties of riverine plants diminished in numbers due to the new flooding patterns. Nests of animals such as the soft-shelled turtle and birds such as the endangered Black-bellied Tern have been flooded or swept away, impeding their reproduction. The water quality has also suffered, with the Ratanakiri Fisheries Office citing the Yali reservoir as a likely source of contamination of toxic blue green algae and perhaps other pollutants.

Local people have also reported human health problems resulting from changes in water quality. Among these are stomach and respiratory problems, throat and nasal irritation, dizziness and vomiting after ingesting the water.

Lake Victoria Water Hyacinth Control Programme

The Water Hyacinth Control Programme was developed by the Ugandan Ministry of Agriculture, Animal Industry and Fisheries to address the infestation of water hyacinth, an invasive aquatic plant with negative environmental and economic impacts, in Lake Victoria. The programme sought to reduce water hyacinth infestations at specific sites through an integrated set of chemical, mechanical, and biological controls.

The EIA for the project was conducted by Aquatics Unlimited (a US company) in 1996, shortly after Uganda first adopted EIA requirements. The EIA relied on a literature review, field visits and interviews with National Environment Management Agency (NEMA) staff

and other stakeholders. The EIA examined direct and indirect effects of the various control methods, predicting that these methods would have no impact on land use, hydrology, air quality or cultural and historic resources, and that they would improve water quality, fish and aquatic life and water recreation activities. The EIA identified some potential temporary negative impacts to aquatic life as a result of the planned chemical application, but they were deemed minor and there were no impacts to human health.

The public consultation process for the EIA raised strong objections to the use of chemical controls, and the public submitted information indicating problems with the proposed herbicide. The public also urged the government to consult with Kenya and Tanzania. In both instances, the government was convinced by the arguments raised by the public: it opted to not to use chemical controls, and it commenced consultations with the governments of Kenya and Tanzania.

Many of the project's actual impacts, including the effects of mechanical control, the economic benefits to local communities involved in control activities, and the absence of negative impacts on land use, hydrology, air quality or cultural/historic resources, were consistent with the EIA's predictions. One unforeseen impact was the destruction of biological controls (weevil facilities) by rising lake levels that resulted from El Niño. In addition, as noted above, the government's decision not to apply chemical controls averted the EIA's projected negative impacts on aquatic life, plant life and human health.

The initial lack of transboundary considerations in the EIA led to the recognition that participation by other countries sharing Lake Victoria and its source rivers, including Kenya, Tanzania and Rwanda, is essential to a successful control programme. Although the control methods effectively reduced water hyacinth populations in targeted areas on the Ugandan side of Lake Victoria, plants transported into the lake by currents in the Kagera River, shared by Rwanda and Tanzania, led to a resurgence of water hyacinth sooner than the EIA had predicted, increasing control costs. Therefore, one notable achievement of the EIA process was the resolve of NEMA to institutionalize a transboundary approach to EIA in Uganda. More broadly, the experiences with this project influenced the development of national EIA regimes in East Africa, particularly for transboundary aspects. It also generated political will to cooperate more closely on shared resources, especially Lake Victoria.[1] Overall, the EIA illustrates the importance of genuine public participation and the incorporation of transboundary considerations, both of which improved the environmental and economic benefits of project, as well as the accuracy of the final EIA.

Lesotho Highlands Water Project, Phase 1B

The Lesotho Highlands Water Project seeks to address projected water shortfalls in South Africa by diverting the headwaters of the Senqu River in Lesotho to the Vaal River in South Africa (Willemse, 2007). The project's initial phases involve the construction of three large dams and associated roads, telecommunications and power transmission infrastructure. Phase 1A of the project, completed in 1998, included construction of the Katse and Muela dams and corresponding infrastructure. Phase 1B, the subject of the case study, consists of construction of the Mohale dam, a concrete tunnel connecting the Mohale and Katse dams, and a weir and diversion tunnel for delivering water to the Katse reservoir.

The EIA for Phase 1B, which was conducted in 1997, did not assess any transboundary impacts. The Lesotho Highlands Development Authority subsequently undertook In-Stream Flow Assessment (IFA) and In-Stream Flow Requirements (IFR) studies to compensate for inadequate consideration of downstream impacts in the EIA, although it is unclear whether they examined impacts in South Africa. These studies were undertaken after the project had been partially completed. As a result, while information about the project's predicted impacts derives from the EIA, documentation of the actual impacts comes largely from the IFR study.

Overall, the EIA for Phase 1B identified 140 predicted impacts, including 29 downstream impacts related to reductions in water availability, wetlands habitat and fisheries. These impacts all appear to be in Lesotho. The most significant predicted impact was the dislocation of downstream communities due to the inundation of settlement areas from the filling of reservoirs. This was predicted to break up social connections, move children away from schools, and reduce food security and livelihoods, among other things. The EIA also forecast impacts on water quality, river ecology and health resulting from the reduced flow of the river. It did not seem to assess economic effects, although it recognized that people would relocate to seek jobs.

Many of the predicted impacts did occur. The reduced flow of the Senqu River led to a prevalence of pests and diseases in livestock. With reductions in wild plants and fish stocks, the low flow affected the nutritional intake of people living downstream. Other effects exceeded the EIA's predictions. Numerous complications arose with the resettlement programme, exacerbating the projected impacts on livelihoods and social cohesion. The project underestimated the number of people who would be affected, did not begin the resettlement process early enough, and failed to complete the required infrastructure prior to resettlement.

Eagerness by project proponents to implement Phase 1B appears to have hampered the impact assessment process. It led to an insufficient prediction of impacts generally and a failure to include any transboundary analysis (of impacts in South Africa). Scant public involvement contributed to the assessment's shortcomings, particularly with regard to resettlement. In particular, the EIA failed to recognize that people living downstream might suffer as much or more harm than those living close to the site.

Epupa Dam

The Epupa Dam project is a joint Angolan-Namibian effort to develop a hydropower on the Cunene River (Tarr, 2007). In part, the project sought to promote Namibia's energy independence. Angola and Namibia formed a Permanent Joint Technical Commission (PJTC) to oversee the venture, in addition to a smaller Steering Committee for the Feasibility Study (SCFS). The countries also agreed to appoint an independent external reviewer to work with the SCFS.

The PJTC appointed a consortium of consultants, known as NamAng, to complete the feasibility study, including an assessment of its projected impacts. After initially considering three alternative dam sites, NamAng focused on the Epupa Falls and Baynes sites in Namibia and Angola, respectively: Epupa would generate more hydropower, but Baynes would cause fewer adverse environmental and social impacts.

NamAng's EIA considered social impacts on the local Himba tribe, aesthetic impacts on the wilderness of Cunene and Namibe, and hydrological and ecological impacts on the

Cunene River. The EIA predicted that the Baynes site would cause less social harm (lost cultural sites and dwellings, flooded graves, displaced residents and flooded tourism lodges). The EIA similarly found that the Baynes site would cause fewer adverse environmental impacts, such as land inundation, CO_2 releases, evaporation, loss of riparian vegetation and palms, loss of fish species and reduced downstream flow. The EIA did not assess aesthetic impacts, labelling them a 'relative value judgment'. Although neither Namibia nor Angola explicitly provide for TIA in their legislation, the EIA did examine transboundary impacts.

Unfortunately, divisive politics surrounding the project undermined the TIA process. NamAng noted that lobbying for the Epupa site by the Namibian government made it difficult for NamAng to gather information from affected communities on potential impacts. Ultimately, NamAng submitted an incomplete feasibility study. While the study adequately examined the project's economic and technical feasibility, the Namibian and Angola governments both agreed that the social and, to a lesser extent, environmental impacts had been inadequately assessed.

Because the project has not yet been implemented, it is not possible to compare the predicted and actual impacts. It now appears that Angola and Namibia will probably proceed with the Baynes site due to strong opposition to the Epupa Falls site. This decision may be due in part to the relative impacts predicted by the EIAs.

Lessons Learned

The five case studies have provided insight into both TIA and the process for assessing their accuracy. While the sample size is modest, a few observations are significant. First, there are some methodological challenges associated with assessing TIAs, the foremost being limited data. There are also many similarities in accuracy of the TIAs, as well as the factors affecting the accuracy of the TIAs.

Methodological Challenges in Conducting the Comparison

The greatest challenge in comparing predicted and actual impacts is lack of data. There is a lack of baseline data, which is a problem for the conducting the TIA. Normally, the process of conducting a TIA (or an EIA) requires collection of baseline data. In practice, insufficient time is often allocated to collect reliable baseline data, so many of TIA predictions are qualitative and based on anecdotal evidence. This affects the accuracy of the TIA. There is also a lack of current data on flow, water quality, aquatic ecosystem health, impacts on livelihoods etc. Without solid baseline or current data, it is difficult to perform a rigorous comparison.

This is not to say that it is impossible to identify potential and actual impacts. Through anecdotal evidence, site visits, interviews and professional opinions, it is often straightforward to identify clear impacts, although not necessarily the full extent of those impacts. It might be difficult to state how many villages have been affected, but it is easy to identify particular villages that have been affected in particular ways.

In practice, though, there have been problems with the use of anecdotal evidence of unpredicted impacts. For example, with the Yali Falls Dam, governments dismissed concerns that were based on 'anecdotal evidence' (Wyatt & Baird, 2007). This is ironic because the evidence concerning the actual impacts was at least as rigorous as the evidence

relied upon in the initial assessment. This apparent double standard for data seems to provide a convenient opportunity to proceed with projects that are deemed desirable and to delay taking mitigation measures or politically difficult decisions.

Another challenge is that to the extent that there is scientific or anecdotal evidence, it is frequently collected by advocacy groups representing local (often disenfranchised) communities or promoting environmental goals. As such, governments and basin organizations have been reluctant to consider the evidence. To the extent that this is the best available information (and sometimes the only information on certain issues), the case studies have considered this evidence.

While the lack of baseline and current data is not unique to transboundary impact assessments, it is aggravated by the transboundary aspect. It can be challenging, if not legally and politically problematic, for a project proponent in one country to collect data in another country. This is particularly true for resources such as water, which can be politically sensitive. In this context, international coordination becomes critical.

Accuracy of TIAs

For the case studies, the TIAs never over-predicted the impacts of the project. In most cases, the impact assessments under-predicted the severity and extent of the impacts. The under-predictions were spread across the environmental, socio-cultural and local economic livelihoods, although the socio-cultural and livelihood impacts seemed to be under-predicted more often and more seriously.

The only case study where the impacts were (generally) accurately predicted was the Lake Victoria Water Hyacinth Project. There were two mis-predictions. First, the resurgence of the hyacinth happened more quickly than expected. This was because the impact assessment did not consider the possible role of upstream countries (Rwanda) in generating new water hyacinth. Second, the impact assessment did not consider the possibility of climate change or climate variability. The project suffered when there was a drought, making mechanical control difficult. Similarly, unseasonable rains flooded the weevil-rearing facilities necessary for biological control. Neither of these inaccuracies was particularly serious.

The case studies illustrate that not all mitigation measures are equal. Environmental mitigation measures are often given more thought, are better modelled, and are more effective than social mitigation measures (where resettlement is often seen as the solution). There are often discrepancies between the predicted costs of mitigation measures and the actual costs: the actual costs are much higher than predicted, so the cost-benefit analysis upon which the proposed project was approved did not provide an accurate estimate of the real costs. For example, this was the case in the Lesotho Highlands Water Project, Phase 1B (Tarr, 2007).

Factors Affecting the Accuracy

In addition to the challenges associated with limited baseline data, five key factors affected the accuracy of the TIAs. These include: the legal and institutional framework; political context; public involvement; project design; and how the TIA was conducted.

Legal framework. The case studies highlight the importance of having a clear set of legal, procedural and institutional requirements and standards regarding how to conduct, review and finalize TIAs. In many cases, the process and standards that the assessments followed were ad hoc, and the people conducting the assessment were not well versed in the particular process. There appears to be a lack of standard requirements, let alone methodology, for conducting TIAs. Sometimes, the approach was adopted informally: the DRIFT process was followed in Lesotho Highlands 1B because of expected downstream impacts, not because it was required (Tarr, 2007). The TIA for the Navigation Channel Improvement followed China's EIA criteria 'under the framework of ESCAP guidelines' (Muramachi & Nakayama, 2007). The Epupa Dam assessment used a combination of Angolan and Namibian standards.

In some cases, there was no requirement to consider transboundary impacts. This was the case, for example, with the Lake Victoria Water Hyacinth Project. The EIA was conducted pursuant to Uganda's recently adopted national legislation. It was only during the public consultation process that the public insisted on consulting with other countries, and NEMA agreed.

While there are often questions about the details for conducting domestic EIAs, the transboundary nature makes it particularly challenging for TIA. There are frequently general requirements to conduct a TIA when a proposed project may have trandsboundary impacts, but the specific standards and methodologies are often lacking (Cassar & Bruch, 2004). In these circumstances, ad hoc approaches are cobbled together, drawing upon various national approaches. The case studies provide real-world expression to challenges that have been identified in the academic literature with regard to how the various TIA requirements relate to one another, as well as the need to develop standardized TIA methodologies (Troell *et al.*, 2006).

Political context. The political context in which the TIA is conducted can have a profound impact on the TIA. Politics can assist the process or it can complicate and impede it, particularly if certain outcomes are prescribed or proscribed.

The Lake Victoria Water Hyacinth experience highlights the importance of political support for the TIA process (Sikoyo & Goldman, 2007). Without high-level political support, it would have been difficult to take advice, let alone act on public comments concerning consultation with the other potentially affected riparian nations, Kenya and Tanzania. The political support for the process was also important in allowing the government officials to consider evidence submitted by the public regarding potential impacts of chemical treatment.

In contrast, political pronouncements about the outcome of the process can be polarizing and counter-productive. Such pronouncements frequently give the appearance that the outcome has been determined, and indeed they may be. With the Epupa Dam, the President of Namibia argued aggressively and publicly for the Epupa site since it would yield more power, and he charged that anyone who challenged it was unpatriotic (Tarr, 2007). This contributed greatly to a polarized TIA process and impeded an objective assessment of the impacts, ultimately yielding a TIA that both Angola and Namibia found inadequate.

The Yali Falls Dam and subsequent controversy appear to be affected by politics in a variety of ways (Wyatt & Baird, 2007). The Vietnamese government asserted that only impacts 8 km downstream (i.e. domestic) should be considered. In part, this was due

to Vietnam's desire to develop its energy infrastructure without 'interference' from other countries. The failure of Cambodia to press the issue with Vietnam is also due to politics. Cambodia is less developed economically than Vietnam and tends to be perceived as 'weaker' in regional politics. Moreover, the current government of Cambodia is indebted to Vietnam for assistance in defeating the Khmer Rouge. Finally, Cambodia has its own plans for developing hydropower in the Se San River Basin. Appeals to the Mekong River Commission (MRC) to resolve the issues associated with the transboundary damage from the Yali Falls Dam have been ineffectual, as the MRC has been reluctant to act without agreement from its member states. All these political considerations factor into the problematic assessments of the Yali Falls Dam and other projects proposed within the Se San River Basin.

The Lesotho Highlands Water Project also seems to have been affected by politics. The consultants initially identified a range of expected transboundary impacts in South Africa and Namibia, but they were directed to analyze only the domestic impacts (Willemse, 2007). As with Yali Falls Dam, there is unequal bargaining power between upstream and downstream countries; in this instance, though, it is the downstream country (South Africa) that is much more powerful. Moreover, the aim of the Lesotho Highlands project to assist in meeting South Africa's expected increase in water demand further complicated the dynamics.

The particular historical contexts are important in order to understand these political dynamics. At the time of the Lake Victoria project, East Africa was integrating economically and politically. It quickly became clear, largely through the water hyacinth experience, that environmental integration should also be considered. In contrast, the riparian countries for the Mekong River are only starting to integrate (e.g. through the Association of South East Asian Nations), and even then, the upstream countries of China and Myanmar are not members of the MRC. The MRC is a relatively weak institution, as illustrated by the Yali Falls and Navigation Channel Improvement cases. These two examples emphasize that the need for an effective legal and institutional framework may be even more necessary when the existing international framework is weak. The historical context was important for the Epupa Dam case, as Namibia was recently independent and politicians were flexing their newfound independence (Tarr, 2007). Free from colonialism, the last thing they wanted was anyone (especially from another country) telling them what to do or not to do.

Politicization of the impact assessment process is also exhibited in the over-reliance on mitigation measures. Rather than presenting and analyzing alternatives in a deliberate manner, a number of impact assessments appear to assume that the project was going to happen and it was only a matter of mitigating damages.

While politicization of TIA decision-making processes happens in both domestic and transboundary contexts, TIA can become much more complicated and politicized because two or more sovereign powers are involved. Epupa Dam provides a clear example of this (Willemse, 2007), while the failure—in at least one case deliberate—of the assessments of Yali Falls and Lesotho Highlands Water Project to consider transboundary impacts may be attributed to a desire to avoid potential international politics (Tarr, 2007; Wyatt & Baird, 2007).

Public involvement. The case studies highlight a range of public involvement—different approaches, experiences, extents and consideration—and the outcomes of the projects and their respective TIAs seem to correlate to the public involvement. When there is more

public involvement (and not just information dissemination) and the government takes the public input seriously, the TIA seems to be more accurate; but where public involvement is rushed and not considered, the TIA often is problematic.

In the Lake Victoria Water Hyacinth Project, the public was actively involved and the government was willing to listen, and the project happened largely as it was approved and the TIA was generally accurate (Sikoyo & Goldman, 2007). In this project, a broad cross-section of the private sector and members of the public were involved in reviewing and discussing the impact assessment. The only significant concern was the use of chemicals to control the water hyacinth, and in particular the herbicide that had been chosen. Although the EIA indicated no significant impacts, many members of the public expressed concern and submitted information on problems associated with the herbicide in other countries. The public also recommended consultations with Kenya and Tanzania. On both issues, the government of Uganda seriously considered the merits of the public comments, and in both instances, the government agreed. It rejected the use of chemical controls, and it initiated discussions with Kenya and Tanzania. Under the regulations governing the EIA, the government was not required to do either; however, by choosing to seriously consider the public comments, it improved the accuracy of the TIA. Based on the evidence presented at the public meetings, impacts from the chemical control methods may have been under-predicted but for the decision by the government not to use the herbicide.

In contrast, for the case studies where the public was not involved, the TIAs are less accurate. It is difficult to know whether the inaccuracies are due to a lack of public participation (which might have highlighted errors), whether the lack of public participation is due to known inadequacies of the impact assessment and a desire to rush through the process, or both. In any case, it is striking that the three case studies where public participation was limited seriously underestimated the impacts; and the fourth assessment was flawed because the outcome appeared to be pre-judged regardless of public input.

In three, the environmental effects are fairly significant, but the social impacts seem to be less accurately predicted. For Yali Falls Dam, there was no transboundary public participation, and the effects experienced in Cambodia would almost certainly have been highlighted had the downstream communities been consulted. For the Navigation Channel, there was very little time for public participation and only a small portion of the likely affected public was actually consulted. As a result, the environmental impacts were under-predicted, and social impacts not considered seriously.

The Lesotho Highlands Water Project provides some lessons learned in problems with public participation (Willemse, 2007). In most instances, efforts to engage the public in Lesotho were ineffectual because they focused on information dissemination and not consultation. The public felt that they were being told what to do, not being consulted—there were no high-level decision makers at public meetings. Similarly, the dispute resolution approaches that were adopted ostensibly to settle grievances associated with the project did not provide for decision makers to be in the field. Moreover, there were serious allegations of corruption and malfeasance with the project, as well as criminal prosecution for corruption. The lack of communication, as well as reported threats and perceived heavy-handedness by the decision makers, generated a hostile political environment and significant ill-will. This was particularly the case with regard to resettlement and other social issues. The impact assessment predicted a variety of benefits to the communities.

It appears that the communities did not recognize or acknowledge these benefits for a long time, and then only grudgingly.

Finally, where the public is involved but the outcome appears to be pre-judged, the TIA process can be stalled by controversy. This was the case with the Epupa Dam (Tarr, 2007). While the formal TIA process stalled, especially over social issues, public participation in the process appears to have been significant. The participation was polarized, with significant disagreements between the public and the government (especially of Namibia, which from the start indicated that they wanted the project at Epupa, not Baynes). The participation seems to have pushed the governments toward considering the Baynes site. So, while the process was perhaps more acrimonious than ideal, it was an important experience in engaging the public and communities in environmental decision making in the region. It also appears to have steered the decision makers toward a less harmful alternative.

There are various reasons why public participation in the TIA process appears to be limited. Timing is often a consideration. The project proponent and the government want to push through the project, so little time is allocated to the TIA and even less time to public consultation. The public participation is then often rushed. Public participation appears to be further limited by the dearth of established procedures, standards and practice.

Experience with domestic EIAs suggests that public participation is often problematic at the local and national levels, not only in the transboundary context. The transboundary nature of public participation in TIA means that often there are more challenges due to different languages of the populations, the geographic spread of those populations, the number of potentially affected and interested people, political challenges of engaging communities in other countries, and the accessibility of local populations to public hearings. However, in the five case studies that are examined here the most significant factor for public participation appears to be the willingness of the decision makers to allocate time and resources to consulting a broad range of stakeholders and to seriously consider the public contributions to the process.

Project design. The accuracy of the TIA depends in part on how the project is designed and undertaken. A good illustration of this is the Lake Victoria Water Hyacinth control Project (Sikoyo & Goldman, 2007). Water hyacinth affected many people and businesses around Lake Victoria, so there was a broad, immediate and significant interest in removing and controlling it. Public and commercial enterprises were actively involved in the impact assessment process. As noted above, they generally accepted the mechanical and biological controls, but objected to chemical controls. When NEMA approved mechanical and biological approaches, but not the chemical approach, there was enhanced support for the project. This was significant because the success of the project, and the accuracy of the impact assessment in predicting the outcomes and impacts, depended significantly on commercial enterprises (for donated equipment and funds) and the public (for contributing labour for mechanical control).

The project was designed also to optimize public involvement, providing for awareness raising and equipment for the public. Moreover, the project took advantage of local structures to assist in the control of the water hyacinth. Due to the combination of the design of the project and the respect that the government paid the public, the emphasis

on public involvement helped the project to be realized with little controversy (and associated cost or delay), essentially as predicted in the impact assessment.

Conducting the impact assessment. The case studies highlight a number of aspects with regard to how the TIA is conducted that affect its accuracy and public acceptance. The composition of the TIA team can affect the objectivity, real or perceived, of the outcome. For example, TIA team for the Navigation Channel Improvement was dominated and led by Chinese, potentially affecting the perceived objectivity of the final TIA (Muramachi & Nakayama, 2007).

The independence of the TIA team can also be an important factor. Where the proposed project is controversial, such independence can be facilitated by involving an external independent reviewer, as was done with the Epupa Dam example (Tarr, 2007). An independent reviewer can add objectivity and rigour. With Epupa Dam, such a reviewer reassured most of the stakeholders (including the governments), who realized that the reviewer could help to reduce the chances that the project would be derailed or high-jacked by special interests.

As noted above, TIA problems are often associated with insufficient time to collect the data, do the analysis and consult the public. The Navigation Channel Improvement, Yali Falls Dam and Lesotho Highlands Water Project all illustrate the challenges associated with rushed assessments (Muramachi & Nakayama, 2007; Willemse, 2007; Wyatt & Baird, 2007).

Finally, TIAs can suffer from an analytic domino effect: a single mistake in the TIA analysis can lead to many mistakes in the predicted impacts. Take for example the Navigation Channel Improvement (Muramachi & Nakayama, 2007). The TIA predicted no change to the water velocity due to removal of the reefs and rapids. In reality, channelization caused the water velocity to speed up. This appears to have led to significant fluctuations in water levels (which were unpredicted) due to the removal of many of the natural barriers in the river that slow down flow. The increased velocity and subsequent fluctuations increased erosion (which was unpredicted), leading to the loss of habitat for birds (unpredicted), fish (unpredicted), and livelihoods in the form of riverside gardens (unpredicted) and fisheries (unpredicted). While it might be tempting to highlight all the ways that the TIA under-estimated the actual impacts, from a procedural and analytic perspective all of these mis-predictions may be attributable to a single, basic error that there would be no change in the water velocity.

Other Considerations

The case studies highlight some of the salutory benefits of conducting TIA, and even problematic TIAs can yield significant benefits. For example, the process of conducting a TIA can improve institutional coordination and collaboration among government institutions, as well as between governmental and non-governmental actors.

The Lake Victoria water hyacinth impact assessment engendered a number of institutional, legal and policy changes at the national and regional levels (Sikoyo & Goldman, 2007). Initially, Uganda did not consult with Kenya or Tanzania or consider effects in those countries, but following suggestions received in the public consultations Uganda ultimately did consult with those countries. At the request of Kenya and Tanzania, Uganda tested the proposed biological method for specificity (i.e. to make sure that the weevils only ate the water hyacinth) before applying it to Lake Victoria. This exchange

of experiences facilitated rapid action in Kenya and Tanzania, which undertook similar biological and mechanical controls.

The experience with the Lake Victoria water hyacinth occurred while the three East African countries were integrating economically and politically. It highlighted the need to also consider integration of environmental management, and it spurred the development of regional TIA guidelines governing shared ecosystems, such as Lake Victoria (Sikoyo & Goldman, 2007). It may also have been a motivating factor in the elaboration of an MOU on environment management in East Africa. Finally, the experience informed the development of national EIA procedures in Kenya and Tanzania, as well as a review of the EIA procedures in Uganda as they relate to transboundary effects.

Although public participation with the Epupa Dam was characterized by a polarized and politicized discourse, it did foster new approaches for providing information to the public (Tarr, 2007). Three particular modalities are significant in this regard: dynamic public meetings, access to the full feasibility report, and filming (which raised public awareness on environmental issues). There are also some indications that the process ultimately improved environmental governance.

Conclusions

TIA methodologies seem to under-predict the severity of the actual impacts: there was not a single instance identified where a TIA over-estimated an impact. This was particularly true for social impacts. Omniscience is not necessary; most of these impacts were reasonably foreseeable. It is significant that the TIAs consistently showed an optimistic bias that the negative effects would not be as severe or extensive as they ultimately were. As such, this assessment revealed a variety of traps in conducting TIA, including traps related to constituencies, data, scoping and quantitative or qualitative analysis.

The limitations of impact assessment, especially relating to long-term assessments of impacts, are not new (Biswas, 2000). However, with the growing attention being paid to adaptation to climate change, it is imperative to understand the limitations of predictive tools being used and it is even more imperative to improve the methodologies and reliability of those tools.

The uncertainty within the TIA process reflects more fundamental predictive challenges. With multiple stressors and actors in a complex, dynamic and often non-linear hydrologic system, prediction is problematic. Adaptive assessment and management provides a framework for predicting, deciding, monitoring, assessing, revising, deciding, etc. This framework can account for limited baseline data, and even limited understanding of the system.

The assessment of TIAs highlights factors that seem to affect the accuracy of a particular assessment. These include the legal and institutional framework, politics, public participation, design of the project, how the TIA was conducted and limited information available to conduct the TIA and to assess the accuracy of the TIA. The case studies show that TIA can be an important tool for assessing potential transboundary environmental, social and economic impacts of a proposed project or activity.

There is a need for more formal, detailed legal, procedural and institutional requirements governing how TIAs are conducted, reviewed and finalized. This includes the need to clarify the sources of TIA requirements and how they relate to one another. A more coherent methodology and precise procedural guidelines are also necessary, since

the lack of clarity and precision is a factor in TIA implementation. Politics is also a significant factor, and it is uncommon in many countries to have public access to data that contradict or undermine official positions. There are several ways to alleviate political interference, including having a well-established and clear TIA methodology, involving international institutions (which often require impact assessments), and engaging the media. Recognizing the value of public participation and providing meaningful opportunities for public participation is particularly important. Indeed, meaningful public participation seems to be a key factor affecting the accuracy of a TIA.

The process of clarifying the details of the regime governing TIA should also take into account the role of the relevant multilateral environmental agreements (MEAs). A number of the case studies highlight MEAs, including the Ramsar Convention and the SADC Water Protocol (for example, Epupa Dam and Lesotho Highlands). However, it is unclear what role these agreements and their respective provisions play with respect to one another and to national requirements.

The case studies also highlight concerns about mitigation measures and the extent to which the TIAs predict that these measures will be able to minimize the impacts of the proposed project. As noted above, there appears to be an over-reliance on mitigation measures. The case studies highlight the need to examine the effectiveness, cost and implementation of mitigation measures, as well as the need for governance structures or processes to ensure that mitigation measures are actually done.

The case studies uniformly highlight the need for long-term monitoring. This is important in part to identify long-term impacts of the project and to provide an informed basis for resolving outstanding issues. Such data also can provide baseline data for future projects along the watercourse. Thus, for example, information about water flow from the Yali Falls Dam can provide baseline data for the other proposed dams in the Se San River Basin. Such monitoring is not particularly expensive or difficult, and it could easily be incorporated into the overall project budget.

Additional research is necessary. While the case studies yield some important insights, they are not (nor were they intended to be) statistically significant. The goal to test the methodology of comparing predicted with actual impacts has been met: the case studies have illustrated the merit of the exercise. Additional case studies, for example, from developed countries, may have more data available to facilitate predicted and actual impacts. Such case studies may include TIAs conducted pursuant to the EU Water Framework Directive or the 1909 Boundary Waters Treaty between the United States and Canada. These additional case studies can help to provide a more nuanced understanding of the factors that affect the accuracy of TIAs, as well as guidance on how to improve the methodology for conducting TIAs.

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Note

1. Within the East African Community, Uganda, Kenya, and Tanzania have signed a Protocol on Environment and Natural Resources Management and developed Environmental Assessment Guidelines for Shared Ecosystems of East Africa, both of which await ratification by each of the three EAC Member States. In 2003,

the countries adopted a Protocol for Sustainable Development of Lake Victoria Basin, which promotes EIA and public participation in planning and decision-making activities.

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